



AEROSPACE STANDARD

AS5960™**REV. C**Issued 2004-07
Revised 2019-04

Superseding AS5960B

Hose Assembly, Polytetrafluoroethylene, Metallic Braid Reinforced,
5080 psi (35000 kPa), 400 °F (204 °C), Aircraft Hydraulic Systems

RATIONALE

Revised spherical ball size requirements to eliminate the straight fittings ball size.

1. SCOPE

This document defines the requirements for polytetrafluoroethylene (PTFE) lined, metallic braid reinforced, hose assembly suitable for use in 400 °F (204 °C), 5080 psi (35000 kPa) aircraft hydraulic systems.

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

2. 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 (302), Solution Heated Treated, Cold Drawn and Stress Relieved, 125 ksi (862 MPa) Tensile Strength
AMS5639	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Mechanical Tubing, and Rings, 19Cr - 10Ni, Solution Heat Treated

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Documents
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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, Mechanical 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
AMS5659	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Rings, and Extrusions, 15Cr - 4.5Ni - 0.30Cb (Nb) - 3.5Cu
AMS5666	Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, Extrusions, and Rings, 62Ni - 21.5Cr - 9.0Mo - 3.65Cb (Nb), Annealed
AMS5688	Steel, Corrosion-Resistant, Wire, 18Cr - 9.0Ni (302), Spring Temper
AMS5689	Steel, Corrosion and Heat Resistant, Wire, 18Cr - 10.5Ni - 0.40Ti (321), Solution Heat Treated
AMS5690	Steel, Corrosion and Heat Resistant, Wire, 17Cr - 12Ni - 2.5Mo (316), Solution Heat Treated
AMS5697	Steel, Corrosion-Resistant, Wire, 19Cr - 9.5Ni (304), Solution Heat Treated
AMS5731	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Heat Treated
AMS5732	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution and Precipitation Heat Treated
AMS5734	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, and Tubing, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1650 °F (899 °C) Solution Heat Treated
AMS5737	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, and Tubing, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1650 °F (899 °C) Solution and Precipitation Heat Treated
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steel
AIR1228	Standard Impulse Machine Equipment and Operation
ARP908	Torque Requirements, Installation and Qualification Test, Hose and Tube Fitting
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies
ARP4266	Hole Contour, Fluid Passage, Tube Fitting
AS478	Identification Marking Methods
AS603	Impulse Testing of Hydraulic Hose, Tubing, and Fitting Assemblies
AS611	Hose Assembly and Tubing, Polytetrafluoroethylene, Cleaning Methods for
AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components
AS1072	Sleeve, Hose Assembly, Fire Protection

AS2078	Test Methods, Hose Assemblies, Polytetrafluoroethylene (PTFE)
AS4207	Fitting End, External Thread, Beam Seal, 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
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter
AS85720	Fittings, Tube, Fluid Systems, Separable, High Pressure 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 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 A313	Standard Specification for Stainless Steel Spring Wire
ASTM B348	Specification for Titanium and Titanium Alloy Bars and Billets, Grade 2
ASTM A580	Specification for Stainless and Heat Resistant Steel Wire

2.1.3 U.S. Government Publications

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

MIL-HDBK-831	Preparation of Test Reports
MIL-PRF-680	Dry Cleaning Solvent
MIL-PRF-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordinance
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.

NAS847	Caps and Plugs, Protective, Dust and Moisture Seal
NAS1760	Fitting End, Flareless Acorn, Standard Dimensions for

2.1.5 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

2.1.6 PRI Publications

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

AC7112 National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components

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

DO-160 Environmental Conditions and Test Procedures 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 performance specification.

