AEROSPACE STANDARD

AS4388™ | **REV. A**

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Superseding AS4388

Hose Assembly
PTFE Heavy Duty, -65 To 400 °F (-55 To 204 °C)
8000 psi (56 000 kPa) Hydraulic and Pneumatic

RATIONALE

This technical report is being stabilized because it covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. SCOPE:

This Aerospace Standard (AS) defines the requirements for polytetrafluoroethylene (PTFE) heavy duty hose assemblies suitable for use in aircraft and missile hydraulic fluid systems service to 8000 psi and -65 to 400 °F. Gaseous service shall be limited to 150 °F.

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 documents shall be as specified in AMS 2350.

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

AMS 3380	Hose, Polytetrafluoroethylene, TFE Fluorocarbon Resin, Wire Braid Reinforced
AMS 4928	Ti Alloy Bars, Forgings and Rings, 6Al - 4V, Anneal 120,000 psi
AMS 4944	Ti Alloy Tubing, Seamless Hydraulic 3.0Al - 2.5V Cold-Worked, Stress Relieved
AMS 4945	Titanium Alloy Tubing, Seamless, Hydraulic 3Al - 2.5V, Texture Controlled, 105,000 psi Yield Strength
AMS 4965	Ti Alloy Bars, Forgings and Rings, 6Al - 4V, Solution and Precipitation Heat Treated
AMS 5536	Steel Bars, Corrosion-Resistant, 18Cr - 8.5Ni (SAE 30302) Cold Drawn, 100,000 psi (690 MPa)
AMS 5556	Steel Tubing, Seamless or Welded, Corrosion and Heat-Resistant 18Cr - 11Ni - (Cb + Ta) (SAE 30347) Hydraulic
AMS 5557	Steel Tubing, Seamless and Welded, Corrosion and Heat-Resistant 18Cr - 11Ni-Ti (SAE 30321) Hydraulic

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2.1.1 (Continued):

AMS 5561	Steel Tubing Welded and Drawn, 9.0Mn - 20Cr - 6.5Ni - 0.28N, High Pressure Hydraulic
AMS 5567	Steel Tubing, Seamless and Welded, Corrosion-Resistant 19Cr - 10Ni (SAE 30304) Hydraulic, Solution Treated
AMS 5570	Steel Tubing, Seamless, Corrosion and Heat-Resistant 18Cr - 11Ni - 0.40Ti (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 - 10.5Ni - 0.40Ti Solution Heat Treated
AMS 5637	Steel Bars, Corrosion-Resistant, 18Cr - 10Ni (SAE 30304)
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) - 3.5 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
ARP603	Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings
AS611	Tetrafluoroethylene Hose Assembly Cleaning Methods
AS1055	Fire Resistance and Fire Test
ARP1153	Method for Determining Relative Specific Gravity, Polytetrafluoroethylene Tubing
AIR1228	Standard Impulse Machine Equipment and Operation
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies
AS2078	Test Methods, Hose Assemblies PTFE (in process)

2.1.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A 262	Detecting Susceptibility to Intergranular Attack on Stainless Steel
ASTM A 313	Chrome Nickel Stainless and Heat-Resistant Steel - Spring Wire
ASTM D 412	Rubber, Determination of Tension Characteristics

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2.1.2 (Continued):

ASTM A 580	Stainless and Heat-Resistant Steel Wire - Type 304 or 316, Condition B
ASTM 644	Sodium Chloride Reagent Grade
ASTM D 792	Specific Gravity and Density of Plastics by Displacement
ASTM D 1457	TFE - Fluorocarbon Resin Molding and Extrusion Materials

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

QQ-S-763	Steel Bars, Wire Shapes and Forgings, Corrosion-Resisting
MIL-F-8815	Filter and Filter Elements, Fluid Pressure, Hydraulic Line, 15 Micron Absolute and 5 Micron Absolute, Type ID Systems
MIL-F-85720	Fittings, Tube, Fluid Systems, Separable, High Pressure Dynamic
MIL-F-85720/1	Fittings, Tube, Fluid Systems, Separable, High Pressure, Dynamic Beam Seal, Design Standard for Male End
MIL-F-85800	Hose Assemblies, Tetrafluoroethylene, Aramid Fiber Reinforced
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-H-83282	Hydraulic Fluid, Fire-Resistant, Synthetic Hydrocarbon Base Aircraft
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter
MIL-T-8504	Tubing, Steel, Corrosion-Resisting (304) Aerospace Vehicle Hydraulic Systems, Annealed, Seamless and Welded
MIL-T-8606	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized and Extra Low Carbon)
MIL-T-8808	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized) Aircraft Hydraulic Quality
DOD-STD-100	Engineering Drawing Practices for Inspection
MIL-STD-105	Sampling Procedures and Tables by Attributes
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of
MS19059	Balls Bearing, Ferrous, Chrome Alloy Steel
H4-1	Cataloging Handbook (Federal Code Numbers)

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.

