SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
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AEROSPACE STANDARD

SAE AS4623

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Submitted for recognition as an American National Standard

HOSE ASSEMBLY, POLYTETRAFLUOROETHYLENE, PARA ARAMID REINFORCED HEAVY-DUTY, 275 °F 3000 psi, AIRCRAFT HYDRAULIC SYSTEMS

1. SCOPE:

This document defines the requirements for heavy-duty hose assemblies suitable for use in 275 °F, 3000 psi aircraft systems where rapid rate pressure pulsing and torsional/longitudinal flexing may occur in addition to normal hydraulic system loading.

2. APPLICABLE DOCUMENTS:

2.1 SAE Publications:

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

AMS 2486	Conversion Coating of Titanium Alloys - Fluoride - Phosphate Type
AMS 3380	Hose, Polytetrafluoroethylene, TFE Fluorocarbon Resin, Wire Braid Reinforced
AMS 4928	Bars and Forgings - 6Al - 4V, Annealed - 120,000 psi
AMS 4945	Tubing, Seamless, Hydraulic, 3Al 2.5V, Texture Controlled, 105,000 psi (724 MPa) Yield Strength
AMS 4965	Bars, Forgings and Rings - 6Al 4V, Solution and Precipitation Heat Treated
AMS 5556	Steel Tubing, Seamless or Welded, Corrosion and Heat-Resistant, 18Cr - 11Ni - (Cb+Ta) (SAE 30347) Hydraulic
AMS 5557	Steel Tubing, Seamless or Welded, Corrosion and Heat-Resistant, 18Cr - 11Ni (SAE 30321) 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)

2.1 (Continued):

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 - 11Ni - 0.40Ti
AMS 5636	Steel Bars, Corrosion-Resistant, 18Cr - 8.5Ni (SAE 30302) Cold Drawn, 100,000 psi (690 MPa)
AMS 5637	Steel Bars, Corrosion-Resistant, 18Cr - 10Ni (SAE 30302)
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) - 3.5Cu Consumable Electrode Melted
AMS 5685	Wire, Safety, 18Cr - 11.5Ni - 0.40Ti, Solution Heat-Treated
AMS 5688	Steel Wire, Corrosion-Resistant, 18Cr - 9.0Ni (SAE 30302) Spring Temper
AMS 5689	Steel Wire, Corrosion and Heat-Resistant, 18Cr - 9.5Ni - Ti (SAE 30321) Solution Heat-Treated
AMS 5690	Steel Wire, Corrosion and Heat-Resistant, 18.5Cr - 13Ni - 2.5Mo (SAE 30316)
AMS 5697	Steel Wire, Corrosion-Resistant, 19Cr - 9.5Ni (SAE 30304)
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	Polytetrafluoroethylene Hose Assembly Cleaning Methods
ARP908	Torque Requirements, Installation and Qualification Test, Hose, and Tube Fitting
AS1055	Fire Testing of Flexible Hose Tube Assemblies, Coils, Fittings, and Similar Systems
AS1072	Sleeve, Hose Assembly, Fire Protection
AS1073	Sleeve, Hose Assembly, Heat Shrinkable
ARP1153	Method for Determining Relative Specific Gravity of Polytetrafluoroethylene Tubing
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
AS4265	Impulse Testing of Hydraulic Tubing and Fittings, S-N Curve
AS4488	Tubular Assemblies, Fusion Welded, Inspection Processes and Acceptance Standards for
AS4624	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, St-St

2.1 (Continued):

AS4625	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, St-45°
AS4626	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, St-90°
AS4627	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, 45°-45°
AS4628	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, 90°-90°
AS4629	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flareless, 45°-90°
AS4630	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, St-St
AS4631	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, St-45°
AS4632	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, St-90°
AS4633	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, 45°-45°
AS4634	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, 90°-90°
AS4635	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Flared, 45°-90°
AS4636	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, St-St
AS4637	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, St-45°
AS4638	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, St-90°
AS4639	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, 45°-45°
AS4640	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, 90°-90°
AS4641	Hose Assembly, 3000 psi, Polytetrafluoroethylene, Para Aramid Reinforced, Heavy Duty, Beam Seal, 45°-90°
AS4658	Fitting End, External Thread, Short Flareless, Design Standard
AS4703	Fitting End, Acorn, Short Flareless, Design Standard

