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AEROSPACE STANDARD

SAE AS4623 | REV. B

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(R) Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 3000 psi, 275 °F, Heavy Duty, Aircraft Hydraulic Systems

1. SCOPE:

This document defines the requirements for heavy-duty polytetrafluoroethylene (PTFE) lined, para-aramid reinforced, hose assembly suitable for use in 275 °F, 3000 psi aircraft systems where rapid rate pulsing and torsional/longitudinal flexing may occur in addition to normal hydraulic system loading. Size -16 and -20 are limited to +225 °F service.

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. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

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

AMS 2486	Conversion Coating of Titanium Alloys, Fluoride-Phosphate Type
AMS 4928	Bars and Forgings - 6Al 4V, Annealed - 120,000 psi
AMS 4945	Tubing, Seamless, Hydraulic, 3Al 2.5V, Texture Controlled, 105,000 psi (724 MPa) Yield Strength
AMS 4965	Bars, Forgings and Rings - 6Al 4V, Sol. and Precip. Heat Treated
AMS 5556	Steel Tubing, Seamless or Welded, Corrosion and Heat-Resistant, 18Cr - 11Ni - (Cb+Ta) (SAE 30347) Hydraulic
AMS 5557	Steel Tubing, Seamless or Welded, Corrosion and Heat-Resistant, 18Cr - 11Ni (SAE 30321) Hydraulic
AMS 5567	Steel Tubing, Seamless and Welded, Corrosion Resistant, 19Cr - 10Ni (SAE 30304) Hydraulic, Solution Treated

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SAE WEB ADDRESS: http://www.sae.org

2.1 (Continued):

AMS 5570	Steel Tubing, Seamless, Corrosion and Heat-Resistant 18Cr - 11Ni - 0.401Ti (SAE 30321)
AMS 5571	Steel Tubing, Seamless, Corrosion and Heat-Resistant, 18Cr - Ni - 0.70(Cb+Ta) (SAE 30347)
AMS 5575	Steel Tubing, Welded, Corrosion and Heat-Resistant, 18Cr - 10.5Ni - 0.70(Cb+Ta) (SAE 30347)
AMS 5576	Tubing, Welded, 18Cr - 11Ni - 0.40Ti
AMS 5636	Steel Bars, Corrosion-Resistant, 18Cr - 8.5Ni - (SAE 30302) Cold Drawn, 100,000 psi (690 MPa)
AMS 5637	Steel Bars, Corrosion-Resistant. 18Cr - 10Ni (SAE 30302)
AMS 5639	Steel Bars, Forgings, Tubing, and Rings, Corrosion-Resistant, 19Cr - 10Ni (SAE 30304)
AMS 5643	Steel Bars, Forgings, Tubing, and Rings, Corrosion Resistant, 16.5Cr - 4.0Ni - 4.0Cu
AMS 5644	Steel Bars and Forgings, Corrosion and Heat Resistant 17Cr - 7Ni - 1Al
AMS 5645	Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat Resistant 18Cr - 10Ni - 0.40Ti (SAE 30321)
AMS 5646	Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat Resistant 18Cr - 11Ni - 0.60(Cb+Ta) (SAE 30347)
AMS 5647	Steel Bars, Forgings, Tubing and Rings, 18Cr - 8Ni
AMS 5659	Steel Bars, Forgings, and Rings, Corrosion Resistant 15Cr - 4.5Ni - 0.30(Cb+Ta) - 3.5Cu Consumable Electrode Melted
AMS 5743	Steel Bars and Forgings, Corrosion and Moderate Heat-Resistant 15.5Cr - 4.5Ni - 2.9Mo - 0.10N, Solution Heat Treated, Sub-Zero Cooled, Equalized and Over-Tempered
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steel
ARP603	Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings
AS150	Hose Assembly, Type Classification of, Basic Performance and Fire Resistance
AS611	Polytetrafluoroethylene Hose Assembly Cleaning Methods
ARP908	Torque Requirements, Installation and Qualification Test, Hose and Tube Fittings
AS1055	Fire Testing of Flexible Hose Tube Assemblies, Coils, Fittings, and Similar Systems
AS1072	Sleeve, Hose Assembly, Fire Protection
AS1073	Sleeve, Hose Assembly, Heat Shrinkable Polytetrafluoroethylene Tubing
AIR1228	Standard Impulse Machine Equipment Operation
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies
AS2078	Test Methods, Hose Assemblies, Polytetrafluoroethylene (PTFE)
AS4265	Impulse Testing of Hydraulic Tubing and Fittings, S-N Curve
AS4375	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
AS4395	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

2.1 (Continued):

