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

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

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Submitted for recognition as an American National Standard

HOSE ASSEMBLIES, POLYTETRAFLUOROETHYLENE, ARAMID REINFORCED, 4000 lbf/in^2 (27 500 kPa), HYDRAULIC AND PNEUMATIC

1. SCOPE:

This specification defines the requirements for a PTFE lined, non-metallic, aramid reinforced assembly suitable for use to 275°F and to 4000 lbf/in^2 (27 500 kPa) aircraft and missile hydraulic and pneumatic systems.

1.1 For service to 3000 lbf/in^2 (20 500 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.

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
PP-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-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-H-83282 - Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft
MIL-H-85421 - Dynamic Beam Fitting
MIL-W-8611 - Welding, Metal Arc and Gas, Steels, and Corrosion and Heat Resistant Alloys; Process for

2.2 Standards:

DOD-STD-100 - Engineering Drawing Practices for Inspection
MIL-STD-105 - Sampling Procedures and Tables by Attributes
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

(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:

A262 - Detecting Susceptibility to Intergranular Attack on Stainless Steel
D412 - Rubber, Determination of Tension Characteristics
D571 - Rubber Hose for Automotive Hydraulic Brake Systems
D792 - Specific Gravity and Density of Plastics by Displacement
D1457 - TFE - Fluorocarbon Resin Molding and Extrusion Materials
ASTM B 348 Grade 2 - Titanium Alloy

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

2.3 (Continued):

Society of Automotive Engineers:

AMS 3380 - Hose, Polytetrafluoroethylene, TFE Fluorocarbon Resin, Wire Braid Reinforced
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
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 - 11Ni - 0.40Ti
AMS 4944 - Tubing, Seamless, Hydraulic - 3.0Al 2.5V, Cold Worked and Stress Relieved
AMS 5536 - 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 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) - 3.5Cu 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
AMS 4928 - Bars and Forgings - 6Al 4V, Annealed - 120,000 psi
AMS 4965 - Bars, Forgings and Rings - 6Al 4V, Sol. and Precip. Heat Treated
ARP 603 - Impulse Testing of Hydraulic Hose Assemblies, Tubing and Fittings
AS 611 - Polytetrafluoroethylene Hose Assembly Cleaning Methods
ARP 908 - Hose Fitting - Installation and Qualification Test Torque Requirements

2.3 (Continued):

Society of Automotive Engineers (Continued):

ARP 1153 - Method for Determining Relative Specific Gravity, Polytetrafluoroethylene Tubing
AIR 1228 - Standard Impulse Machine Equipment and Operation
AS 1072 - Sleeve Hose Assembly, Fire Protection
ARP 1835 - Preparation for Delivery, General Requirements for Hose Assemblies

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

National Aerospace Standards:

NAS 1760 - Fitting End, Flareless Acorn, Standard Dimensions for

(Application for copies should be addressed to National Standards Association, Inc., 5161 River Road, Washington, DC 20016)

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-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 or AMS 5575, AMS 5556)
AMS 4944 - Ti 3Al 2.5V Cold Worked and Stress Relieved

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

3.3 Construction: The hose assembly shall consist of a seamless polytetrafluoroethylene innertube, treated aramid reinforcement, polyester braid or polybenzimidazol/aramid blend braid cover and corrosion-resistant steel and/or titanium end fittings, 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 a treated aramid braid and/or wraps with braided polyester or polybenzimidazol/aramid blend braid cover conforming to the applicable specifications listed in 3.2.2. The reinforcement shall be arranged over the innertube 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 flared fittings to mate with MS33656; flareless fittings according to NAS 1760 to mate with MS33514; or dynamic beam fittings to mate with male end per MIL-F-85421, in accordance with applicable documents (See 2.). Anti-torque hexes shall be provided and shall fit standard wrench openings.

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 A262 Practice E, prior to assembly to the nipple and crimp 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 VI.

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 the Table IV 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 to the Table IV proof-pressure values for one 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 2200 lbf/in^2 (15 200 kPa) minimum at 77 ± 2°F (25 ± 1°C). The transverse tensile strength for sizes -10 and larger shall be 1800 lbf/in^2 (12 500 kPa) 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 ± 2°F (25 ± 1°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 ± 0.20 in (± 5.1 mm) in 10 in (254 mm) of hose length, when subjected to the maximum operating pressure for a minimum of five minutes. The test method is specified in 4.6.4.

