SAE Aerospace
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AEROSPACE STANDARD

AS5951	REV. B
Issued 2004-09 Revised 2006-11 Superseding AS5951A	

Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 5080 psi (35,000 kPa), 275 °F (135 °C), Aircraft Hydraulic Systems

RATIONALE

Error correction was required to delete AS4375 from 2. References and from 3.3.5 Fittings, and to replace AS4375 by AS5827.

1. SCOPE

This document defines the requirements for polytetrafluoroethylene (PTFE) lined, para-aramid reinforced, hose assemblies suitable for use in 275 °F (135 °C), 5080 psi (35,000 kPa) aircraft hydraulic systems.

NOTE: The SI metric units defined herein are soft conversion units.

2. REFERENCES

2.1 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.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS 2486 Conversion Coating of Titanium Alloys, Fluoride-Phosphate Type

AMS 2487 Anodic Treatment of Titanium and Titanium and Titanium Alloys Solution pH 12.4 Maximum

AMS 2700 Passivation of Corrosion Resistant Steels

AMS 4928 Bars and Forgings - 6Al 4V, Annealed - 120,000 psi

AMS 4965 Bars, Wire, Forgings and Rings - 6Al 4V, Solution Heat Treated and Aged

AMS 5637 Steel Bars, Corrosion-Resistant. 18Cr - 10Ni (SAE 30302)

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

AMS 5639	Steel Bars, Forgings, Tubing, and Rings, Corrosion-Resistant, 19Cr - 10Ni (SAE 30304)
AMS 5647	Bars and Forgings, 304L CRES (S30403)
AMS 5645	Bars and Forgings, 321 CRES (S32100)
AMS 5646	Bars and Forgings, 347 CRES (S34700)
AMS 5656	Bars and Forgings, 21-6-9 CRES
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steel
ARP603	Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings
AS611	Hose Assembly and Tubing, Polytetrafluoroethylene, Cleaning Methods
ARP908	Torque Requirements, Installation and Qualification Test, Hose and Tube Fittings
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)
ARP4266	Hole Contour, Fluid Passage, Tube Fitting
AS4458	Fluid Storage Devices - Pressure Vessels, Gas Cylinders - Pressure Equipment - Manufacture
AS478	Identification Marking Methods
AS5272	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
AS5827	Fitting End, Flareless, Extra Fine Thread, Design Standard
AS7003	National Aerospace and Defense Contractors Accreditation Program (NADCAP)
AS7112	National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components
AS8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter, General Specification of
AS4207	Fitting End, External Thread, Beam Seal, Design Standard
AS85720	Fittings, Tube, Fluid Systems, Separable, High Pressure Dynamic Beam Seal, General Specifications
AS85720/1	Fitting Tube, Fluid Systems, Separable, High Pressure Dynamic Beam Seal, Design Standard

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 262 Detecting Susceptibility to Intergranular Attack on Stainless Steel

ASTM B 348 Specification for Titanium and Titanium Alloy Bars and Billets

2.1.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

MIL-PRF-680 Dry Cleaning Solvent

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordinance

MIL-HDBK-831 Preparation of Test Reports

MIL-PRF-83282 Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft

MIL-PRF-87257 Hydraulic Fluid, Fire Resistant, Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile

2.1.4 NAS Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS 847 Caps and Plugs, Protective, Dust and Moisture Seal

NAS 1760 Fitting End, Flareless Acorn, Standard Dimensions for

2.1.5 ASME Publications

Available from ASME, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture

ASME Y14.100 Engineering Drawing Practices

2.1.6 PRI Publications

Available from Performance Review Institute, 161 Thornhill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2001 Qualified Product Management Council Procedures for Qualified Products Group

PD2101 Aerospace Quality Assurance, Product Standard, Qualification Procedures, Fluid Systems

2.1.7 RTCA Publications

Available from Radio Technical Commission for Aeronautics, Inc., 1828 L Street, NW, Suite 805, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

DO-160 Environmental Conditions and Test Procedure for Airborne Equipment

3. TECHNICAL REQUIREMENTS

3.1 Qualification

Hose assemblies supplied in accordance with this document shall be representative of products which have been subjected to and which have successfully passed the qualification tests specified in this standard.