AS4488	Tubular Assemblies, Fusion Welded, Inspection Processes and Acceptance Standards for
AS4624	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, St-St
AS4625	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, St-45°
AS4626	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, St-90°
AS4627	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, 45°-45°
AS4628	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, 90°-90°
AS4629	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flareless, 45°-90°
AS4630	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, St-St
AS4631	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, St-45°
AS4632	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, St-90°
AS4633	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, 45°-45°
AS4634	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, 90°-90°
AS4635	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Flared, 45°-90°
AS4636	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, St-St
AS4637	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, St-45°
AS4638	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, St-90°
AS4639	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, 45°-45°
AS4640	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, 90°-90°
AS4641	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para-Aramid Reinforced, Heavy Duty, Beam Seal, 45°-90°
AS4658	Fitting End, External Thread, Short Flareless, Design Standard
AS5272	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
AS8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter, General Specification of

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959.

ASTM A 262	Detecting Susceptibility to Intergranular Attack on Stainless Steel
ASTM B 348	Specification for Titanium and Titanium Alloy Bars and Billets, Grade 2

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

P-D-680	Dry Cleaning Solvent
QQ-S-763	Steel Bars, Wire Shapes, and Forgings, Corrosion-Resisting
MIL-PRF-5501	Caps and Plugs, Protective, Dust and Moisture Seal, General Specifications for
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordinance (Inactive For New Design)
MIL-PRF-83282	Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft
MIL-F-85421	Fittings, Tube, Fluid Systems, Separable, Dynamic Beam Seal, Requirements for
MIL-F-85421/1	Fitting End, Standard Dimensions for, Dynamic Beam Seal, Male
MIL-STD-100	Engineering Drawing Practices for Inspection
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of

2.4 NAS Publications:

Available from Aerospace Industries Association, 1250 Eye Street N.W., Washington, DC 20005.

NAS1760	Fitting End, Flareless Acorn, Standard Dimensions for

2.5 ASME Publications:

Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B46.1	Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

The hose assemblies furnished under this document shall be products which are qualified by meeting all the requirements covered by this document (such as AS4624 through AS4641).

3.2 Materials:

The hose assembly materials shall be uniform in quality, free from defects, consistent with good manufacturing practice, and shall conform to applicable specifications and the requirements specified herein.

3.2.1 Metals: Metals used in the hose and fittings shall be corrosion-resistant and shall conform to the following specifications:

3.2.1.1 Bars and Forgings:

QQ-S-763	Class 302 - Condition A or Condition B (AMS 5636 and AMS 5637)
QQ-S-763	Class 304 - Condition A or Condition B (AMS 5639)
QQ-S-763	Class 304L - Condition A (AMS 5647)
QQ-S-763	Class 321 - Condition A (AMS 5645)
QQ-S-763	Class 347 - Condition A (AMS 5646)
AMS 4928	6Al-4V Titanium - Annealed
AMS 4965	6Al-4V Titanium - Solution Treated
AMS 5643	17-4 PH Solution Heat Treated
AMS 5644	17-7 PH Solution Heat Treated
AMS 5659	15-5 PH Solution Heat Treated
AMS 5743	AM 355 - Solution Heat Treated
ASTM B 348	Grade 2 - Titanium Alloy

3.2.1.2 Tubing:

AMS 4945	Titanium 3Al-2.5V Texture Controlled
AMS 5556	Type 1 or Type 2 Stainless Steel Tubing, 347
AMS 5557	Type 1 or Type 2 Stainless Steel Tubing, 321
AMS 5567	Type 1 or Type 2 Stainless Steel Tubing, 304
AMS 5570	Seamless Stainless Steel Tubing, 321
AMS 5571	Seamless Stainless Steel Tubing, 347
AMS 5575	Welded Stainless Steel Tubing, 347
AMS 5576	Welded Stainless Steel Tubing, 321

3.2.2 Reinforcement: Para-aramid textile treated and applied to the hose with an outer polyester braid or polybenzimidazol/para-aramid blend braid cover to meet all the requirements herein.

3.3 Design and Construction:

The hose assembly shall consist of a seamless PTFE inner tube, treated para-aramid reinforcement, polyester or polybenzimidazol/para-aramid blend outer braid cover and corrosion-resistant steel and/or titanium end fittings, as required, to meet the construction and performance requirements of this document.

3.3.1 Inner Tube: The inner tube shall be of a seamless construction of virgin PTFE resin of uniform gage. It shall have a smooth bore and shall be free from pitting or projections on the inner surface. Additives may be included in the compound from which the tube is extruded.

3.3.2 Reinforcement: The reinforcement shall consist of a treated para-aramid braid and/or wraps with braided polyester or polybenzimidazol/para-aramid blend braid cover. The reinforcement shall be arranged over the inner tube to provide sufficient strength and protection for ensuring conformance with the requirements specified herein. Broken reinforcing cords shall be cause for rejection. The outer braid shall provide 100% coverage to protect the para-aramid reinforcement from exposure to ultraviolet light. A continuous lay line interrupted with AS4623 and hose manufacturer's name and trademark shall be marked in contrasting color along length of hose.