TABLE I – Physical and Performance Requirements

Hose Size In DM	Operating Pressure (Max.)		Proof Pressure (Min.) -0 +1000		Burst Pressure (Min.)				Bend Radius Min Inside of Bend				Volumetric Expansion (Max.)		Hose Wt. (Max.)	
					Room Temp.		High Temp.		3,000 lbf/in²		4,000 lbf/in²					
	lbf/in²	(kPa)	lbf/in²	(kPa)	lbf/in²	(kPa)	lbf/in²	(kPa)	in	(mm)	in	(mm)	cc/in	(cc/cm)	lb./in	(kg/m)
-04	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	1.50	(38.1)	3.00	(76.2)	0.089	(0.035)	0.007	(0.124)
-06	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	2.50	(63.5)	5.00	(127.0)	0.132	(0.052)	0.010	(0.178)
-08	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	2.88	(73.2)	5.75	(146.1)	0.187	(0.074)	0.013	(0.232)
-10	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	3.25	(82.6)	6.50	(165.1)	0.303	(0.119)	0.020	(0.357)
-12	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	4.00	(101.6)	7.75	(196.9)	0.413	(0.163)	0.026	(0.464)
-16	4000	(27 500)	8000	(55 000)	16 000	(110 000)	12 000	(83 000)	7.50	(190.5)	12.00	(304.8)	1.034	(0.407)	0.035	(0.625)
-20	To be determined															
-24	To be determined															

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 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 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 -65°F (-54°C) to 275°F (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 3000 lbf/in^2 and 100 000 impulse cycles for 4000 lbf/in^2. 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 -67°F (-54°C) to 275°F (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 2.0 cc/in/min (0.78 cc/cm/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 lbf/in^2. 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 8.0 cc/ft. (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 ARP 908. 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 -4 through -8 shall conduct a minimum direct current equal to 6 µA and sizes -10 through -16, a minimum direct current equal to 12 µA and neither case shall exceed 10 000 µA 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 18 in (456 mm), not less than 1/8 in (3.2 mm)
18 - 36 in (456 - 914 mm), not less than 1/4 in (6.4 mm)
36 - 50 in (914 - 1 270 mm), not less than 1/2 in (12.7 mm)
Over 50 in (1 270 mm), not less than 1 in (25.4 mm)

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

Tolerances on hose assembly lengths shall be as follows:

± 1/8 in (3.2 mm) for lengths under 18 in (457 mm)
± 1/4 in (6.4 mm) for lengths from 18 - 36 in (457 - 914 mm)
± 1/2 in (12.7 mm) for lengths from 36 - 50 in (914 - 1 270 mm)
± 1% for lengths over 50 in (1 270 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-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 nonmetallic flexible band on the hose shall be used. A permanent metallic band may be used on the collar or over a fire sleeve. The band shall be no wider than 1 in (25 mm) 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 AS 1975.

b. Complete hose assembly part number.

c. Operating pressure 4000 lbf/in^2 (27 500 kPa) or 3000 lbf/in^2 (20 500 kPa) (maximum) as applicable.

3.9.2 (Continued):

d. Operating temperature 275°F or 135°C, as applicable.

e. Pressure test symbol "PT".

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

g. Hose manufacturer's federal code number (Handbook H4-1) when hose manufacturer defers 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 µin (2.5 µm) root/mean square maximum 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.

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 AS 611, 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 his 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: The number and length of test samples required to qualify each hose size are specified in Table II. All specimens for each hose size shall be required for qualifying each of the methods of (1) end fitting attachment, (2) permanent and field attachable, and (3) end fitting construction, bent tube or forged. Simultaneous qualification of two (flared, flareless or dynamic beam), of three types of end fittings may be accomplished by having fittings on one hose end flared and flareless fittings on the other end. If a supplier qualifies one end

4.3.1 (Continued):

fitting outlet design and at a later date desires to qualify others, two hose assemblies of each size and type to be qualified shall be subjected to the tests specified in 4.5.2.2.