3.1.1 Manufacturer Qualification

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of PD2101, AS7003 and AS7112, and shall be listed in a Performance Review Institute (PRI) Qualified Manufacturers List (QML).

3.1.2 Product Qualification

All products shall conform to the requirements of this procurement specification and shall be approved in accordance with the requirements of PD2001, and PD2101, for listing in a Performance Review Institute (PRI) Qualified Parts List (QPL). When this performance specification is specified on a design activity controlled drawing, the approved source of supply shall be defined by the design activity.

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 fittings shall be titanium and corrosion-resistant steel and shall conform to the following specifications:

3.2.1.1 Bars and Forgings

- AMS 4928 6Al-4V Titanium - Annealed
- AMS 4965 6Al-4V Titanium - Solution Treated
- AMS 5637 302 CRES
- AMS 5639 304 CRES
- AMS 5645 321 CRES
- AMS 5646 347 CRES
- AMS 5647 304L CRES
- AMS 5656 21-6-9 CRES
- ASTM B 348 Grade 2 - Titanium Alloy

3.2.2 Reinforcement

Para-aramid textile treated, as required, and applied to the hose with an outer polyester, polybenzimidazol/para-aramid blend or air textured nylon braid cover to meet all the requirements herein.

3.3 Design and Construction

The hose assembly shall consist of a seamless PTFE inner tube, para-aramid reinforcement, polyester, polybenzimidazol/para-aramid blend or air textured nylon outer braid cover and titanium end fittings, which may have corrosion resistant sockets/collars 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 be a wrapped or braided para-aramid yarn. The reinforcement shall be arranged over the inner tube to provide sufficient strength and protection to ensure conformance with the requirements specified herein. Broken reinforcement cords shall be cause for rejection. The reinforcement shall be a color different than the cover material.

3.3.3 Fluid Barrier

A full coverage fluid barrier shall be used between the reinforcement and cover.

3.3.4 Cover

The cover shall be a braided polyester, polybenzimidazol/para-aramid blend or air textured nylon. The cover braid shall provide 100% coverage to protect the para-aramid reinforcement from exposure to ultraviolet light, ozone and abrasion. The cover material may be black in color but shall be sufficiently treated to protect against ultraviolet light. There shall be two continuous lay lines, white or other vivid color, consisting of a 4-1/8 inch wide solid stripe, number AS5951/and suppliers name or trademark.

3.3.5 Fittings

All fittings shall be permanently attached. Standard hose assemblies shall have flareless fittings according to NAS 1760, AS4458 or equivalent to mate with AS5827, or dynamic beam seal fittings to mate with male end per AS85720/1 or AS4207. Anti-torque hexes or flats shall be provided on fittings and shall fit standard wrench openings. All internal surfaces of fitting nuts and retainer wire, when used, shall be dry filmed with dry film per AS5272. Dry film on external surfaces and overspray is not cause for rejection.

3.3.5.1 Straight and Standard Shaped Fittings

Straight fittings shall be machined and standard shapes shall be forged or machined. The hose assembly fitting material shall be titanium, except the collar may be corrosion resistant steel (CRES). For elbow fittings, the inside corner shall be a radius in accordance with ARP4266.

3.3.5.2 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. Embrittlement tests are not required on sockets fabricated from stabilized austenitic steel (304L, 321, or 347) and titanium. Titanium collars are per ASTM B 348 - Grade 2.

3.3.5.3 Finish

3.3.5.3.1 Corrosion Resistant Steel Parts

Unless otherwise specified, corrosion resistant steel parts shall be passivated in accordance with AMS 2700 or AMS-QQ-P-35.

3.3.5.3.2 Titanium Alloy Parts

Titanium alloy parts shall be fluoride phosphate coated per AMS 2486 or titanium anodized per AMS 2487 unless otherwise specified.

3.3.6 Dimensions

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

3.3.7 Hose Weight

Hose consisting of inner tube, reinforcement, fluid barrier and outer cover as outlined in 3.3.1 through 3.3.4 shall not exceed the maximum hose weights specified in Table 2.