3.3.3 Fittings: All fittings shall be permanently attached and proven to meet the requirements herein. Standard hose assemblies shall have flared fittings to mate with AS4395, flareless fittings according to NAS1760 to mate with AS4375 or short flareless fittings according to mate with AS4658 or beam seal fittings to mate with male end fittings per MIL-F-85421. Anti-torque hexes shall be provided and shall fit standard wrench openings. All internal surfaces of fitting nuts shall be dry filmed with dry film per AS5272. Dry film on external surfaces is optional.

3.3.3.1 Straight Fittings: Straight fittings shall be of one piece construction. Welded joints must not be located in the fluid paths, except welded and redrawn tubing, in accordance with AMS 5567 or AMS 5576 or AMS 5557 may be used.

3.3.3.2 Other Fittings: Other fittings including elbow fittings shall be of one piece construction to the maximum extent possible. However, those made with other than one piece construction shall use welded and redrawn tubing in accordance with AMS 5576 or AMS 5567 or AMS 5557 and shall employ a butt-weld joint method per AS4488. If welding is used, a stabilized grade of stainless steel shall be used. Titanium tubes shall be in accordance with AMS 4945 and employ a butt-weld joint method per AS4488 or equivalent.

3.3.3.3 End Fitting Collars (Sockets): All end fitting collars (sockets), crimped or swaged, and fabricated from Type 304 stainless steel are required to be capable of passing an embrittlement test as specified in ASTM A 262 Practice E, prior to assembly to the nipple and crimp or swaging operation. Sockets fabricated from stabilized austenitic steel (304L, 321, or 347) and titanium are acceptable without being subjected to the embrittlement test. Titanium collars are per ASTM B 348 - Grade 2.

3.3.3.4 Finish:

3.3.3.4.1 Corrosion Resistant Steel Parts: Unless otherwise specified, corrosion resistant steel parts shall be passivated in accordance with AMS-QQ-P-35.

3.3.3.4.2 Titanium Alloy Parts: Titanium alloy parts shall be fluoride phosphate coated per AMS 2486 unless otherwise specified.

3.4 Dimensions:

The hose assembly dimensions, except for length, shall be as specified in Figure 1 and Table 1.

3.4.1 Hose Weight: Hose consisting of inner tube, reinforcement, and outer layers as outlined in 3.3.1 and 3.3.2 shall not exceed the maximum hose weights specified in Table 2.

3.5 Performance:

The inner tube and hose assembly shall meet the following performance requirements:

3.5.1 Inner Tube:

3.5.1.1 Tube Roll: The tube shall not leak, split, burst, or show any evidence of malfunction, when rolled to the flattening and rounding gaps of AS2078 (3000 psi or higher) values. The test method is specified in 4.6.2.1.

3.5.1.2 PTFE Tube Proof Pressure: The tube, without reinforcement, shall not leak, burst, or show any evidence of malfunction when tested to AS2078 (3000 psi and higher) proof pressure values. Test method is specified in 4.6.2.1.

3.5.1.3 Tensile Strength: The longitudinal tensile strength for all sizes of tubes shall be 2200 psi minimum. The transverse tensile strength for sizes -10 and larger shall be 1800 psi minimum. For sizes -08 and smaller, the transverse tensile strength need not be tested. The test method is specified in 4.6.2.2.

3.5.1.4 Elongation: Elongation shall be a minimum of 200%. Test method is specified in 4.6.2.3.

3.5.1.5 Specific Gravity: The specific gravity values of the hose inner tube shall not exceed 2.155 apparent and 2.190 relative. The test method is specified in 4.6.2.4.

3.5.2 Hose Assembly: The hose, complete with reinforcing braids and assembled with end fittings, shall meet the following performance requirements:

3.5.2.1 Proof Pressure: The hose assembly shall withstand the proof pressure listed in Table 2 without malfunction or leakage. The test method is specified in 4.6.3.

3.5.2.2 Elongation and Contraction: The hose assembly shall not change in length by more than ±2% in 10 in of hose length, when subjected to the maximum operating pressure in Table 2 for a minimum of 5 min. The test method is specified in 4.6.4.