TABLE II - Length of Hose Assemblies for Test

HOSE ASSEMBLY SIZE	SIX ASSEMBLIES FOR EACH IMPULSE TEST (4.6.9)				TWO ASSEMBLIES FOR EACH FLEX TEST (4.6.10)				SIX ASSEMBLIES FOR OTHER TESTS 3, 4	
	3000 lbf/in^2		4000 lbf/in^2		3000 lbf/in^2		4000 lbf/in^2			
	in	(mm)	in	(mm)	in	(mm)	in	(mm)	in	(mm)
-4	12.5	(317.5)	15.5	(393.7)	16.5	(419.1)	19.5	(495.3)	18	(457.2)
-6	15.5	(393.7)	23.0	(584.2)	19.5	(495.3)	27.0	(685.8)	18	(457.2)
-8	18.5	(469.9)	27.0	(685.8)	21.5	(546.1)	30.5	(774.7)	18	(457.2)
-10	22.0	(558.8)	31.5	(800.1)	24.0	(609.6)	35.0	(889.0)	18	(457.2)
-12	26.5	(673.1)	37.5	(952.5)	28.5	(723.9)	40.5	(1028.7)	18	(457.2)
-16	38.0	(965.2)	46.0	(1168.4)	34.0	(863.6)	49.0	(1244.6)	18	(457.2)
-20	To be determined									
-24										

1. End fitting outlet design shall have flared fittings to mate with MS33656 or flareless fittings according to NAS 1760 to mate with MS33514 or dynamic beam fitting to mate with male end per MIL-F-85421.

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

3. Two additional samples of each size in lengths as shown in Table VIII shall be used for examination, push/pull test, and conductivity tests (sample Nos. 16 and 17, Table III).

4. Two additional samples of each size are required if tests in accordance with 4.5.2.2 are conducted.

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

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.

TABLE III - Qualification Test Schedule

SAMPLE NO.	TUBE	ASSEMBLIES								
	1	2	3	4	5	6	7	8	9	10 THRU 15	16 & 17
PARA.	4.6.1	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2	4.6.1.2
	4.6.2	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3	4.6.3
		4.6.4	4.6.4	4.6.5	4.6.5	4.6.6	4.6.6	4.6.11	4.6.11	4.6.9	4.6.16
		4.6.10	4.6.10	4.6.13	4.6.13	4.6.8	4.6.8	4.6.12	4.6.12		4.6.15
		4.6.14	4.6.14	4.6.7.1	4.6.7.2	4.6.7.1	4.6.7.2				

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

4.3.3 (Continued):

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 carry part numbers of 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, 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 sub lot of 375 hose assemblies shall be sufficient for protracted or small assembly run conditions.

a. Internal cleanliness (AS 611, 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 (6096 m) 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 (1524 m) of hose is also permitted.

4.4.3.1 Four hose assemblies or one hose assembly from a lot of 5000 ft (1524 m) in accordance with Table II shall be subjected to the following tests in the order indicated.

a. Elongation and contraction test (See 4.6.4)

b. Impulse test (See 4.6.9) (unaged samples only)

4.4.3.2 Four hose assemblies or one hose assembly from a lot of 5000 ft (1524 m) in accordance with Table II shall be subjected to the following tests in the order indicated:

a. Stress degradation test (See 4.6.11).

b. Conductivity test (See 4.6.15).

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 by the contractor, in writing.

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 III, on test sample configurations as specified in Table II. 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 specification.

4.5.2 Preparation of Sample:

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

4.5.2.2 If test samples use either one or two of the three types of standard fittings (flared, flareless or dynamic beam) and qualification approval is desired for the other type(s), two 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)

b. Proof pressure test (See 4.6.3)

c. Leakage test (See 4.6.6)

d. Overtightening torque test (See 4.6.14)

e. Room temperature burst pressure test (See 4.6.7.1)

4.5.2.3 Oil Aging: In all of the tests using oil aged samples, the hose assemblies shall be fully immersed in MIL-H-83282 hydraulic fluid and soaked in an air oven at a temperature of 275°F (135°C) for seven days. All air shall be excluded from the bore of the assembly during the test. No pressure shall be applied to the assembly during the aging period.