3.1.1 Manufacturer Qualification

A manufacturer producing a product in conformance to this performance specification shall be accredited in accordance with the requirements of PD2101, AS7003, and AC7112, 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 design activity controlled drawings, 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 hose and fittings shall be corrosion resistant steel, nickel alloy, or titanium, and shall conform to the following specifications:

3.2.1.1 Bars and Forgings

1. AMS49286Al-4V Titanium - Annealed
2. AMS49656Al-4V Titanium - Solution Treated
3. AMS5637302 CRES
4. AMS5639304 CRES
5. AMS5645321 CRES
6. AMS5646347 CRES
7. AMS5647304L CRES
8. AMS565621-6-9 CRES
9. AMS565915-5PH Solution Treated
10. AMS5666 Nickel Alloy Type 625
11. AMS5731A286 Solution Heat Treated
12. AMS5732A286 Solution and Precipitation Heat Treated
13. AMS5734A286 Solution Heat Treated
14. AMS5737A286 Solution and Precipitation Heat Treated
15. ASTM B348 Grade 2 Titanium Alloy

3.2.1.2 Wire

1. ASTM A580/313 Comp. 302 (AMS5688)
2. ASTM A580/313 Comp. 304 (AMS5697)
3. ASTM A580/313 Comp. 316 (AMS5690)
4. ASTM A580/313 Comp. 321 (AMS5689)
5. AS5685305 CRES

3.3 Design and Construction

The hose assembly shall consist of a seamless PTFE inner tube, corrosion resistant steel wire reinforcement, and corrosion resistant steel, nickel alloy, 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 corrosion resistant braid(s) and/or wraps conforming to the applicable material specification listed in 3.2.1.2. The reinforcement shall be arranged over the inner tube to provide sufficient strength and protection for ensuring conformance to the requirements specified herein. Broken reinforcing wires shall be cause for rejection. Crossed-over reinforcing wires shall not be cause for rejection of the hose assembly.

3.3.3 Interlayers

Interlayers, if used, shall be of a suitable material and shall be resistant to pressure pounding and to all fluids with which the hose may come in contact during normal service. They shall be capable of withstanding temperatures of -65 to 400 °F (-54 to 204 °C) and shall not extrude through the outer braid during testing or in service.

3.3.4 Fittings

All fittings shall be permanently attached and proven to meet the requirements herein. Standard hose assemblies shall have flareless fittings according to NAS1760, 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 and shall fit standard wrench openings. All internal surfaces of fitting nuts and retaining wire, when used, shall be dry filmed with dry film per AS5272. Dry film on external surfaces and overspray is not cause for rejection.

3.3.4.1 Straight and Standard Shaped Fittings

Straight fittings shall be machined, and standard shapes shall be machined or forged. For elbow fittings, the inside diameter corner shall be a radius in accordance with ARP4266.

3.3.4.2 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. Sockets fabricated from stabilized austenitic steel (304L, 321, or 347) and titanium are acceptable without being subjected to the embrittlement test. Titanium collars, if used, shall be per ASTM B348 - Grade 2.

3.3.5 Finish

3.3.5.1 Corrosion Resistant Steel Fittings

Unless otherwise specified, corrosion resistant steel fittings shall be passivated in accordance with AMS2700 or AMS-QQ-P-35.

3.3.5.2 Titanium Alloy Fittings

Unless otherwise specified, titanium alloy fittings shall be fluoride phosphate coated per AMS2486 or titanium anodized per AMS2487.

3.4 Dimensions

The hose assembly dimensions, except for length, shall be as specified in Figure 1 and Tables 1A or 1B.

3.4.1 Hose Weight

Hose consisting of inner tube, reinforcement, and interlayers, as outlined in 3.3.1 through 3.3.3, 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. 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. 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 (15200 kPa) 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.