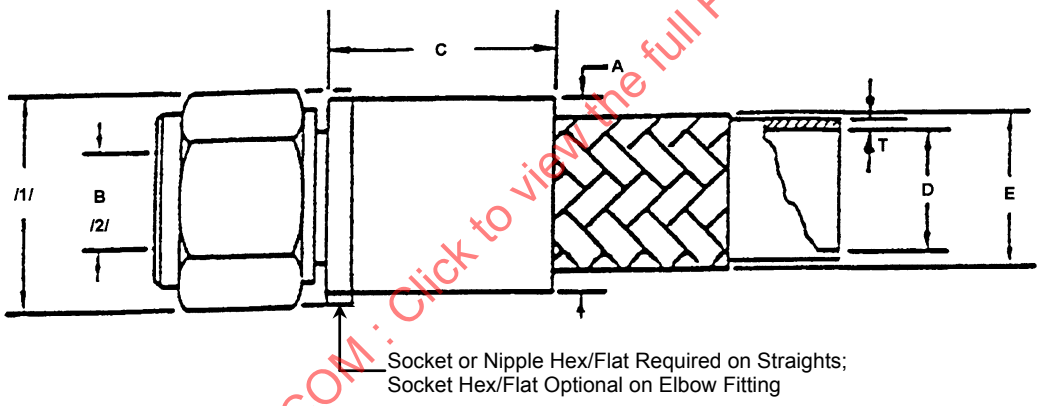


FIGURE 1 - HOSE AND FITTING DIMENSIONS

TABLE 1A - HOSE AND FITTING DIMENSIONS AS SHOWN IN FIGURE 1 - U.S. INCH-POUND UNITS

Hose Size	Rigid Tube OD (Ref.)	Fitting OD A Max /1/	Fitting ID B /2/ (Ref.)	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided PTFE Wall Thickness T Ref.	Spherical Ball Size for Determining Min. Hose Assy ID /3/	
									Straight Fittings	Elbow Fittings
04	.250	.78	.133	1.53	.212	.420	.590	.042	.120	.113
06	.375	.90	.226	1.72	.298	.525	.760	.045	.203	.192
08	.500	1.08	.330	1.94	.391	.750	.925	.045	.297	.280
10	.625	1.20	.410	2.47	.485	.870	.985	.045	.369	.349
12	.750	1.40	.510	3.26	.602	.980	1.180	.050	.459	.434
16	1.000	1.84	.760	3.69	.852	1.264	1.580	.056	.684	.646

/1/ Cross Corners of nut and socket hex may exceed “A” dimension.
/2/ “Fitting ID B” is the minimum of the machined nipple/insert, before assembling the hose. It is used to calculate the inspection “spherical ball size” to be used after the fitting has been swaged/crimped.
/3/ Minimum specified inside diameter shall be verified by passing the applicable size spherical ball through the hose assembly.

TABLE 1B - HOSE AND FITTING DIMENSIONS AS SHOWN IN FIGURE 1 - SI UNITS (CM)

Hose Size	Hose Size (mm) (Ref.)	Fitting OD A Max /1/	Fitting ID B Min /2/ (Ref.)	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided PTFE Wall Thickness T Ref.	Spherical Ball Size for Determining Min. Hose Assy ID /3/	
									Straight Fittings	Elbow Fittings
04	DN06	19.81	3.38	38.86	5.38	10.67	14.99	1.07	3.04	2.87
06	DN10	22.86	5.74	43.69	7.57	13.34	19.71	1.14	5.17	4.88
08	DN12	27.43	8.38	49.28	9.93	19.30	23.50	1.14	7.54	7.12
10	DN16	30.48	10.41	62.74	12.32	22.10	25.02	1.14	9.37	8.86
12	DN20	35.56	12.95	82.89	15.29	24.89	29.98	1.27	11.66	11.02
16	DN25	46.74	19.30	93.73	21.64	32.11	40.13	1.42	17.37	16.41

/1/ Cross Corners of nut and socket hex may exceed “A” dimension.
/2/ “Fitting ID B min” is the minimum of the machined nipple/insert, before assembling the hose. It is used to calculate the inspection “spherical ball size” to be used after the fitting has been swaged/crimped.
/3/ Minimum specified inside diameter shall be verified by passing a spherical ball through the hose assembly.