2.2 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 B 348	Specification for Titanium and Titanium Alloy Bars and Billets, Grade 2
ASTM D 380	Rubber Hose for Automotive Hydraulic Brake Systems
ASTM D 792	Specific Gravity and Density of Plastics by Displacement
ASTM D 4895	Standard Specification for PTFE Resin Produced from Dispersion

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

P-D-680	Dry Cleaning Solvent
QQ-P-35	Passivation Treatment for Corrosion Resistant Steel
QQ-S-763	Steel Bars, Wire Shapes, and Forgings, Corrosion-Resisting
TT-I-735	Isopropyl Alcohol
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft Missile, and Ordnance
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-T-8504	Tubing, Steel, Corrosion-Resisting (304) Aerospace Vehicle Hydraulic Systems, Annealed, Seamless, and Welded
MIL-T-8505	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-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification of
MIL-L-10547	Liner, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
MIL-L-46010	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting
MIL-H-83282	Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft
MIL-F-85421	Fittings, Tube, Fluid Systems, Separable, Dynamic Beam Seal, Requirements for
MIL-STD-100	Engineering Drawing Practices for Inspection
MIL-STD-105	Sampling Procedures and Tables by Attributes
MIL-STD-129	Marking for Shipping and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of
MS19059	Balls, Bearing, Ferrous, Chrome Alloy Steel
MS21900	Adapter, Flareless Tube to AN Flared Tube
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

2.4 National Aerospace Standards:

Available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005.

NAS 1760 Fitting End, Flareless Acorn, Standard Dimensions for

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 (such as AS4624 through AS4641).

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:

3.2.1.1 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

3.2.1.2 Tubing:

MIL-T-8504	Comp. 304 (AMS 5567)
MIL-T-8505	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 4945	Ti 3Al 2.5V Cold Worked and Stress Relieved

3.2.2 Reinforcement: Para aramid textile treated and applied to the hose with an outer polyester braid or polybenzimidazol/para aramid blend braid cover to meet all of the requirements herein.

3.2.3 Finish:

3.2.3.1 Cres stainless steel, passivate per QQ-P-35.

3.2.3.2 Titanium fluoride phosphate conversion coating shall be per AMS 2486 when applicable.

3.3 Design and Fabrication:

The hose assembly shall consist of a seamless polytetrafluoroethylene inner tube, treated para aramid reinforcement, polyester braid or polybenzimidazol/para aramid blend braid cover and corrosion-resistant steel 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 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 a treated para aramid braid and/or wraps with braided polyester or polybenzimidazol/para aramid blend braid 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 para aramid from exposure to ultraviolet light. A continuous lay line interrupted with AS4623 and hose manufacturer's name and trademark shall be permanently marked in contrasting color along length of hose.

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 flared fittings to mate with MS33656; flareless fittings according to NAS 1760 to mate with MS33514; or beam fittings to mate with male end fitting per MIL-F-85421 and short flareless fittings to mate with AS4658, in accordance with applicable documents. Antitorque hexes shall be provided and shall fit standard wrench openings. All internal surfaces of fitting nuts shall be dry filmed with dry film per MIL-L-46010. Dry film on external surfaces is optional.

3.3.3.1 Insert Fittings: Insert fittings shall be of one-piece construction. Welded 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.