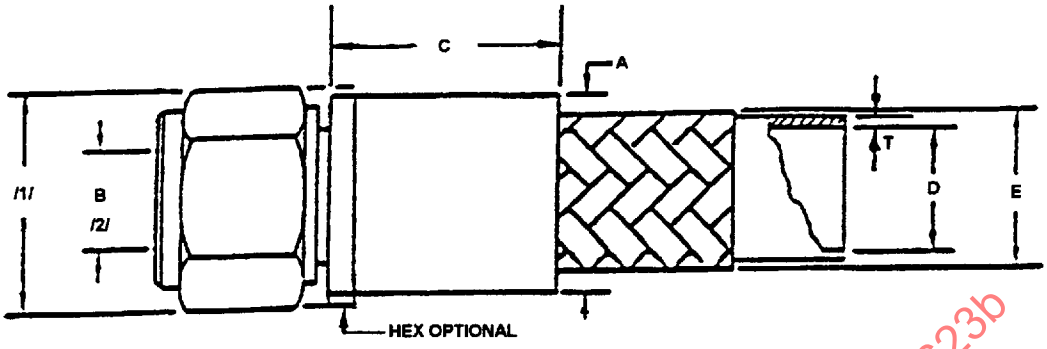

FIGURE 1 - Hose and Fitting Dimensions

TABLE 1 - Hose and Fitting Dimensions as Shown in Figure 1 (in)

Hose Size	Rigid Tube OD (ref)	/1/ Fitting OD A Max	/2/ Fitting ID B Min	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided PTFE Wall Thickness T Min
04	.250	.690	.135	1.25	.212	.480	.540	.035
06	.375	.800	.240	1.45	.298	.600	.660	.035
08	.500	.970	.340	1.78	.391	.765	.825	.045
10	.625	1.150	.410	2.25	.485	.860	.930	.045
12	.750	1.380	.510	2.50	.602	1.130	1.210	.045
16	1.000	1.660	.760	3.00	.852	1.427	1.507	.050
20	1.250	2.320	.925	3.55	1.101	1.700	1.780	.050

/1/ Cross Corners of nut and socket hex may exceed "A" dimension

/2/ Minimum specified inside diameter shall be verified by passing a spherical ball through the hose assembly. The minimum I.D. shall not be less than 90% of the value(s) shown for a straight fitting nor less than 85% of the value(s) shown for an elbow fitting.

TABLE 2 - Physical Requirements of Hose Assemblies and Weight of Hose

Hose Size	Hose Weight Max /1/ lb/in	Operating Pressure psi	Proof Pressure psi	Burst Pressure Room Temperature Min psi	Burst Pressure High Temperature Min psi	Bend Radius at inside of Bend Min in	Volumetric Expansion Max cm^3/in	Maximum Operating Temperature °F
04	.010	3000	6000	16 000	12 000	1.50	.089	275
06	.014	3000	6000	14 000	10 500	2.50	.132	275
08	.020	3000	6000	14 000	10 500	2.88	.187	275
10	.023	3000	6000	12 000	9 000	3.25	.383	275
12	.032	3000	6000	12 000	9 000	4.00	.493	275
16	.055	3000	6000	12 000	9 000	7.50	1.000	225
20	.075	3000	6000	12 000	9 000	12.00	1.150	225

/1/ Hose weight shall be determined on a minimum length of 12 in

3.5.2.3 Volumetric Expansion: The volumetric expansion of the hose assemblies shall not exceed the limits specified in Table 2. The test method is specified in 4.6.5.

3.5.2.4 Leakage: The hose assembly shall not leak (no external wetting) when subjected to two pressure cycles of 70% of minimum room temperature burst pressure. The test method is specified in 4.6.6. For -16 and -20 sizes only 66% of minimum room temperature burst is required.

3.5.2.5 Burst Pressure:

3.5.2.5.1 Room Temperature Burst Pressure: The hose assembly shall not leak nor burst at any pressure below the room temperature burst value specified in Table 2. The test method is specified in 4.6.7.1.

3.5.2.5.2 High Temperature Burst Pressure: The hose assembly shall not leak nor burst at any pressure below the high temperature burst value specified in Table 2. The test method is specified in 4.6.7.2.

3.5.2.6 Thermal Shock: The hose assemblies shall not leak nor show any evidence of malfunction when subjected to the Table 2 proof and high temperature burst pressure, after being thermally shocked by rapidly increasing hose temperature from -65 to 275 °F. The test method is specified in 4.6.8. Temperature shall be -65 to 225 °F for -16 size and larger.

3.5.2.7 Torsion - Impulse: The hose assemblies shall be capable of withstanding 250,000 impulse cycles including torsion for the last 50,000 cycles and one million rapid rate impulse cycles when tested in accordance with 4.6.9. Any hose or fitting leakage, hose burst, fitting blowout, or any other evidence of malfunction during the test shall constitute failure.

3.5.2.8 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 2 proof pressure after 400,000 flexure cycles. The test method is specified in 4.6.10.