3.2 Materials:

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

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

a. Bars and Forgings:

(1) QQ-S-763	Class 302 - Cond. A and Cond. B (AMS 5636 and AMS 5637)
(2) QQ-S-763	Class 304 - Cond. A and Cond. B (AMS 5639)
(3) QQ-S-763	Class 304L - Cond. A (AMS 5647)
(4) QQ-S-763	Class 321 - Cond. A (AMS 5645)
(5) QQ-S-763	Class 347 - Cond. A (AMS 5646)
(6) AMS 5643	17-4PH
(7) AMS 5644	17-7PH
(8) AMS 5659	15-5PH
(9) AMS 5743	AM-355
(10)AMS 4928	Titanium 6Al 4V Annealed
(11)AMS 4965	Titanium 6Al 4V Heat Treated

b. Tubing:

(1) MIL-T-8504	Comp. 304 (AMS 5567)
(2) MIL-T-8505	Type I, Comp. 321 (AMS 5570)
(3) MIL-T-8808	Type I or Type II, Comp. 321 (AMS 5557, AMS 5570, or AMS 5576)
(4) MIL-T-8808	Type I or Type II, Comp. 347 (AMS 5571, AMS 5575, or AMS 5556)
(5) AMS 4944	Titanium 3Al 2.5V Cold Worked and Stress Relieved
(6) AMS 5561	Welded and Redrawn Stainless Steel Tubing
(7) AMS XXXX	Titanium Alloy Tubing, Seamless, Hydraulic, Ti - 15V - 3.0Cr - 3.01Al - 3.0Sn, Cold Worked and Precipitation Heat Treated
(8) AMS 4945	Titanium Alloy Tubing, Seamless, Hydraulic, 3Al - 2.5V, Texture Controlled, 105,000 psi Yield Strength

c. Wire:

(1) ASTM A 580	Specification for Stainless and Heat-Resisting Steel Wire, Type 304 or 316 Condition B
(2) ASTM A 313	Chrome Nickel Stainless and Heat-Resistant Steel - Spring Wire

3.3 Construction:

The hose assembly shall consist of a seamless PTFE inner tube, corrosion-resistant steel-wire reinforcement, and corrosion-resistant metal end fittings as required to meet the construction and performance requirements of this document and as required for its intended use. Assembly shall pass a ball per Table 7.

3.3.1 Inner Tube: The inner tube shall be of a seamless construction of virgin PTFE resin of uniform gauge. It shall have a smooth bore and shall be free from pitting, deep scratches, or projections on the inner surface. Additives may be included in the compound from which the tube is extruded. The inner tube will be conductive per 3.5.2.13.

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3.3.2 Reinforcement: The reinforcement shall consist of corrosion-resistant steel wires conforming to the applicable specifications listed in 3.2.1. The wires shall be so arranged over the inner tube as to provide sufficient strength to ensure conformance with 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 to withstanding temperatures of -65 to 400 °F and shall not extrude through the outer braid during testing or in service.

3.3.4 Fittings: All fittings shall be proven to meet the requirements herein. Standard hose assemblies shall have reconnectable configuration of beam seal fittings per MIL-F-85720 to mate with MIL-F-85720/1. Fitting hex portions shall fit standard wrench openings.

3.3.4.1 Straight Fittings: Straight fittings shall be of one piece construction. Weld or braze joints must not be located in the fluid paths.

3.3.4.2 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 can use stainless steel welded and redrawn tubing per AMS 5561 or titanium seamless tubing per AMS 4944 or AMS 4945. When weld joints are required the butt weld method will be used.

3.3.4.3 End Fitting Collars (Sockets): All end fitting collars (sockets) crimped or swaged, 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 or the swaging or crimping operation. Sockets fabricated from stabilized austenitic steel (304L, 321, or 347) are acceptable without being subjected to the embrittlement test. Titanium sockets are not recommended.

3.4 Dimensions:

The hose assembly dimensions, except for length, shall be as specified in Figure 2 and Table 6.

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 covered in Table 1A.

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TABLE 1 - Physical and Pressure Requirements

TABLE 1A - Physical Requirements

Hose Size	Tube Size Nominal in	Hose Weight Max lb/in	Bend Rad Min Inside of Bend in	Volumetric Expansion Max 8000 psi cm^3/in
-03	3/16	.020	3.0	.10
-05	5/16	.025	5.0	.15
-07	7/16	.043	6.0	.23
-09	9/16	.068	7.0	.35
-11	11/16	.092	9.0	.48
-13	13/16	.126	11.5	.62
-15	15/16	.160	14.0	.75

TABLE 1B - Pressure Requirements

Operating Max psi	Proof Min psi	Burst Min Room Temperature psi	Burst Min High Temperature psi
8000	16 000	28 000	24 000

3.5 Performance:

The hose assembly shall meet the following performance requirements:

3.5.1 Tube:

3.5.1.1 Tube Roll and Proof Pressure Test: The tube shall not leak, split, burst, or show any evidence of malfunction, when rolled to the Table 4 flattening and rounding gaps. Test method is specified in 4.6.2.1.

3.5.1.2 Tube Proof Pressure: The tube, without reinforcing wires, shall not leak, burst, or show any evidence of malfunction when held at the Table 4 proof pressure values for 1 min. The 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 at 77 °F ± 2. The transverse tensile strength for sizes -10 and larger shall be 1800 psi minimum at the same temperature. For sizes -8 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 at 77 °F ± 2 shall be a minimum of 200%. The 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 2.210 relative gravity. The test method is specified in 4.6.2.4.

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