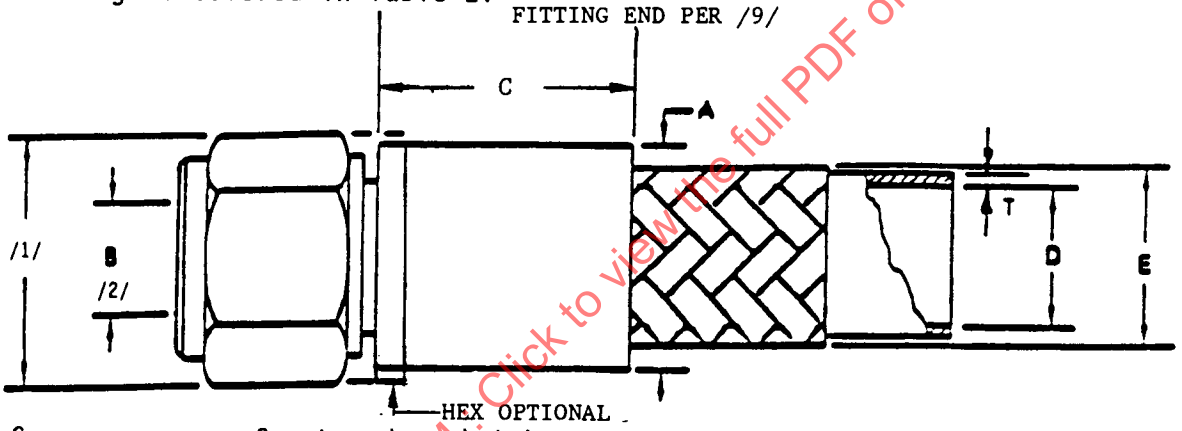
3.3.3.2 Other Fittings: Other fittings including elbow fittings shall preferably be of one piece construction, if possible. However, those made with other than one piece construction shall use welded and redrawn tubing in accordance with MIL-T-8504 or MIL-T-8808 and shall employ a butt-weld joint method per AS4488. Titanium tubes shall be in accordance with AMS 4945 and employ a butt-weld joint method per AS4488, or equivalent.

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 and crimp or swaging operation. Sockets fabricated from stabilized austenitic steel (304 L, 321, or 347) and titanium 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 Figure 1 and Table 1.

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 2.



/1/ Cross corners of nut and socket hex may exceed "A" dimension.
/2/ Minimum specified inside diameter shall be verified by passing a spherical ball through the hose assembly.

FIGURE 1 - Hose and Fitting Dimensions

TABLE 1 - Hose and Fitting Dimensions

Hose Size	Rigid Tube DD (Ref) in	Fitting DD A Max in	Fitting ID B Min in	Socket Length C Max in	Hose ID D Min in	Hose DD E Min in	Hose DD E Max in	Unbraided PTFE Wall Thickness T Min in
04	.250	.690	.135	1.25	.212	.480	.540	.035
06	.375	.800	.240	1.45	.298	.630	.690	.035
08	.500	.970	.340	1.78	.391	.765	.825	.045
10	.625	1.150	.410	2.25	.485	.880	.950	.045
12	.750	1.380	.510	2.50	.602	1.130	1.210	.045
16	1.000	1.660	.760	3.00	.852	1.427	1.507	.050
20	1.250	2.32	.925	3.55	1.101	1.70D	1.780	.050

TABLE 2 - Physical Requirements of Hose Assemblies and Weight of Hose

Hose Size	Hose Weight Maximum /1/ lb/in	Operating Pressure psi	Proof Pressure psi	Burst Pressure Room Temperature Minimum psi	Burst Pressure High Temperature Minimum psi	Bend Radius at Inside of Bend Minimum in	Volumetric Expansion Maximum cm^3/in
04	.010	3000	6000	16 000	12 000	1.50	.089
06	.014	3000	6000	14 000	10 500	2.50	.132
08	.020	3000	6000	14 000	10 500	2.88	.187
10	.023	3000	6000	12 000	9 000	3.25	.383
12	.032	3000	6000	12 000	9 000	4.00	.493
16	.055	3000	6000	12 000	9 000	7.50	1.134
20	.075	3000	6000	12 000	9 000	12.00	1.39

/1/ Hose weight shall be determined on a minimum length of 12 in.

3.5 Performance:

The hose assembly shall meet the following performance requirements:

3.5.1 Tube:

3.5.1.1 Tube Roll: The tube shall not leak, split, burst, or show any evidence of malfunction, when rolled to the Table 3 flattening and rounding gaps. The test method is specified in 4.6.2.1.