TABLE 2 - PHYSICAL REQUIREMENTS OF HOSE ASSEMBLIES

Hose Size	Hose Weight Max /1/ lb/in	Hose Weight Max /1/ Kg/cm	Bend Radius at Inside of Bend Min in	Bend Radius at Inside of Bend Min cm	Volumetric Expansion cm^3/in	Volumetric Expansion cm^3/cm
04	.010	.018	1.50	3.81	.10	.04
06	.014	.025	2.50	6.35	.15	.06
08	.020	.036	2.88	7.32	.23	.09
10	.023	.042	3.25	8.26	.38	.15
12	.032	.058	4.00	10.16	.49	.20
16	.055	.100	9.63	24.45	1.13	.45

/1/ Hose weight shall be determined on a minimum length of 12 in (30 cm)

3.4 Performance

3.4.1 Inner Tube

The inner tube shall meet the following performance requirements:

3.4.1.1 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 (21,000 kPa) and higher) values. The test method is specified in 4.6.2.1.

3.4.1.2 PTFE Tube Proof Pressure

The inner tube, without reinforcement, shall not leak, burst, or show any evidence of malfunction when tested to AS2078 (3000 psi (21,000 kPa) and higher) tube proof pressure values. Test method is specified in 4.6.2.1.

3.4.1.3 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 (12,500 kPa) minimum. For sizes -08 and smaller, the transverse tensile strength need not be tested. The test method is specified in 4.6.2.2.

3.4.1.4 Elongation

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

3.4.1.5 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.

3.4.2 Hose Assembly

The hose, complete with reinforcement, fluid barrier, cover and assembled with end fittings, shall meet the following performance requirements:

3.4.2.1 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.

3.4.2.2 Elongation and Contraction

The hose assembly shall not change in length by more than ±2% in 10 in (250 mm) 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.

3.4.2.3 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.

3.4.2.4 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 size only 66% of minimum room temperature burst is required.

3.4.2.5 Room Temperature Burst Pressure

The hose assemblies shall not leak nor burst at any pressure below the room temperature burst value specified in Table 3. The test method is specified in 4.6.7.1.

3.4.2.6 High Temperature Burst Pressure

The hose assembly shall not leak nor burst at any pressure below the high temperature burst value specified in Table 3. The test method is specified in 4.6.7.2.

3.4.2.7 Thermal Shock

The hose assemblies shall not leak nor show any evidence of malfunction when subjected to the Table 3 proof and high temperature burst pressure, after being thermally shocked by rapidly increasing hose temperature from -65 to +275 °F (-54 to +135 °C). The test method is specified in 4.6.8.

TABLE 3 - PRESSURE REQUIREMENTS OF HOSE ASSEMBLIES

Operating Pressure Min	Proof Pressure Min	Burst Pressure Room Temp. Min	Burst Pressure High Temp. Min
5080 psi (35,000 kPa)	10,160 psi (70,000 kPa)	20,320 psi (140,000 kPa)	15,240 psi (105,000 kPa)

3.4.2.8 Standard and Torsion - Impulse

The hose assemblies shall be capable of withstanding 300,000 impulse cycles including torsion for the last 50,000 cycles when tested in accordance with 4.6.9. Any hose or fitting leakage, hose burst, fitting blowoff, or any other evidence of malfunction during the test shall constitute failure.

3.4.2.9 Assembly Flexibility

The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 3 proof pressure after 400,000 flexure cycles. The test method is specified in 4.6.10.

3.4.2.10 Stress Degradation (Air Leakage)

The air leakage rate from the hose and two end fittings (not including “B” nuts) when held at the Table 3 operating pressure after completion of the stress degradation test shall not exceed 4.0 cc/in/min (1.57 cc/cm/min). The test method is specified in 4.6.11.

3.4.2.11 Vibration

The hose assembly shall withstand vibration testing without leakage or other malfunction. The test method is specified in 4.6.12.