4.5.2.4 Air Aging: Air-aged samples shall be kept in air at a temperature of 275°F (135°C) for seven 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 lbf/in^2 ($\pm$ 689 kPa).

4.5.4 Temperature Measurements: Unless otherwise specified, temperature measurements shall be taken within 6 in (152 mm) of the hose assemblies under test. Unless otherwise specified, all temperatures shall have a tolerance of +15°F (+8°C), -5°F (-3°C).

4.5.5 End Connections: Except as otherwise noted, each hose end shall be connected to a steel male fitting end in accordance with MS33656 or MS33514, lubricated with either MIL-H-5606 fluid or the test fluid, and with an installation torque range as specified in ARP 908.

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 specification 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 specification, 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 IV. The test fluid shall be air or water.

TABLE IV - Tube Roll Gap and Proof Pressure

SIZE	FLATTENING GAP-MAX		ROUNDING GAP-MAX		PROOF PRESSURE	
	in	(mm)	in	(mm)	lbf/in^2	(kPa)
-4	0.281	(7.14)	0.250	(6.35)	380	(2620)
-6	0.281	(7.14)	0.328	(8.33)	280	(1931)
-8	0.328	(8.33)	0.469	(11.91)	220	(1517)
-10	0.328	(8.33)	0.578	(14.68)	170	(1172)
-12	0.328	(8.33)	0.688	(17.48)	130	(896)
-16	0.328	(8.33)	0.828	(21.03)	95	(655)
-20	To be determined					
-24						

4.6.2.2 Tensile Strength: Size -10 tube, and under, shall be subjected to tensile strength tests in accordance with ASTM D 412, except that the separation speed shall be two inches per minute. Tubes larger than -10 shall be tested in accordance with ASTM D 1457. See 3.5.1.3.

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 ± 2°F (25 ± 1°C) 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 ARP 1153 (D 1505) or ASTM D 792, Method A, and shall not exceed 2.155 at 77 ± 2°F (25 ± 1°C). 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 the ARP 1153 (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 I for not less than 30 s and not more than five minutes. 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 specification shall have this proof pressure test applied to them. Any evidence of leakage from hose or fittings, or any evidence of malfunction shall constitute failure. Proof pressure test of hose assemblies having firesleeves shall be tested 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 ±0.20 in (5.1 mm) in 10 in (254 mm) of length when subjected to the maximum operating pressure shown in Table I for not less than five minutes. With the hose held in a straight position, unpressurized, a 10 in (254 mm) 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 571. The volumetric expansion of the test assemblies shall be in accordance with the values shown in Table I for 4000 lbf/in^2 operating pressure and 0.75 times Table I for 3000 lbf/in^2 for operating pressure.

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 I and held for 5 min minimum. The pressure shall then be reduced to zero 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. Any evidence of leakage from the hose or fitting, or a hose burst, fitting blow-off or other evidence of malfunction shall constitute failure.

4.6.7 Burst Tests:

4.6.7.1 Room Temperature Burst Pressure Test: Two hose assemblies of each size shall be oil aged per 4.5.2.3, then they shall be subjected to a pressure sufficient to burst the assemblies with a rate of pressure rise equal to 20 000 lbf/in^2 ± 5000 lbf/in^2 (137 895 kPa ± 34 474 kPa) per minute. The assemblies shall be observed throughout the test and the type of failure and the pressure where failure occurred shall be recorded. The assemblies shall not leak or show any evidence of malfunction at any pressure below the specified pressure listed in Table I.