TABLE 3 - Tube Roll Gap and Proof Pressure

Size	Flattening Gap-Max in	Rounding Gap-Max in	Proof Pressure psi
04	.281	.250	380
06	.281	.328	280
08	.328	.469	220
10	.328	.578	170
12	.328	.688	130
16	.328	.828	95
20	.538	1.00	95

3.5.1.2 PTFE Tube Proof Pressure: The tube, without reinforcement, shall not leak, burst, or show any evidence of malfunction, when pressurized to the Table 3 proof-pressure values for 1 min. 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%. 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 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 2 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 ±.20 in in 10 in of hose length, when subjected to the maximum operating pressure for a minimum of 5 min. 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 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 66% 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 2. 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 2. 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 2 proof and high temperature burst pressure, after being thermally shocked by rapidly increasing hose temperature from -65 to 275 °F. The test method is specified in 4.6.8 and 4.6.7.2.

3.5.2.7 Torsion-Impulse: The hose assemblies shall be capable of withstanding 250 000 (ARP603) impulse cycles including torsion for the last 50 000 impulse cycles and one million rapid rate impulse cycles when tested in accordance with 4.6.9. Any hose or fitting leakage, hose burst, fitting blowout, or any other evidence of malfunction during the test shall constitute failure.

3.5.2.8 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 2 proof pressure after 400 000 flexure cycles when tested from -67 to 275 °F. 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 2, after completion of the stress degradation test shall not exceed 2.0 cm^3/in/min. The test method is as specified in 4.6.11.

3.5.2.10 Repetitive Assembly Torque: The fitting shall withstand repetitive assembly overtightening torque values specified in ARP908. Test method is specified in 4.6.12. There shall be no leakage, galling, or other malfunction during the pressure tests specified in 4.6.12.

3.5.2.11 Conductivity: Hose assembly sizes -4 through -20 shall conduct a minimum DC equal to 900 μA minimum and shall not exceed 10 000 μA maximum. The test method is specified in 4.6.13.

3.5.2.12 Push/Pull Test: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the push/pull test specified in 4.6.14.

3.6 Screw Threads:

Coupling nut threads shall be in accordance with MIL-S-8879. For inspection purposes, the thread shall be categorized "other thread". 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:

a. Under 18 in, not less than .125 in
b. 18 to 36 in, not less than .250 in
c. 36 to 50 in, not less than .500 in
d. Over 50 in, not less than 1 in

NOTE: Flareless hose assembly lengths shall be made from "gage point" to "gage point".

Tolerances on hose assembly lengths shall be as follows:

a. ±.125 in for lengths under 18 in
b. ±.250 in for lengths from 18 to 36 in
c. ±.500 in for lengths from 36 to 50 in
d. ±1% for lengths over 50 in

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 MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.9 Identification of Product:

Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. The following special marking shall be added:

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

3.9.2 Assembly: A permanent marking on the fitting or a permanent stainless steel band on the hose shall be used. If band is used on hose, it shall be covered with translucent shrink sleeve per AS1073 code "A" and extend beyond the edge of the band by approximately .125 in. A permanent metallic band may be used on the collar or over a firesleeve. The band shall be no wider than 1 in and shall not impair the flexibility or the performance of the hose. The marking on the fitting or band shall include the following information:

a. Assembly manufacturer's name or trademark and assembly specification AS4623

b. Cage code and manufacturer's assembly part number

c. Operating pressure 3000 psi (maximum)

d. Operating temperature 275 °F

e. Pressure test symbol "PT"

f. Date of hose assembly manufacture expressed in terms of month and year

g. Hose manufacturer's commercial and government entity (cage) code when hose manufacturer differs from assembly manufacturer

3.10 Workmanship:

The hose assembly, including all parts, shall be constructed and finished in a workmanlike manner. All surfaces shall be free from burrs. All sealing surfaces shall be smooth, except that annular tool marks up to 100 Ra will be acceptable.

3.10.1 Dimensions and Tolerances: All pertinent dimensions and tolerances, where interchangeability, operation, or performance of the hose assembly may be affected, shall be specified on all drawings.

