

**HOSE ASSEMBLIES, POLYTETRAFLUOROETHYLENE, ARAMID REINFORCED,
28 000 kPa, HYDRAULIC AND PNEUMATIC**

1. SCOPE:

This specification defines the requirements for a PTFE lined, non-metallic, aramid reinforced assembly suitable for use to 135°C and 28 000 kPa aircraft and missile hydraulic and pneumatic systems.

- 1.1 For service to 21 000 kPa, this hose assembly is suitable for use at reduced bend radius per Table I.
- 1.2 This is not recommended for gaseous service where minor effusion is detrimental.
- 1.3 For use with phosphate ester, silicate ester and CTFE hydraulic fluids, tests per 3.5.2.5 and 3.5.2.7 must be repeated using the specific fluid for immersion and test media. Due precaution must be taken in handling any toxic hydraulic fluid.

CANCELLED

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Comments on this Standard are invited from interested parties and can be submitted in writing to SAE Headquarters.

TABLE I – Physical and Performance Requirements

Hose Size DN	Operating Pressure (Max) kPa	Proof Pressure (Min) -0 +5000 kPa	Burst Pressure (Min)		Bend Radius Min Inside of Bend		Volumetric Expansion (Max) cc/cm	Hose Wt. (Min) kg/m
			Room Temp. kPa	High Temp. kPa	21 000 kPa mm	28 000 kPa mm		
6	28 000	55 000	110 000	83 000	38	76	0.035	0.124
10	28 000	55 000	110 000	83 000	64	127	0.052	0.178
12	28 000	55 000	110 000	83 000	73	146	0.074	0.232
16	28 000	55 000	110 000	83 000	83	165	0.119	0.357
20	28 000	55 000	110 000	83 000	102	197	0.163	0.464
25	28 000	55 000	110 000	83 000	190	305	0.407	0.625
32	To be determined							
40	To be determined							

2. APPLICABLE DOCUMENTS:

The following documents of the issue in effect on date of invitation for bids or request for proposals, form a part of this specification to the extent specified herein.

2.1 Specifications:

2.1.1 Federal:

PPP-T-60 - Tape, Packaging, Waterproof
PPP-B-585 - Box, Wood, Wirebound
PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated
PPP-B-601 - Boxes, Wood, Cleated Plywood
PPP-B-636 - Box, Shipping, Fiberboard
PPP-B-676 - Boxes, Setup
P-D-680 - Dry Cleaning Solvent
QQ-S-763 - Steel Bars, Wire Shapes, and Forgings, Corrosion-Resisting
TT-I-735 - Isopropyl Alcohol

2.1.2 Military:

MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft Missile, and Ordnance
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
MIL-F-8815 - Filter and Filter Elements, Fluid Pressure, Hydraulic Line, 15 Micron Absolute and 5 Micron Absolute, Type II Systems
MIL-STD-1595 - Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-L-10547 - Liner, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
MIL-H-83282 - Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft
MIL-F-85421/1 - Dynamic Beam Fitting
MIL-W-8611 - Welding, Metal Arc and Gas, Steels, and Corrosion and Heat Resistant Alloys; Process for
MIL-T-81533 - Trichloroethane

2.2 Standards:

DOD-STD-100 - Engineering Drawing Practices
MIL-STD-105 - Sampling Procedures and Tables by Attributes
MIL-STD-129 - Marking for Shipment and Storage
MIL-STD-831 - Test Reports, Preparation of
MS19059 - Balls, Bearing, Ferrous, Chrome Alloy Steel

(Copies of documents required by suppliers in connection with specific procurement functions shall be obtained from the procuring activity or as directed by the Contracting Officer.)

2.3 Industry Publications:

American Society for Testing and Materials:

- ASTM A 262 - Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- ASTM D 412 - Rubber, Properties in Tension Characteristics
- ASTM D 792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement
- ASTM D 1457 - PTFE - Molding and Extrusion Materials
- ASTM B 348 - Titanium and Titanium Alloy Bars and Billets

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103)

Society of Automotive Engineers:

- AMS 4928K - Bars, Forgings, and Rings-6Al 4V, Annealed - 120,000 psi (825 MPa) Yield Strength
- AMS 4944D - Tubing, Seamless, Hydraulic-3.0Al 2.5V, Cold Worked, Stress Relieved
- AMS 4965E - Bars, Forgings and Rings-6Al 4V, Solution & Precipitation Heat Treated
- AMS 5536K - Sheet, Strip, and Plate, 47.5Ni 22Cr 1.5Co 9.0Mo 0.60W 18.5Fe, Solution Heat Treated
- AMS 5556E - Tubing, Seamless or Welded, Hydraulic 18Cr 11Ni 0.70(Cb+Ta) Hydraulic, Solution Heat Treated
- AMS 5557F - Tubing, Seamless or Welded, Hydraulic, Solution Heat Treated, 18.5Cr 10.5Ni 0.40Ti
- AMS 5567C - Tubing, Seamless or Welded-19Cr 10Ni, Hydraulic, Annealed
- AMS 5570L - Tubing, Seamless-18Cr 11Ni 0.40Ti, Solution Heat Treated
- AMS 5571F - Tubing, Seamless-18Cr 10.5Ni 0.70(Cb+Ta), Solution Heat Treated
- AMS 5575K - Tubing, Welded-18Cr 10.5Ni 0.70(Cb+Ta), Solution Heat Treated
- AMS 5576G - Tubing, Welded-18Cr 10.5Ni 0.40Ti, Solution Heat Treated
- AMS 5637E - Bars-18Cr 9Ni Solution Heat Treated and Cold Drawn 125,000 psi (860 MPa) TS
- AMS 5639E - Bars, Forgings, Tubing & Rings-19Cr 10Ni Solution Heat Treated
- AMS 5643M - Bars, Forgings, Tubing, and Rings-16Cr 4.0Ni 0.30(Cb+Ta) 4.0Cu, Solution Heat Treated
- AMS 5644C - Bars and Forgings, 17Cr 7Ni 1Al
- AMS 5645L - Bars, Forgings, Tubing & Rings-18Cr 10Ni 0.40Ti, Solution Heat Treated
- AMS 5646H - Bars, Forgings, Tubing & Rings-18Cr 11Ni 0.60(Cb+Ta) Solution Heat Treated
- AMS 5647E - Bars, Forgings, Tubing & Rings-19Cr 9.5Ni Solution Heat Treated
- AMS 5659F - Bars, Forgings, Rings, and Extrusions, 15Cr 4.5Ni 0.30(Cb+Ta) 3.5Cu, Consumable Electrode Melted, Sol. Heat Treated
- AMS 5685H - Wire Safety, 18Cr 11.5Ni, Solution Heat Treated
- AS611 - Polytetrafluoroethylene Hose Assembly Cleaning Methods
- ARP908 - Hose Fitting - Installation and Qualification Test Torque Requirements
- AS1370 - Metric Screw Threads - MJ Profile

2.3 (Continued):

Society of Automotive Engineers (Continued):

- ARP1153 - Method for Determining Relative Specific Gravity, Polytetrafluoroethylene Tubing
- AIR1228 - Standard Impulse Machine Equipment and Operation
- AS1072 - Sleeve Hose Assembly, Fire Protection
- ARP1835 - Preparation for Delivery, General Requirements for Hose Assemblies
- MA2001/ISO6771 - Temperature and Pressure Classes
- MA2002/ISO6772 - Impulse Testing Hydraulic Hose, Tubing & Fitting Assemblies
- MA2004/ISO6773 - Thermal Shock Testing of Fluid System Piping & Fittings
- MA2078 - Test Methods, Hose Assemblies PTFE
- MA2014 - Fitting End, Flareless Acorn, Metric

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096)

3. REQUIREMENTS:

3.1 Qualification: The hose assemblies furnished under this specification 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 and shall conform to applicable specifications and the requirements specified herein shall be of the highest quality and suitable for the purpose intended.

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

Bars and Forgings:

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

3.2.1 (Continued):

Tubing:

MIL-T-8504 - Comp. 304 (AMS 5567)
MIL-T-8606 - Type I, Comp. 321 (AMS 5570)
MIL-T-8808 - Type I or Type II, Comp. 321 (AMS 5557, AMS 5570 or AMS 5576)
MIL-T-8808 - Type I or Type II, Comp. 347 (AMS 5571, AMS 5575 or AMS 5556)
AMS 4944D - Tubing, Seamless, Hydraulic - 3.0Al 2.5V, Cold Worked, Stress Relieved

3.2.2 Reinforcement: Aramid textile treated and braided on the hose with polybenzimidazol/aramid blend or polyester braided cover to meet all of the requirements herein.

3.3 Construction: The hose assembly shall consist of a seamless polytetrafluoroethylene inner tube, aramid reinforcement with polybenzimidazol/aramid blend or polyester braided cover and corrosion-resistant steel and titanium end fittings or both, as required, to meet the construction and performance requirements of this specification.

3.3.1 Inner Tube: The inner tube shall be of a seamless construction of virgin polytetrafluoroethylene 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.

3.3.2 Reinforcement: The reinforcement shall consist of an aramid braid or wraps with braided polyester or polybenzimidazol/aramid blend cover conforming to the applicable specifications listed in 3.2.2. 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 aramid from exposure to ultra-violet light.

3.3.3 Fittings: All fittings shall be permanently attached by crimp or swage and proven to meet the requirements herein. Standard hose assemblies shall have flareless fittings per MA2014 or dynamic beam fittings to mate with male end per MIL-F-85421/1, in accordance with applicable documents (see 2). Anti-torque hexes shall be provided and shall fit standard wrench openings. Threads will conform to AS1370.