3.4.2.12 Repetitive Assembly Torque

The beam seal fitting shall withstand the repetitive torque values specified in AS85720, and flareless fittings per ARP908, without failure or leakage. There shall be no leakage or other malfunction of the fitting nut and interface connection during the specified pressure test. The test method is specified in 4.6.13.

3.4.2.13 Fitting Continuity

A resistance of 10 mΩ maximum is permissible at each connection. The test method is specified in 4.6.14.

3.4.2.14 Hose Assembly Electrical Conductivity

The 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 4.6.15.

3.4.2.15 Push/Pull Test

The hose assembly shall not leak nor show any evidence of malfunction when subjected to the push/pull test specified in 4.6.16.

3.5 Screw Threads

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

3.6 Length

Tolerances on hose assembly lengths shall be as follows:

a. ±0.125 in (3.2 mm) for lengths under 18 in (457 mm)

b. ±0.250 in (6.4 mm) for lengths from 18 to 36 in (457 mm to 914 mm) exclusive

c. ±0.500 in (12.7 mm) for lengths from 36 to 50 in (914 to 1270 mm) exclusive

d. ±1% for lengths of 50 in (1270 mm) and over

3.7 Part Numbering and Interchangeable Parts

All parts having the same SAE or manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirement of ASME-Y14.100 shall govern the manufacturer's part numbers and changes thereto.

3.8 Identification of Product

Assemblies and parts shall be marked for identification in accordance with 3.8.1 and 3.8.2.

3.8.1 Fittings

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

3.8.2 Assembly

A permanent marking shall be on a stainless steel (CRES) band not over 1 in wide or on the collar and the marking method shall be in accordance with AS478. If a band is used, it shall be located over the collar. The band shall be so designed to remain tight on the collar, to prevent relative motion and of sufficient strength to prevent removal by hand. The band shall be covered with transparent polyolefin shrink sleeve, per AS1073, Code A and extend beyond the edges of the band by approximately 0.125 in (12.5 cm). The band shall have the following information:

a. Assembly manufacturer's name or trademark, and assembly specification number AS5951

b. CAGE code and manufacturer's assembly part number

c. Operating pressure 5080 psi (35,000 kPa) (maximum)

d. Operating temperature 275 °F (135 °C)

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 ownership is different than the hose assembly manufacturer)

h. Fire resistance type per AS1055, type and class (when applicable)

i. Additional information as required

3.8.3 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.

3.8.4 Dimensions and Tolerance

All pertinent dimensions, tolerances, materials and processing document numbers where interchangeability, operation, or performance of the hose assembly may be affected, shall be specified on all drawings.

3.8.5 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 4 and tested as specified in Table 5. 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, machined and forged shapes. Simultaneous qualification of two (flareless or beam seal) types of end fittings may be accomplished by having different fittings on each end of the hoses. If a supplier qualifies one end style 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 4.5.1.

TABLE 4 - LENGTH OF HOSE ASSEMBLIES IN INCHES FOR TEST

Hose Size	Two Assys for Flex Test		Twelve Assys for Impulse /1/ /5/		One Assy for Push Pull /2/		One Assy for Conductivity /3/		Three Assys for Vibration /1/		Ten Assys for Other Test	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
04	20	508	12	305	13	330	13	330	10	254	18	457
06	27	686	15	381	15	381	13	330	16	406	18	457
08	30	762	18	457	18	457	13	330	20	508	18	457
10	34	864	21	533	21	533	13	330	25	635	18	457
12	39	991	25 (18) /4/	635 (457) /4/	24	610	13	330	30	762	18	457
16	47	1194	47 (31) /4/	1194 (787) /4/	28	711	13	330	47	1194	18	457

NOTES: /1/ The six test specimens required for the impulse (4.6.9) and three specimens for the vibration test (4.6.13) shall have straight end fittings on one end, and a 90° elbow end fitting on the other end. All remaining samples shall have straight-to-straight end fittings.

/2/ The length shown is the free hose length. The free hose length is the assembly length minus two straight fitting length measured from the gage point to the hose end of the collar.

/3/ 13 in (330 mm) of hose with one fitting.