TABLE 4

Hose Size	Spherical Ball Size for Determining Minimum ID MS19059 Dash No.	Spherical Ball Size for Determining Minimum ID in
04	4807	.109
06	4812	.188
08	4816	.313
10	4818	.375
12	4821	.469
16	4829	.719
20	4834	.875

3.10.2 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 their 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 Inspections:

The examining and testing of hose assemblies shall be classified as:

a. Qualification inspections (see 4.3)
b. Quality conformance inspections (see 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 5. The end fitting outlet design for the samples shall have flared fittings to mate with MS33656, or flareless fittings according to NAS 1760 to mate with MS33514, or beam seal fittings to mate with male fittings per MIL-F-85421. Simultaneous qualification of two (flared, flareless short flareless, or beam seal) of four types of end fittings may be accomplished by having different fittings on each end of the hoses. If a supplier qualifies one or more ends and at a later date desires to qualify others, four hose assemblies of each size and type to be qualified shall be subjected to the tests specified in 4.5.2.2.

The six test specimens required for the impulse test (4.6.9) shall have straight end fittings on one end and 90° elbow end fittings on the other. All remaining test samples shall have straight-to-straight end fittings.

TABLE 5 - Length of Hose Assemblies in Inches for Test

Hose Assembly Size	Six Assemblies for Each Impulse Test	Two Assemblies for Each Flex Test	Assemblies for Other
04	10.5	14.00	18
06	15.0	18.50	18
08	17.5	21.00	18
10	20.5	24.00	18
12	24.5	28.00	18
16	38.0 (25.0-90°)/1/	41.00	18
20	55.0 (34.5-90°)/1/	58.50	18

/1/ When assemblies are tested at 90° in place of 180°.

4.3.2 Qualification Test Sequence: Test sequence and procedure shall be as specified in Table 6 and if applicable 4.5.2.2.

TABLE 6 - Qualification Test Schedule

Sample No.	Tube 1	Assemblies 2	Assemblies 3	Assemblies 4	Assemblies 5	Assemblies 6	Assemblies 7	Assemblies 8	Assemblies 9	Assemblies 10 Thru 15	Assemblies 16 and 17
Paragraph	4.6.1 4.6.2	4.6.1.2 4.6.3 4.6.4 4.6.10 4.6.12	4.6.1.2 4.6.3 4.6.4 4.6.10 4.6.12	4.6.1.2 4.6.3 4.6.5 4.5.23 4.6.7.1	4.6.1.2 4.6.3 4.6.5 4.5.23 4.6.7.2	4.6.1.2 4.6.3 4.6.6 4.6.8	4.6.1.2 4.6.3 4.6.6 4.6.8	4.6.1.2 4.6.3 4.6.11	4.6.1.2 4.6.3 4.6.11	4.6.1.2 4.6.3 4.6.9	4.6.1.2 4.6.3 4.6.14 4.6.13

NOTE: Production inspection records shall be used to verify tube conformance to 4.6.2 for all assemblies.

4.3.3 Test Report, Test Samples, and Data for the Procuring Activity: When the tests are conducted at a location other than the laboratory of the procuring activity, the following shall be furnished to that activity:

a. Test Report: The test report shall include a report of all tests and outline description of the tests and conditions, according to MIL-STD-831.

b. Test Samples: Test samples when requested by the procuring activity and subjected to qualification testing, shall not be shipped as part of contract or order.

c. Drawings: Three sets of assembly and subassembly drawings shall have a cut-away section showing all details in their normal assembly position and shall identify all details and subassemblies.

d. Sources: A list of sources of hose or hose components, including the sources' names and product identification for inner tube, hose, and assembly, shall be supplied.

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 be sampled in accordance with the procedure in MIL-STD-105 and 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 3.10.2).