3.3.3.1 Standard Fittings: Standard fittings shall be of one piece construction. Welded or brazed joints must not be located in the fluid paths, except welded and redrawn tubing, in accordance with MIL-T-8504 or MIL-T-8808 may be used. Elbow fittings and titanium fittings may be classified per 3.3.3.2 for construction.

- 3.3.3.2 Other Fittings: Other fittings shall be of one piece construction, if possible. However, those made with other than one piece construction shall use welded and redrawn tubing in accordance with MIL-T-8504 or MIL-T-8808 and shall employ a butt-weld joint method. Titanium tubes shall be seamless and employ a butt-weld joint method, per MIL-W-8611 or equivalent and MIL-STD-1545.
- 3.3.3.3 End Fitting Collars (Sockets): All end fitting collars (sockets), crimped or swaged and fabricated from Type 304 stainless steel shall be capable of passing an embrittlement test as specified in ASTM A 262 Practice E, prior to assembly to the nipple or swaging operation. Sockets fabricated from stabilized austenitic steel (304 L, 321 or 347) are acceptable without being subjected to the embrittlement test. Titanium collars are per ASTM B 348 - Grade 2.
- 3.4 Dimensions: The hose assembly dimensions, except for length, shall be as specified in Fig. 6 and Table V.
- 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 covered in Table I.
- 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 Table I and Table II of MA2078 flattening and rounding gaps. 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 rolled and tested to proof-pressure values of Table II in MA2078 for 1 minute. 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 15 200 kPa minimum at $25 \pm 1^\circ\text{C}$. The transverse tensile strength for sizes DN16 and larger shall be 12 500 kPa minimum at the same temperature. For sizes DN8 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 $25 \pm 1^\circ\text{C}$ 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 2.210 specific. The test method is specified in 4.6.2.4.
- 3.5.2 Hose Assembly: The reinforced hose 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 I 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 ± 5 mm in 250 mm of hose length, when subjected to the maximum operating pressure 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 assemblies shall not exceed the limits specified in Table I. 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.
- 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 burst value specified in Table I. 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 burst value specified in Table I. The test method is specified in 4.6.7.2.
- 3.5.2.6 Thermal Shock: The hose assemblies shall not leak nor show evidence of malfunction when subjected to the Table I proof and high temperature burst pressure, after being thermally shocked by rapidly increasing hose temperature from -54 to 135°C . The test method is specified in 4.6.8 and 4.6.7.2.
- 3.5.2.7 Impulse: The hose assemblies shall show no evidence of leakage from hose or fitting prior to completion of 250 000 pressure impulse cycles for 20 500 kPa and 100 000 impulse cycles for 27 500 kPa. The test method is specified in 4.6.9.
- 3.5.2.8 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table I proof pressure after 400 000 flexure cycles when tested from -55 to 135°C . 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 maximum operating pressure, shown in Table I, after completion of the stress degradation test shall not exceed 78 cc/m/min. The test method is as specified in 4.6.11.

- 3.5.2.10 Pneumatic Surge: There shall be no evidence of inner tube collapse, sponging or shedding of PTFE particles from the inner tube after 16 cycles of rapid reduction of pneumatic pressure from the Table I maximum operating pressure to zero. The test method is as specified in 4.6.12.
- 3.5.2.11 Effusion: The effusion rate for any hose size shall not exceed 26 cc/m of hose length. The test method is as specified in 4.6.13.
- 3.5.2.12 Repetitive Assembly Torque: The fitting shall withstand repetitive assembly overtightening torque values specified in ARP908. Test method is specified in 4.6.14. There shall be no leakage, galling or other malfunction during the pressure tests specified in 4.6.14.
- 3.5.2.13 Conductivity: Hose assembly sizes DN4 through 8 shall conduct a minimum direct current equal to 6 μ A and sizes DN10 through 16, a minimum direct current equal to 12 μ A and neither case shall exceed 10 000 μ A with a test potential of 1000 V DC. The test method is specified in 4.6.15.
- 3.6 Screw Threads: Coupling nut threads shall be in accordance with MIL-S-8879. Thread tolerance increase of 10% during assembly or testing shall not be cause for rejection of the hose assembly.
- 3.7 Length: Hose assembly length shall be specified in the following increments only:
- Under 500 mm, not less than 5 mm
 - 500 - 1000 mm, not less than 10 mm
 - 1000 - 1500 mm, not less than 15 mm
 - Over 1500 mm, not less than 1% of length
- NOTE: Flareless hose assembly lengths shall be made from "gage point" to "gage point."
- Tolerances on hose assembly lengths shall be as follows:
- ± 5 mm for lengths under 500 mm
 - ± 10 mm for lengths from 500 - 1000 mm
 - ± 15 mm for lengths from 1000 - 1500 mm
 - $\pm 1\%$ for lengths over 1500 mm
- 3.8 Part Numbering of 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 DOD-STD-1000 shall govern the manufacturer's part numbers and changes thereto.