/4/ Reduced assembly length if testing is performed with a 90° bend.

/5/ Only six assemblies required for -16.

4.3.2 Qualification Test Sequence

Test sequence and procedure shall be as specified in Table 5 and if applicable 4.5.1.

TABLE 5 - QUALIFICATION TEST SCHEDULE

Sample No.	PTFE Tube 1, 2 /1/ /2/	/3/ 3,4	/3/ 5	/3/ 6	/3/ 7,8	/3/ 9,10	/3/ 11,12	/3/ 13,14	/3/ 15,16	/3/ 17,18	/3/ 19,20	/3/ 21,22	/3/ 23	/3/ 24	/3/ 25,26,27	/3/ 28,29	/3/ 30,31,32
Examination of Product	O																
Proof Pressure	O																
Tube Roll	O																
Tensile Strength	O																
Elongation	O																
Specific Gravity	O																
Examination of Product		O	O	O	O	O	O	O	O	O	O	O	O	O			
Proof		O	O	O	O	O	O	O	O	O	O	O	O	O			
Elongation and Contraction		O															
Volumetric Expansion			O	O													
Leakage					O												
Thermal Shock					O												
Oil Aging			O	O								O					
Air Aging											O					O	
UV Resistance (-08 Size Only)																O	
Std Impulse - Unaged							O										
Std Impulse - Air Aged								O									
Std Impulse - Oil Aged									O								
Torsion Impulse – Unaged										O							
Torsion Impulse - Air Aged											O						
Torsion Impulse - Oil Aged												O					
Assembly Flexibility		O															
Room Temperature Burst			O													O	
High Temperature Burst				O													
Stress Degradation						O											
Vibration															O		
Repeated Assembly Torque		O															
Electrical Conductivity														O			
Fitting Continuity														O			
Push Pull													O				
Fire Test (as required)																	O

/1/ Tube only.
/2/ Production lot records may be used to verify conformance to those tests when PTFE tube being used is an established production item.
/3/ Samples 3 through 32 are hose assemblies.

4.3.3 Test Report, Test Samples, and Data

The following data shall be available and submitted when requested:

a. Test Report: The test report shall include a report of all tests and outline description of the tests and conditions, as listed in MIL-HDBK-831.

b. Test Samples: Test samples shall be retained for one year after completion of the qualification test.

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.

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 3.8.5).

4.4.2 Sampling Tests

The following inspections and tests shall be performed on eight 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 3000 hose assemblies, all of one hose size, manufactured under essentially the same conditions, but not necessarily during one continuous run. One hose assembly tested for each lot of 375 hose assemblies is also permitted for protracted or small assembly runs.

a. Internal cleanliness (AS611, Class 0)

b. Leakage test (see 4.6.6)

c. Room temperature burst test (see 4.6.7.1)

4.4.3 Periodic Control Tests

The following inspections and tests shall be performed as indicated on eight 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 (6096 m) of hose, all of one dash number size, and manufactured under essentially the same conditions, but not necessarily during one continuous run. Two hose assemblies may be tested for each lot of 5000 ft (1524 m) of hose is also permitted.

a. Elongation and contraction test (see 4.6.4) (Samples 1 through 4)

b. Impulse test (see 4.6.9a and 4.6.9b): (unaged samples only; may have straight fittings on both ends; at room temperature, and may be terminated after completion of 300,000 cycles) (Samples 1 through 4).

c. Stress degradation test (see 4.6.11) (Samples 5 through 8)

d. Electrical Conductivity Test (see 4.6.15) (Samples 5 through 8)

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 supplier.

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 Additional Fitting End Designs

If test samples use one type of standard fitting (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)

b. Proof pressure test (see 4.6.3)

c. Leakage test (see 4.6.6)

d. Repetitive assembly torque test (see 4.6.13)

e. Room temperature burst pressure test (see 4.6.7.1)

4.5.2 Preparation of Samples

4.5.2.1 Sample Lengths

Unless otherwise specified, the length of sample assemblies shall be in accordance with Table 4.