3.5.2.9 Stress Degradation (Air Leakage): The air leakage rate from the hose and two end fittings (not including "B" nuts) when held at the Table 2 operating pressure after completion of the stress degradation test shall not exceed 2.0 cc/in/min. The test method is specified in 4.6.11.

3.5.2.10 Repetitive Assembly Torque: The beam seal fitting shall withstand the repetitive torque values specified in MIL-F-85421, and flared and flareless fittings per ARP908, without failure or leakage. There shall be no leakage, galling, or other malfunction of the fitting nut and interface connection during the specified pressure test. The test method is specified in 4.6.12.

3.5.2.11 Electrical Conductivity: Hose assembly shall conduct a direct current equal to 900 µA minimum to 10,000 µA maximum with a test potential of 1000 V DC. The test method is specified in 4.6.13.

3.5.2.12 Push/Pull Test: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the push/pull test specified in 4.6.14.

3.6 Screw Threads:

Coupling nut threads shall be in accordance with AS8879. Thread tolerance increase of 10% during assembly or testing shall not be cause for rejection of the hose assembly.

3.7 Length:

Tolerances on hose assembly lengths shall be as follows:

a. ±0.125 for lengths under 18 in
b. ±0.250 in for lengths from 18 to 36 in exclusive
c. ±0.500 in for lengths from 36 to 50 in exclusive
d. ±1% for lengths of 50 in and over

3.8 Part Numbering and Interchangeable Parts:

All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirement of MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.9 Identification of Product:

Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. The following special marking shall be added.

3.9.1 Fittings: The manufacturer's name or trademark shall be permanently marked on all end fittings.

3.9.2 Assembly: A permanent marking on the fitting or a permanent stainless steel band or bands on hose shall be used. If band is used on hose, it shall be covered with translucent shrink sleeve per AS1073 code "A" and extend beyond the edge of the band by approximately 0.125 in. Shrink sleeve should also be used as a chafe guard under any band applied to the hose. A permanent metallic band may be used on the collar or over a firesleeve. The band shall be no wider than 1 in and shall not impair the flexibility or the performance of the hose. Unless otherwise specified, the marking on the fitting or band shall include the following information:

a. Assembly manufacturer's name or trademark, and assembly specification number AS4623
b. CAGE code and manufacturer's assembly part number
c. Operating pressure 3000 psi (maximum)
d. Operating temperature 275 °F or 225 °F (as applicable per Table 2)
e. Pressure test symbol "PT"
f. Date of hose assembly manufacture expressed in terms of month and year
g. Hose manufacturer's CAGE code number (Required only when hose manufacturer is different than the hose assembly manufacturer)
h. Fire resistance type per AS1055, type and class or AS150 and type (when applicable)

3.10 Workmanship:

The hose assembly, including all parts, shall be constructed and finished in a thoroughly workmanlike manner. All surfaces shall be free from burrs. All sealing surfaces shall be smooth, except that annular tool marks up to 100 µin Ra maximum per ASME B46.1 will be acceptable.

3.10.1 Dimensions and Tolerance: All pertinent dimensions and tolerances, where interchangeability, operation, or performance of the hose assembly may be affected, shall be specified on all drawings.

3.10.2 Cleaning: All hose assemblies shall be free from oil, grease, dirt, or other foreign materials both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned to Class 0 of AS611, using approved alkaline cleaners only. Do not use chlorinated solvents.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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.

4.2 Classification of Inspection:

The examining and testing of hose assemblies shall be classified as:

a. Qualification inspections (4.3)
b. Quality conformance inspections (4.4)

4.3 Qualification Inspections:

4.3.1 Qualification Test Samples: Test samples shall consist of the number of samples and lengths specified in Table 3. All specimens for each hose size are required for qualification each of the methods of end fitting attachment and for each, method of end fitting construction, bent tube or forged. Simultaneous qualification of two (flared, flareless, short flareless, or beam seal) of four types of end fittings may be accomplished by having different fittings on each end of the hoses. If a supplier qualifies one or more ends and at a later date desires to qualify others, two hose assemblies of each size and type to be qualified shall be subjected to the tests specified in 4.5.2.2.

The six test specimens required for the impulse test (4.6.9) shall have straight end fittings on one end and 90° elbow fittings on the other. All remaining test samples shall have straight-to-straight end fittings.

TABLE 3 - Length of Hose Assemblies in Inches for Test

Hose Assembly Size	Six Assemblies for Each Impulse Test	Two Assemblies for Each Flex Test	Assemblies for Other
04	10.5	14.00	18
06	15.0	18.50	18
08	17.5	21.00	18
10	20.5	24.00	18
12	24.5	28.00	18
16	38.0 (25.0-90°)/1/	41.00	18
20	55.0 (34.5-90°)/1/	58.50	18

/1/ When assemblies are tested at 90° in place of 180°

4.3.2 Qualification Test Sequence: Test sequence and procedure shall be as specified in Table 4 and if applicable 4.5.2.2.