4.4.2 Sampling Tests: The following inspections and tests shall be performed in the order indicated on eight hose assemblies with straight fittings at each end, selected at random, from each sampling lot. The sampling lot shall consist of approximately, but not more than, 3000 hose assemblies, all of one dash size and manufactured under essentially the same conditions, but not necessarily during one continuous run. One hose assembly tested from each sublot of 375 hose assemblies shall be permitted. The hose asemblies may have straight end fittings on both ends.

a. Internal cleanliness (AS611, Class 0)

b. Leakage tests (see 4.6.6)

c. Room-temperature burst pressure test (see 4.6.7.1)

d. Specific gravity tests (apparent and relative) (see 4.6.2.4)

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 periodic control lot. The periodic control lot shall consist of not more than 20 000 ft 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 manufactured and tested from each lot of 5000 ft of hose is also permitted. The hose assemblies may have straight end fittings on both ends.

4.4.3.1 Four hose assemblies from a lot of 5000 ft in accordance with Table 5 shall be subjected to the following tests in the order indicated:

a. Elongation and contraction test (see 4.6.4)
b. Impulse test two samples per 4.6.9(b) less torsion and two samples per 4.6.9(c) (unaged samples only)

4.4.3.2 Four hose assemblies or one hose assembly from a lot of 5000 ft in accordance with Table 5 shall be subjected to the following tests in the order indicated:

a. Stress degradation test (see 4.6.11)
b. Conductivity test (see 4.6.13)

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 contractor.

4.4.5 Switching Procedures: Switching inspection severity levels (for example, from normal to tightened inspection) shall be in accordance with MIL-STD-105. All inspection plans shall be single-sample plans with an AQL of 1.5% at special inspection level S-2.

4.4.6 Destructive Test Sample: Prior to testing, a letter "D" shall be impression-stamped on each end fitting of assemblies used for destructive tests (4.4.2 and 4.4.3).

4.5 Test Conditions:

4.5.1 Fitting Ends: Qualification tests shall be conducted in accordance with the test sequence specified in Table 6, on test sample configurations as specified in Table 5. Satisfactory completion of qualification tests shall also constitute qualification approval for hose assemblies having nonstandard fittings that have an identical attachment method and design, and meet the requirements of this document.

4.5.2 Preparation of Sample:

4.5.2.1 Unless otherwise specified, length of sample assemblies shall be in accordance with Table 5.

4.5.2.2 If test samples use either one or two of the three types of standard fittings (flared, flareless, or beam seal), and qualification approval is desired for the other type(s), three 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): Samples 1, 2, and 3
b. Proof pressure test (see 4.6.3): Samples 1, 2, and 3
c. Leakage test (see 4.6.6): Sample 1
d. Overtightening torque test (see 4.6.12): Sample 1
e. Room temperature burst pressure test (see 4.6.7.1): Sample 1
f. Impulse/torsional test (unaged) (see 4.6.9): Samples 2 and 3

4.5.2.3 Oil Aging: In all of the tests using oil-aged samples, the hose assemblies shall be fully preconditioned in AS1241 Type IV fire resistant fluid or the system hydraulic fluid, as applicable. Preconditioning shall be done in two phases:

a. The hose assemblies shall be filled with AS1241 hydraulic fluid or system hydraulic fluid, as applicable, and shall then be pressurized to operating pressure. While maintaining the pressure at room temperature, the hose asssembly shall be immersed in AS1241 or system fluid, as applicable, 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 hose shall be filled with AS1241 hydraulic fluid or system hydraulic fluid, as applicable (excluding all air), and the hose shall then be pressurized to operating pressure and aged at 275 °F in air for 168 h.

4.5.2.4 Air Aging: Air-aged samples shall be kept in air at a temperature of 275 °F for 7 days.

4.5.2.5 Unaged Samples: Unaged assemblies shall be as shipped from the hose assembly manufacturer.

4.5.3 Test Fluids and Pressure Measurements: Unless otherwise specified, the pressure test fluid shall be hydraulic oil conforming to MIL-H-5606, or water. Where a high temperature test fluid is required, the test fluid shall be MIL-H-83282 hydraulic fluid.

Unless otherwise specified, all pressures shall have a tolerance of ±100 psi.

4.5.4 Temperature Measurements: Unless otherwise specified, temperature measurements shall be taken within 6 in of the hose assemblies under test. Unless otherwise specified, all temperatures shall have a tolerance of +15 °F, -5 °F.