4.5.2.2 Oil Aging

In all the tests using oil-aged samples, the hose assemblies shall be fully preconditioned in “Low Density” AS1241 Type IV fire resistant fluid. Preconditioning shall be done in two phases:

a. The hose assemblies shall be filled with AS1241 hydraulic fluid, and then shall be pressurized to Table 2 operating pressure. While maintaining the pressure at room temperature, the hose assembly shall be immersed in AS1241 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 filled hose assembly shall then be pressurized to Table 2 operating pressure and aged at 275 °F (135 °C) in air for 168 h.

4.5.2.3 Air Aging

Air aged samples shall be kept in air at a temperature of 275 °F (135 °C) for 168 h.

4.5.2.4 Unaged Samples

Unaged assemblies shall be as manufactured.

4.5.2.5 U.V. Exposure Apparatus

The test chamber contains a device composed of a xenon arc with a quartz/borosilicate filtering which allow the insulation conditions of this test to be respected. Install the hose assembly such as it will facing the xenon lamp (see Figure 2). The distance between the xenon lamp and the hose assembly is not important while the defined irradiance at the sample level is reached.

NOTE: Most sources of ultraviolet rays have a limited lifetime after which the intensity of their rays decreases. A replacement for the xenon arc, its rotation and a repositioning of test samples may be necessary so that all the samples may be uniformly exposed to UV rays and to temperature. The manufacturer's recommendations shall be followed for the replacement and the rotation of the xenon arc.

The ultraviolet light shall have a wavelength of 270 to 400 nm.

The maximum temperature of the sample, measured at the Black Standard Thermometer, shall be regulated at 175 °F ±10 °F (80 °C ±5 °C).

The relative humidity in the chamber shall be regulated at 30 to 80%.

Preconditioning: Prior to testing, the hose assemblies shall be air aged.

Procedure: Place the test device in the chamber and expose it to the effects of the source of radiation, temperature and humidity. Time of exposure shall be 2054 hours with an irradiance level of radiation of 136 W/m^2 between 300 to 400 nm. The samples shall be submitted to a water spray cycle to simulate combined effects of UV light and rain. This spray cycle will be of 18 minutes spray every 102 minutes of exposure during all the test time exposure.

Submit the hose assembly to the room temperature burst to check resistance.

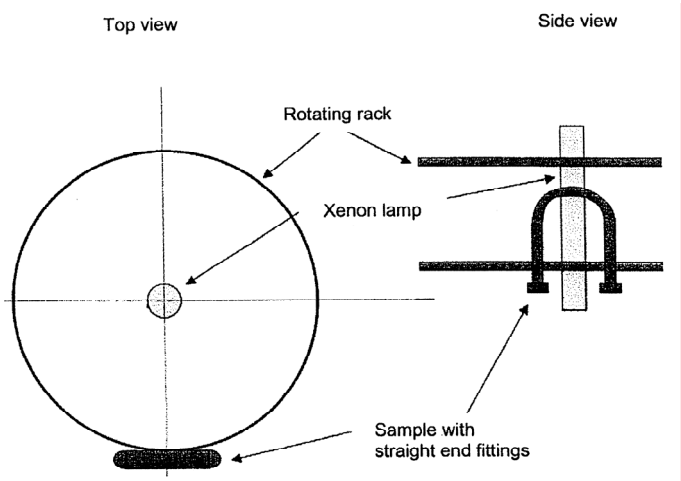


FIGURE 2 - UV TEST SETUP

4.5.2.6 Corrosion Conditioning

A salt spray test according to RTCA/DO-160D, Section 14 shall be performed with four test assemblies of each size for a minimum of 56 days (the RTCA procedure, i.e. the exposition to the salt fog for a period of a minimum of 48 hours and then the storage in an ambient temperature for a minimum of 48 hours for drying, must be repeated in order to reach 56 days).

4.5.3 Test Fluids

Unless otherwise specified, the pressure test fluid shall be hydraulic oil conforming to MIL-PRF-5606, MIL-PRF-87257, or water. Where a high temperature test fluid is required, the test fluid shall be MIL-PRF-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 (+9 °C, -2 °C).