TABLE 4 - Qualification Test Schedule

Sample No.	PTFE Tube 1 /1/	Hose Assys 2, 3	Hose Assys 4, 5	Hose Assys 6, 7	Hose Assys 8, 9	Hose Assys 10 through 15 /2/	Hose Assy 16	Hose Assy 17 /3/
4.6.1.1 Examination of Product	O							O
4.6.2.1 Tube Roll	O							
4.6.2.1 Proof Pressure	O							
4.6.2.2 Tensile Strength	O							
4.6.2.3 Elongation	O							
4.6.2.4 Specific Gravity	O							
4.6.3 Proof Pressure	O							
4.6.1.2 Examination of Product		O	O	O	O	O	O	
4.6.3 Proof Pressure		O	O	O	O	O	O	
4.6.4 Elongation and Contraction		O						
4.6.5 Volumetric Expansion			O					
4.6.6 Leakage				O				
4.5.2.3 Oil Aging			O					
4.6.7.1 Room Temperature Burst Pressure			O (1ea)					
4.6.7.2 High Temperature Burst Pressure			O (1ea)					
4.6.8 Thermal Shock				O				
4.6.9 Torsion-Impulse						O		
4.6.10 Assembly Flexibility		O						
4.6.11 Stress Degradation					O			
4.6.12 Repetitive Assembly Torque		O						
4.6.13 Electrical Conductivity								O
4.6.14 Push/pull							O	

/1/ Production lot records may be used to verify conformance to 4.6.1 and 4.6.2 when the tube being used is an established production item.

/2/ These samples shall have a 90° elbow fitting on one end of the hose and a straight-type fitting on the other end of the hose. If approval is being sought for both the bent-tube and the forged elbow configuration, then one-half of the samples (three) shall use one type of configured elbow, while the other half of the samples use the other type.

/3/ Fitting required on one end only

4.3.3 Test Report, Test Samples, and Data for the Procuring Activity: When the tests are conducted at a location other than the laboratory of the procuring activity, the following shall be furnished to that activity:

a. Test Report: The test report shall include a report of all tests and outline description of the tests and conditions, according to MIL-STD-831.

b. Test Samples: Test samples when requested by the procuring activity and subjected to qualification testing, shall not be shipped as part of contract order.

c. Drawings: Three sets of assembly and subassembly shall have a cut-away section showing all details in their normal assembly position and shall identify all details and subassemblies.

d. Sources: A list of sources of hose or hose components, including source's name and product identification for inner tube, hose, and assembly shall be supplied.

NOTE: Log sheets and recorded test data shall remain on file at the source test facility and are not to be sent to the qualifying activity unless specifically requested.

4.3.4 Qualification Inspection Methods: Qualification inspection methods shall consist of all the examinations and tests specified under 4.6.

4.4 Quality Conformance Inspections:

Quality conformance inspections shall consist of the following tests:

a. Individual tests (see 4.4.1) (100% inspection)
b. Sampling tests (see 4.4.2)
c. Periodic control tests (see 4.4.3)

4.4.1 Individual Tests: Each hose assembly shall be subjected to the following tests:

a. Examination of product (see 4.6.1)
b. Proof pressure test (see 4.6.3)

NOTE: Production samples that are proof pressure tested with water should be air dried prior to capping (see cleaning requirements in 3.10.2).

4.4.2 Sampling Tests: The following inspections and tests shall be performed on hose assemblies with straight fittings on each end, selected at random from each inspection lot. Initially, an inspection lot shall be hose made from each of the first four reinforcement setups for the construction of each dash size. After successfully testing four consecutive reinforcement setups (lots), an inspection lot shall consist of no more than 9000 hose assemblies, all of one hose size, manufactured under essentially the same conditions.

TABLE 5

	No. of Samples Per Test Initial Lots	No. of Samples Per Test Per 9000 Assemblies
Room temperature burst	1	3
Specific gravity	Tubing Only	Tubing Only
Impulse per 4.6.9(b) less torsion (unaged)	1	3
Stress degradation	1	3

4.4.3 Periodic Control Tests: The following inspections and tests shall be performed as indicated on four hose assemblies manufactured from bulk hose lengths selected at random from each inspection lot. The inspection lot shall consist of not more than 20,000 ft of hose, all of one dash number size, and manufactured under essentially the same conditions.

TABLE 6

	No. of Samples Per Test
Elongation and contraction	4
Leakage	Use same samples for all tests
Conductivity	Use same samples for all tests

4.4.4 Rejection and Retest: Where one or more items selected from a lot fails to meet the specifications, all items in the lot shall be rejected.