4.5.5 End Connections: Except as otherwise noted, each hose end shall be connected to a steel male fitting end in accordance with 3.3.3 and shall have an installation torque range as specified in ARP908 or male end fitting per MIL-F-85421/1 with installation torques per MIL-F-85421.

4.6 Inspection Methods:

4.6.1 Examination of Product:

4.6.1.1 Inner Tube (TFE): 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 and inspected for broken or missing reinforcement or evidence of malfunction that shall be cause for rejection. Crossed over reinforcement shall not be cause for rejection.

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 AMS 3380, except that the flattening gap, rounding gap, and proof pressure shall be as specified in Table 3. The test fluid shall be air or water.

4.6.2.2 Tensile Strength: The tube shall be subjected to tensile strength tests in accordance with ASTM D 4895.

4.6.2.3 Elongation: The tube shall be subjected to the elongation in accordance with the ASTM methods specified in 4.6.2.2. Elongation at a temperature of 77 °F ± 2 shall be a minimum of 200%.

4.6.2.4 Specific Gravity of the Tube:

4.6.2.4.1 Apparent Specific Gravity: Apparent specific gravity shall be determined in accordance with ARP1153 (D 1505) or ASTM D 792, Method A, and shall not exceed 2.155 at 77 °F ± 2. Two drops of wetting agent shall be added to the water. 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 ARP1153 (D 1505) or D 792 Method A and shall not exceed a value of 2.190 for all sizes and types of tubes.

4.6.3 Proof Pressure Test: All hose assemblies shall be pressure tested to the values specified in Table 2 for not less than 30 s and not more than 5 min. The test fluid may be either water or hydraulic oil conforming to MIL-H-5606 for tests conducted at room temperature. All assemblies used for the tests described in this document shall have this proof pressure test applied to them. Any evidence of leakage from the hose or fittings, or any evidence of malfunction shall constitute failure. Proof pressure test of hose assemblies having firesleeves shall be performed before sleeving, when possible, using water as the test medium. Proof pressure shall be held for a minimum of 2 min, during which time the firesleeves, if installed, shall be pulled back from the end fittings.

4.6.4 Elongation and Contraction Test: Two hose assemblies of each size shall be subjected to the elongation and contraction test. The hose shall not change in length by more than ±.20 in in 10 in of length when subjected to the maximum operating pressure shown in Table 2 for not less than 5 min. With the hose held in a straight position, unpressurized, a 10 in gage length shall be marked off on the hose and the hose pressurized. After 5 min, while still pressurized, the gage length shall be measured and the change in length calculated.

4.6.5 Volumetric Expansion Test: Two assemblies of each size shall be tested in accordance with ASTM D 380. The volumetric expansion of the test assemblies shall be in accordance with the values shown in Table 2.

4.6.6 Leakage Test: Two assemblies of each size shall be pressurized to 66% of the minimum room temperature burst pressure shown in Table 2 and held for 5 min minimum. The pressure shall then be reduced to 0 lbf/in^2, after which it shall again be raised to 66% of the minimum room temperature burst pressure for a final 5 min check.

4.6.7 Burst Tests:

4.6.7.1 Room Temperature Burst Pressure Test: One oil aged hose assembly of each size shall be subjected to a pressure sufficient to burst the assemblies with a rate of pressure rise equal to 20 000 psi ± 5000 psi per minute. The assemblies shall be observed throughout the test and the type of failure and the pressure where failure occurred shall be recorded.

4.6.7.2 High Temperature Burst Pressure Test: One oil aged and one unaged hose assembly of each size shall be filled with high temperature test fluid, placed into a suitable container, and into an oven preheated to 275 °F. There the assembly shall be soaked for 1 h with ambient and fluid temperatures at 275 °F. At the end of that period, the assemblies shall be pressurized to the proof pressure of Table 2 for a minimum of 5 min. The pressure shall then be released, and, while the temperature is held at 275 °F, the pressure shall be increased to failure as described in 4.6.7.1.