4.5.6 End Connections

Except as otherwise noted, each hose end shall be connected to a male fitting end in accordance with 3.3.5 and shall have an installation torque range as specified in ARP908 or male end fitting per AS85720/1 with installation torques per AS85720. For qualification testing, a double tightening method shall be used. It shall consist of the following steps:

- Tighten to the specified torque values
- Loosen one turn, without disconnecting
- Tighten again to the original value

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 nitrogen.

4.6.2.2 Tensile Strength

The test samples from each lot of tube shall be subjected to tensile strength tests in accordance with AS2078.

4.6.2.3 Elongation

The test samples from each lot of tube shall be subjected to the elongation tests in accordance with AS2078.

4.6.2.4 Specific Gravity of the Tube

The test samples from each heat lot of tube shall be subjected to the specific gravity tests.

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 3 in accordance with AS2078.

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 assembly 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. For -16 size only, the assemblies shall be subjected to 66% of the minimum room temperature burst pressure, as shown in Table 3.

4.6.7 Burst Tests

4.6.7.1 Room Temperature Burst Pressure Test

One oil aged hose assembly of each size and two ultraviolet light exposed hose assemblies for -8 size shall be subjected to room temperature burst pressure test in accordance with AS2078. The assembly 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 (135 °C). The assembly shall be observed throughout the test and the type of failure and the pressure when failure occurred shall be recorded.

4.6.8 Thermal Shock Test

Two hose assemblies of each size shall be subjected to the thermal shock test in accordance with AS2078. One assembly shall be air aged and one shall be unaged.

4.6.9 Standard and 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 and AIR1228.

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 -12 and -16 may be bent in a 90° shape at a reduced length to reduce fluid volume as noted in Table 4.

b. Two air aged, two oil aged and two unaged samples shall be impulse tested 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 300,000 cycles. For qualification tests only, one air aged, one oil aged and one unaged sample shall be continued until failure occurs or 450,000 cycles is attained.

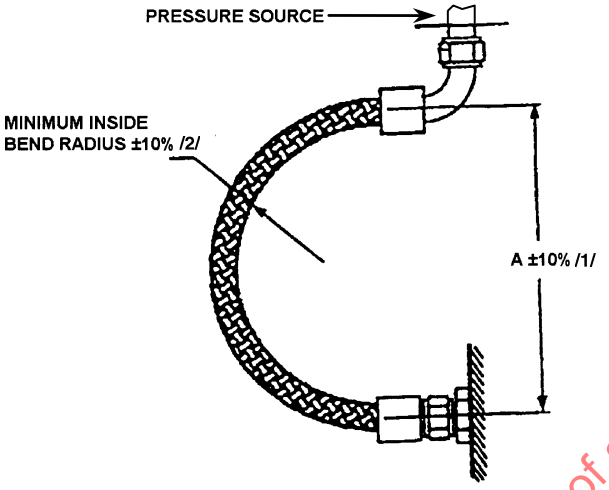
   The sequence and duration of impulse testing and temperatures used are shown in Table 6.

TABLE 6 - SEQUENCE AND DURATION OF IMPULSE TESTING

Sequence	Number of Cycles (%)	Number of Cycles	Temperature
1	55	165,000	Maximum (275 °F) (135 °C)
2	30	90,000	Room
3	5	15,000	Minimum (-40 °F) (-40 °C)
4	10	30,000	Maximum
5	--	Beyond 300,000	Room

c. Two air aged, two oil aged and two unaged samples shall be impulse tested 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 300,000 cycles. During cycles 250,000 through 300,000, 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 size -16. For qualification tests only, one air aged, one oil aged, and one unaged sample shall be continued until failure occurs or 450,000 cycles is attained.

   The test shall be run in such a manner that the hose assemblies shall temperature cycled a minimum of two times with a minimum of 80% of the cycles at 275 °F.



/1/ See Table 7
/2/ See Table 2

FIGURE 3 - IMPULSE TEST SETUP

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 4 and subjected to the flexure testing in accordance with AS2078 except the test temperature shall be 275 °F (135 °C).

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 MIL-PRF-680 in lieu of trichlorotrifluoroethane and the test temperature shall be 275 °F (135 °C).