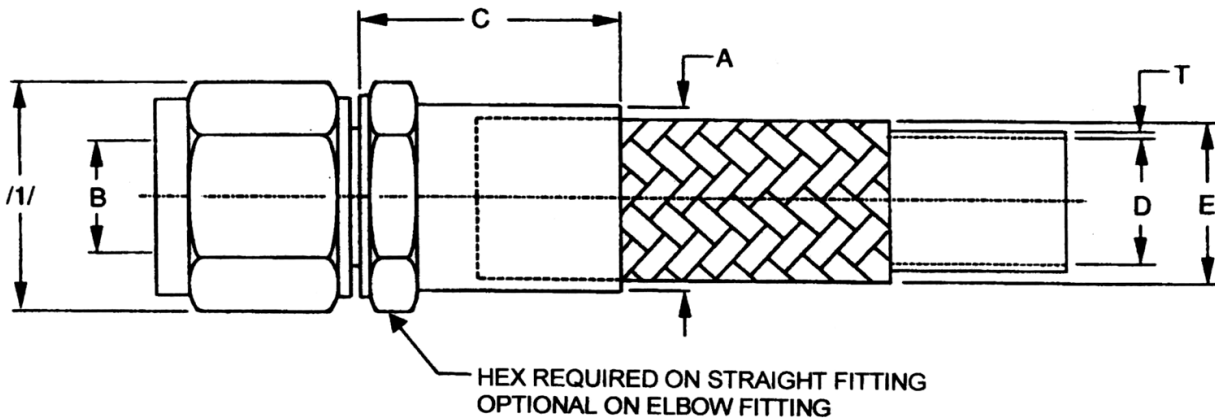


Figure 1 - Hose and fitting dimensions

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

Hose Size	Rigid Tube OD (Ref)	Fitting OD A Max	Fitting ID B (Ref) /2/	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided PTFE Wall Thickness T Min	Spherical Ball Size for Determining Min Hose Assy ID /3/
04	0.250	0.875	0.133	2.25	0.212	0.450	0.510	0.042	0.113
06	0.375	1.000	0.226	2.50	0.298	0.560	0.620	0.045	0.192
08	0.500	1.200	0.330	2.75	0.391	0.700	0.760	0.045	0.281
10	0.625	1.406	0.410	3.00	0.485	0.835	0.960	0.045	0.349
12	0.750	1.687	0.510	3.25	0.602	0.995	1.120	0.050	0.434
16	1.000	2.000	0.750	3.75	0.852	1.305	1.430	0.056	0.638
20	1.250	2.250	0.925	3.94	1.100	1.560	1.685	0.060	0.786

/1/ Cross corners of nut and anti-torque hex may exceed "A" dimension.

/2/ "Fitting ID B" is the minimum diameter of the machined nipple/insert before assembling to the hose. It is used to calculate the inspection "spherical ball size" to be used after the fitting has been swaged/crimped.

/3/ Minimum hose assembly inside diameter shall be verified by passing the applicable, or larger, spherical ball through the hose assembly.

Table 1B - Hose and fitting dimensions as shown in Figure 1 - SI units (mm)

Hose Size Inch	Hose Size mm (Ref)	Fitting OD A Max	Fitting ID B (Ref) /2/ Max	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided PTFE Wall Thickness T Min	Spherical Ball Size for Determining Min Hose Assy ID /3/ Min
04	DN06	22.22	3.38	57.15	5.38	11.43	12.95	1.07	2.87
06	DN10	25.40	5.74	63.50	7.57	14.22	15.75	1.14	4.88
08	DN12	30.48	8.38	69.85	9.93	17.78	19.30	1.14	7.12
10	DN16	35.71	10.41	76.20	12.32	21.21	24.38	1.14	8.86
12	DN20	42.85	12.95	82.55	15.29	25.27	28.45	1.27	11.02
16	DN25	50.80	19.05	95.25	21.64	33.15	36.32	1.42	16.20
20	DN32	57.15	23.50	100.08	27.94	39.62	42.80	1.52	19.96

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

/2/ "Fitting ID B" is the minimum diameter of the machined nipple/insert before assembling to the hose. It is used to calculate the inspection "spherical ball size" to be used after the fitting has been swaged/crimped.

/3/ Minimum hose assembly inside diameter shall be verified by passing the applicable, or larger, spherical ball through the hose assembly.

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/or wraps and interlayer(s) if used, 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 3. 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 $\pm 2\%$ in 10 inches (250 mm) of hose length, when subjected to the maximum operating pressure in Table 3 for a minimum of 5 minutes. The test method is specified in 4.6.4.

3.5.2.3 Volumetric Expansion

The volumetric expansion of the hose assembly 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.