



AEROSPACE STANDARD

AS5951™**REV. D**Issued 2004-09
Revised 2017-02

Superseding AS5951C

Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced,
5080 psi (35000 kPa), 275 °F (135 °C), Aircraft Hydraulic Systems

RATIONALE

Changed layline requirement, added hose assembly part standards from AS5951SUP1, corrected wire material title, and clarified Sampling Test requirements for burst samples.

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 (35000 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 document 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 document and references cited herein, the text of this document takes precedence. Nothing in this document, 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 +1 724-776-4970 (outside USA), www.sae.org.

AMS2486	Conversion Coating of Titanium Alloys Fluoride-Phosphate Type
AMS2487	Anodic Treatment of Titanium and Titanium Alloys Solution pH 12.4 Maximum
AMS2700	Passivation of Corrosion Resistant Steels
AMS4928	Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed
AMS4965	Titanium Alloy, Bars, Wire, Forgings, and Rings 6.0Al 4.0V Solution Heat Treated and Aged
AMS5637	Steel, Corrosion Resistant, Bars and Wire 18Cr - 9.0Ni (SAE 30302) Solution Heat Treated, Cold Drawn and Stress Relieved 125 ksi (862 MPa) Tensile Strength

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

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Documents
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AMS5639	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 10Ni Solution Heat Treated
AMS5645	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing, and Rings 18Cr - 10Ni - 0.40Ti (321) Solution Heat Treated
AMS5646	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings 18Cr - 11Ni - 0.60Cb(Nb) (347) Solution Heat Treated
AMS5647	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings 19Cr - 9.5Ni Solution Heat Treated
AMS5656	Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, and Rings 9.0Mn - 20Cr - 6.5Ni - 0.27N Solution Heat Treated
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steel
AS478	Identification Marking Methods
ARP603	Impulse Testing of Hydraulic Hose, Tubing, and Fittings Assemblies
AS611	Hose Assembly and Tubing, Polytetrafluoroethylene, Cleaning Methods for
ARP908	Torque Requirements, Installation and Qualification Test, Hose and Tube Fitting
AS1073	Sleeve Hose Assembly, Heat Shrinkable
AIR1228	Standard Impulse Machine Equipment and 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)
AS4207	Fitting End, External Thread, Beam Seal, Design Standard
ARP4266	Hole Contour, Fluid Passage, Tube Fitting
AS4458	Fitting End, Flareless, Blunt Nose, Design Standard
AS5272	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, Procurement Specification
AS5685	Steel, Corrosion Resistant, Safety Wire, 18Cr - 11.5Ni (UNS S30500) Solution Heat Treated, Cold Finished
AS5827	Fitting End, Flareless, Extra Fine Thread, Design Standard
AS7003	Nadcap Program Requirements
AS7112	National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components
AS8879	Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter
AS85720	Fittings, Tube, Fluid Systems, Separable, High Pressure Dynamic Beam Seal, 5000/8000 psi, General Specification For
AS85720/1	Fittings, Tube, Fluid Systems, Separable, High Pressure, Dynamic Beam Seal, Design Standard for Male End

2.1.2 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1 Surface Texture

ASME Y14.100 Engineering Drawing Practices

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A262 Detecting Susceptibility to Intergranular Attack on Stainless Steel

ASTM B348 Specification for Titanium and Titanium Alloy Bars and Billets

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 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill 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

2.1.6 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

DO-160 Environmental Conditions and Test Procedure for Airborne Equipment

2.1.7 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-PRF-680 Degreasing 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

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

2.2.1 Hose Assembly Parts Standards

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

The hose assembly standards applicable to this procurement standard include:

CLASS 5080:

AS5952	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 5080 psi, Flareless, Titanium Fittings, Straight to Straight
AS5953	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 5080 psi, Flareless, Titanium Fittings, Straight to 45°
AS5954	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 5080 psi, Flareless, Titanium Fittings, Straight to 90°
AS5955	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 5080 psi, Flareless, Titanium Fittings, 45° to 45°
AS5956	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 5080 psi, Flareless, Titanium Fittings, 45° to 90°

CLASS 4000:

AS6013	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 4000 Max Psi, Flareless, Titanium Fittings, Straight to Straight
AS6014	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 4000 Max Psi, Flareless, Titanium Fittings, Straight to 45°
AS6015	Hose Assembly, Polytetrafluoroethylene, Para-Aramid Reinforced, 275°F, 4000 Max Psi, Flareless, Titanium Fittings, Straight to 90

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

AMS4928	6Al-4V Titanium - Annealed
AMS4965	6Al-4V Titanium - Solution Treated
AMS5637	302 CRES
AMS5639	304 CRES
AMS5645	321 CRES
AMS5646	347 CRES
AMS5647	304L CRES
AMS5656	21-6-9 CRES
ASTM B348	Grade 2 - Titanium Alloy

3.2.2 Wire

AS5685	305 CRES
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3.2.3 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, of a contrasting color, approximately 180° apart. Optionally, the lay lines may be interrupted by supplier's name, operating pressure, etc.

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 and swivel nut retaining wire 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 A262 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 B348 - 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 AMS2700 or AMS-QQ-P-35.

3.3.5.3.2 Titanium Alloy Parts

Titanium alloy parts shall be fluoride phosphate coated per AMS2486 or titanium anodized per AMS2487, 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.

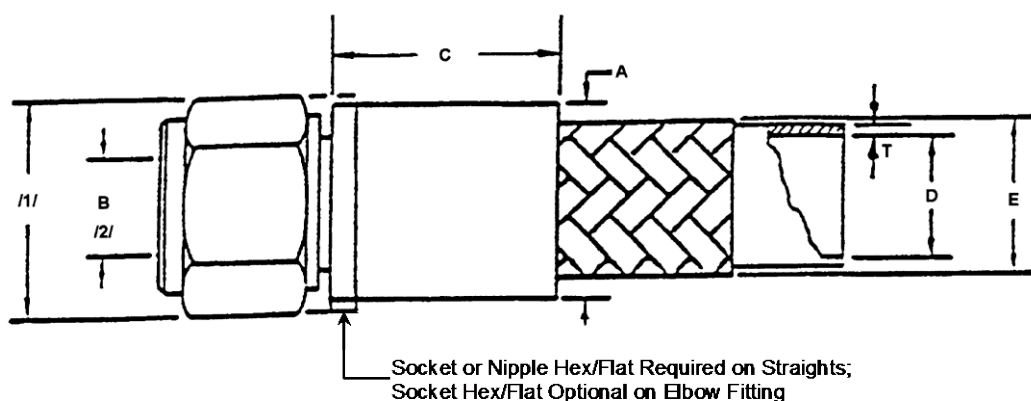


Figure 1 - Hose and fitting dimensions

Table 1

Table 1A - Hose and fitting dimensions as shown in Figure 1 - U.S. inch-pound units

Hose Size	Rigid Tube OD (Ref)	Fitting	Fitting	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 Minimum Hose Assy ID /3/	
		OD A Max /1/	ID B /2/ (Ref)						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 Minimum 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/		Bend Radius at Inside of Bend Min		Volumetric Expansion	
	lb/in	Kg/cm	in	cm	cm ³ /in	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 inches (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 (21000 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 (21000 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 (12500 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.