4.6.8 Thermal Shock Test: The thermal shock test shall be as follows:

a. Two hose assemblies of each size shall be subjected to this test. One assembly shall be air aged and one assembly shall be unaged. The assemblies shall be subjected to the proof pressure specified in Table 2 for a minimum of 5 min.

b. The test assemblies shall then be mounted, empty, in a low- and high-temperature test fixture (typical setup shown in Figure 2). The ambient temperature shall be reduced to -65 °F ± 2 for a minimum of 2 h. At the end of this period, while maintaining this temperature, high temperature test fluid at a temperature of 275 °F shall be quickly introduced at a minimum pressure of 50 psi. Immediately after the hot oil has filled the assembly, the pressure shall be raised to the proof pressure specified in Table 2 for a minimum of 5 min. Not more than 15 s shall elapse between the introduction of the high temperature oil at 50 psi and the raising of the pressure to proof pressure.

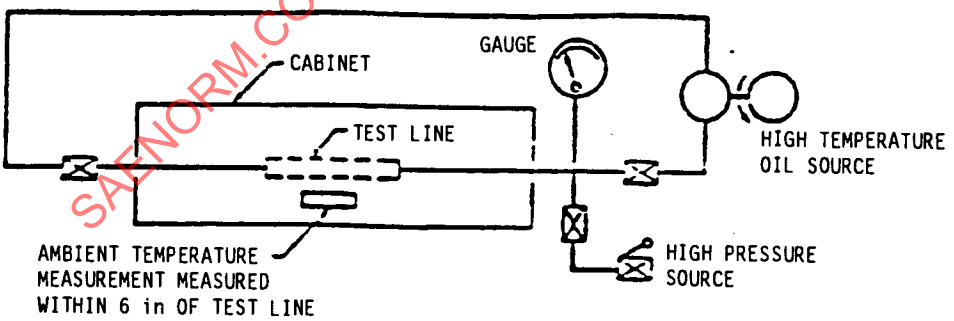


FIGURE 2 - Typical Setup for Thermal Shock Testing

4.6.8 (Continued):

c. The test assemblies shall then be filled with one of the specified high temperature test fluids at a pressure of 75 psi ± 24 psi and soaked with ambient, and the fluid temperature maintained at 275 °F for 1 h. At the end of this period, the assemblies shall be pressurized to the proof pressure specified in Table 2 for a minimum of 5 min. The pressure shall then be released, and, while still maintaining the 275 °F, the pressure shall then be increased at the same rate of rise as specified in 4.6.7 until failure is obtained. The hose assemblies shall be under continuous observation during the preceding test, and the pressure where the failure occurred and the type of failure shall be recorded.

d. During part (b) and the proof portion of part (c) of the test, any evidence of leakage from the hose or fittings, hose burst, fitting blow-off, or other evidence of malfunction, shall constitute failure. During the burst portion of part (c), any of the above occurring below the minimum high temperature burst pressure shown in Table 2 shall constitute failure.

4.6.9 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, AIR1228 and AS4265.

a. The test assemblies shall be connected to rigid supports and bent in a U-shape with a bend radius at the apex of the bend as specified in Table 2. For sizes -16 and -20, the assemblies may be bent to 90°.

b. One air aged, one oil aged, and one unaged sample shall be impulsed as specified in ARP603 with peak pressures of 150% measured at the inlet manifold. Impulsing shall occur at a rate of 70 cpm ± 10 cpm for a minimum of 250 000 cycles. During the last 50 000 cycles of the 250 000 cycles, the straight end of the assembly shall be rotation cycled ±5° for sizes -4, -6, -8, and ±2° for sizes -10 and -12 at 15 cpm. No rotation on sizes -16 and larger.

c. Three unaged samples shall be subjected to one million cycles of rapid rate impulse testing 0 (0 to 300 psi operating pressure) -5500 psi ± 200 psi at 600 cpm ± 30 cpm. The ambient and fluid temperature shall be 275 °F.

d. Impulse testing shall be run in such a manner that the assemblies are temperature-cycled from room temperature to a specific fluid and ambient air temperature a minimum of two times, with a minimum of 80% of the impulse cycles at 275 °F.