4.4.4.1 Resubmitted Lots: Once a lot (or part of a lot) has been rejected by a procuring activity (government or industry), and before it can be resubmitted for tests, full particulars concerning the cause of rejection, and the action taken to correct the defects in the lot, shall be furnished in writing by the contractor.

4.4.5 Inspection Procedures: All inspection plans shall be single sample plans with an accept number of zero.

4.4.6 Destructive Test Sample: Prior to testing, a letter "D" shall be permanently marked on each end fitting of those assemblies used for destructive tests (4.4.2 and 4.4.3).

4.5 Test Conditions:

4.5.1 Fitting Ends: Qualification tests shall be conducted on assemblies using straight type swivel ends except for impulse test samples requiring a 90° elbow fitting on one end. Satisfactory completion of qualification tests shall also constitute qualification approval for hose assemblies having other fittings that have an identical attachment method and design, and meet the requirements of this document.

4.5.2 Preparation of Samples:

4.5.2.1 Unless otherwise specified, the length of sample assemblies shall be in accordance with Table 3.

4.5.2.2 If test samples use either one or two of the three types of standard fittings (flared, flareless, or beam seal), and qualification approval is desired for the other type(s), two additional hose assemblies with the other type(s) of fitting end and size to be qualified shall be subjected to the following tests in the sequence indicated:

a. Examination of product (see 4.6.1): Samples 1, 2
b. Proof pressure test (see 4.6.3): Samples 1, 2
c. Leakage test (see 4.6.6): Samples 1, 2
d. Repetitive assembly torque test (see 4.6.12): Samples 1, 2
e. Room temperature burst pressure test (see 4.6.7.1): Samples 1, 2
f. Impulse/torsional test (unaged) (see 4.6.9): Samples 1, 2

4.5.2.3 Oil Aging: In all the tests using oil-aged samples, the hose assemblies shall be fully preconditioned in AS1241 Type IV fire resistant fluid or the system hydraulic fluid, as applicable. Preconditioning shall be done in two phases:

a. The hose assemblies shall be filled with AS1241 hydraulic fluid or system hydraulic fluid, as applicable, and then shall be pressurized to operating pressure. While maintaining the pressure at room temperature, the hose assembly shall be immersed in AS1241 or system fluid, as applicable, for 8 to 10 min and then allowed to air dry for the remainder of 1 h. This sequence of immersion and air drying shall be repeated for a total of not less than 50 times.

b. After completing item (a), the hose shall be filled with AS1241 hydraulic fluid or system fluid, as applicable (excluding all air), and the hose shall then be pressurized to operating pressure and aged at 275 °F in air for 168 h. Sizes -16 and -20 shall be aged at 225 °F.

4.5.2.4 Air Aging: Air aged samples shall be kept in air at a temperature of 275 °F for 7 days. Sizes -16 and -20 shall be aged at 225 °F.

4.5.2.5 Unaged Samples: Unaged assemblies shall be as manufactured.

4.5.3 Test Fluids: Unless otherwise specified, the pressure test fluid shall be hydraulic oil conforming to MIL-H-5606, or water. Where a high temperature test fluid is required, the test fluid shall be MIL-H-83282 hydraulic fluid.

4.5.4 Pressure Measurement: Unless otherwise specified, all pressures shall have a tolerance of -0%, +5%.

4.5.5 Temperature Measurements: Unless otherwise specified, temperature measurements shall be taken within 6 in of hose assemblies under test. Unless otherwise specified, all temperatures shall have a tolerance of +15 °F, -5 °F.

4.5.6 End Connections: Except as otherwise noted, each hose end shall be connected to a male fitting end in accordance with 3.3.3 and shall have an installation torque range as specified in ARP908 or male end fitting per MIL-F-85421/1 with installation torques per MIL-F-85421.

4.6 Inspection Methods:

4.6.1 Examination of Product:

4.6.1.1 Inner Tube (PTFE): Each length of tubing shall be examined to determine conformance to this document with respect to material, size, workmanship, and dimensions.

4.6.1.2 Hose Assembly: All hose assemblies shall be visually inspected to determine conformance to this document with respect to material, size and workmanship.

4.6.2 Tube Tests:

4.6.2.1 Tube Roll and Proof Pressure Test: Each length of tubing shall be subjected to a tube roll and proof pressure test in accordance with AS2078. The flattening gap, rounding gap, and proof pressure shall be as specified for 3000 psi and higher. The test media shall be air or water.

4.6.2.2 Tensile Strength: The tube shall be subjected to tensile strength tests in accordance with AS2078.

4.6.2.3 Elongation: The tube shall be subjected to the elongation in accordance with AS2078.

4.6.2.4 Specific Gravity of the Tube:

4.6.2.4.1 Apparent Specific Gravity: Apparent specific gravity shall be determined in accordance with AS2078. When test samples are prepared from braided hose, the braid impression must be removed prior to testing.

4.6.2.4.2 Relative Specific Gravity: Relative specific gravity shall be determined in accordance with AS2078.

4.6.3 Proof Pressure Test: All hose assemblies shall be pressure tested to the values specified in Table 2 in accordance with AS2078. The test fluid may be either water or hydraulic oil conforming to MIL-H-5606 for tests conducted at room temperature. All assemblies used for the tests described in this document shall have this proof pressure test applied to them. Any evidence of leakage from the hose or fittings, or any evidence of malfunction shall constitute failure. Proof pressure of hose assemblies having firesleeves shall be performed before sleeving, when possible, using water as the test medium. Proof pressure shall be held for a minimum of 2 min, during which time the firesleeves, if installed, shall be pulled back from the end fittings.

4.6.4 Elongation and Contraction Test: Two hose assemblies of each size shall be subjected to the elongation and contraction test in accordance with AS2078.

4.6.5 Volumetric Expansion Test: Two hose assemblies of each size shall be subjected to the volumetric expansion test in accordance with AS2078.

4.6.6 Leakage Test: Two hose assemblies of each size shall be subjected to the leakage test in accordance with AS2078.

4.6.7 Burst Tests:

4.6.7.1 Room Temperature Burst Pressure Test: One oil aged hose assembly of each size shall be subjected to room temperature burst pressure test in accordance with AS2078. The assemblies shall be observed throughout the test and the type of failure and the pressure when failure occurred shall be recorded.

4.6.7.2 High Temperature Burst Pressure Test: One oil aged hose assembly of each size shall be subjected to the high temperature burst pressure test in accordance with AS2078 except high temperature shall be 275 °F. Sizes -16 and -20 shall be tested at 225 °F.

4.6.8 Thermal Shock Test: Two hose assemblies of each size shall be subjected to the thermal shock test in accordance with AS2078, except sizes -16 and larger shall be limited to 225 °F. One assembly shall be air aged and one shall be unaged.

4.6.9 Torsion-Impulse Test: Impulse testing shall be performed as follows on six straight-to-90° elbow hose assemblies of each size. The impulse test equipment shall conform to ARP603, AIR1228, and AS4265.

a. The test assemblies shall be connected to rigid supports and bent in a U-shape as illustrated in Figure 3 with a bend radius at the apex of the bend as specified in Table 2 except that sizes -16 and larger may be bent in a 90° shape at a reduced length as noted in Table 3 to reduce fluid volume.

b. One air aged, one oil aged, and one unaged sample shall be impulsed as specified in ARP603 with peak pressures of 150% of operating pressure measured at the inlet manifold. Impulsing shall occur at a rate of 70 cpm ± 10 cpm for a minimum of 250,000 cycles. During the last 50,000 cycles of the 250,000 cycles, the straight end of the assembly shall be rotation cycled ±5° for sizes -04, -06, -08 and ±2° for sizes -10 and -12 at 15 cpm. No rotation on sizes -16 and larger.

c. Three unaged samples shall be subjected to one million cycles of rapid rate impulse testing 0(+300 psi -0 psi) to 5500 psi (±200 psi) at 600 cpm ±30 cpm. For -20 size, the hose shall be tested at 4500 psi ± 200 psi at 600 cpm.

d. Impulse testing in b and c shall be run in such a manner that the assemblies are temperature-cycled from room temperature to a specific fluid and ambient air temperature a minimum of two times, with a minimum of 80% of the impulse cycles at 275 °F. Sizes -16 and -20 shall be tested at 225 °F.

4.6.10 Assembly Flexibility Test: Two hose assemblies of each size shall be mounted in the assembly flexure test setup as illustrated in Figure 2 and subjected to the flexure testing in accordance with AS2078 except the maximum temperature shall be 275 °F. For sizes -16 and larger, temperature shall be limited to 225 °F.

4.6.11 Stress Degradation Test: Two hose assemblies of each size shall be subjected to the stress degradation test in accordance with AS2078 except that the assemblies shall be flushed with solvent per P-D-680 in lieu of trichlorotrifluoroethane and the maximum temperature shall be 275 °F. For sizes -16 and larger, temperature shall be 225 °F.

4.6.12 Repetitive Assembly Torque Test: Two hose assemblies of each size shall be subjected to the repetitive test procedure and torque values as defined in MIL-F-85421 for the beam seal fitting design and ARP908 for the flared and flareless design.

4.6.13 Electrical Conductivity Test: One test specimen shall be subjected to the electrical conductivity test in accordance with AS2078 except that optional method of testing per Figure 4 is allowed.