4.6.7.2 High Temperature, Burst Pressure Test: Two hose assemblies of each size shall be oil aged per 4.5.2.3, then they shall be filled with MIL-H-83282 fluid, placed into a suitable container, and into an oven preheated to 275°F (135°C). 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 proof pressure of Table I for a minimum of five minutes. The pressure shall then be released, and, while the temperature is held at 275°F (135°C), 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 I for a minimum of five minutes.

b. The test assemblies shall then be mounted, empty, in a low- and high-temperature test fixture (typical setup shown in Fig. 1). The ambient temperature shall be reduced to −65 ± 2°F (−54 ± 1°C) for a minimum of two hours. At the end of this period, while maintaining this temperature, high temperature test fluid at a temperature of 275°F (135°C) shall be quickly introduced at a minimum pressure of 50 lbf/in^2 (350 kPa). Immediately after the hot oil has filled the assembly, the pressure shall be raised to the proof pressure specified in Table I for a minimum of five minutes. Not more than 15 s shall elapse between the introduction of the high temperature oil at 50 lbf/in^2 (350 kPa) and the raising of the pressure to proof pressure.

c. The test assemblies shall then be filled with one of the specified high temperature test fluids at a pressure of 75 ± 24 lbf/in^2 (520 ± 175 kPa) and soaked with ambient, and fluid temperature maintained at 275°F (135°C) for one hour. At the end of this period, the assemblies shall be pressurized to the proof pressure specified in Table I for a minimum of five minutes. The pressure shall then be released, and, while still maintaining the 275°F (135°C), 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.

4.6.8 (Continued):

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 I shall constitute failure.

4.6.9 Impulse Test: Impulse testing shall be performed as follows on six straight-to-90 deg elbow hose assemblies of each size. The impulse test equipment shall conform to ARP 603 and AIR 1228.

a. Two assemblies shall be oil aged per 4.5.2.3, two shall be air aged per 4.5.2.4 and two shall be unaged. The assemblies shall then be subjected at room temperature to the proof pressure specified in Table I for a minimum of five minutes.

b. The hose assemblies shall then be pressurized as applicable, to 4000 lbf/in^2 (27 500 kPa) or 3000 lbf/in^2 (20 500 kPa) and, while maintaining this pressure at room temperature, the hose assemblies shall be immersed in a 3.5 ± 0.1% NaCl solution by weight for 8 - 10 min, then allowed to air dry for the remainder of one hour. This sequence of immersion and air drying shall be repated no less than 50 times. (See Note a.)

c. The test assemblies shall be connected to rigid supports and bent in a U-shape as specified in Fig. 2B and bend radius per Table I for the 3000 or 4000 lbf/in^2 as applicable.

d. The impulse pattern shall be as specified in ARP 603, with peak pressures of 150% measured at the inlet manifold. Impulsing shall occur at a rate of 70 ± 10 cycles per minute. The test fluid shall be one of the high-temperature test fluids. Fluid temperature shall be maintained at 275°F (135°C) for all hose sizes and measured at the test manifold. Ambient temperature shall be 275°F (135°C), measured at a point within 6 in from the hose assemblies.

e. Impulse testing shall be run in such a manner that the assemblies are temperature-cycled from room temperature to a specified fluid and ambient air temperatures a minimum of two times, with a minimum of 80% of the impulse cycles at 275°F (135°C). Any evidence of leakage from the hose or fittings prior to the completion of 250 000 impulse cycles for 3000 lbf/in^2 (20 500 kPa) and 100 000 impulse cycles for 4000 lbf/in^2 (27 500 kPa) shall constitute failure. (See Note b.)

Notes: a) The sodium chloride (NaCl) shall contain on a dry basis not more than 0.1% sodium iodine and not more than 0.5% total impurities.

b) It is preferred that testing be continuous with a minimum number of shutdowns to accommodate shift schedules and maintenance.

4.6.10 Assembly Flexure Test: Two hose assemblies of each size in 3000 lbf/in^2 (20 500 kPa) and 4000 lbf/in^2 (27 500 kPa) shall be mounted in the assembly flexure test setup as illustrated on Fig. 2A and subjected to the following test sequence. The assemblies shall be filled with oil as specified in 4.5.3. Temperature indicated is both fluid and ambient. Flexing shall occur at a rate of 70 ± 10 cpm during portions c., d. and e.

a. The test assemblies shall be soaked with no pressure or flexing at a temperature of -67 ± 2°F (-55 ± 1°C) for a minimum of 1 h at the minimum bend radius for 3000 (20 500 kPa) or 4000 lbf/in^2 (27 500 kPa) as applicable.

b. With no flexing, the test assemblies shall be pressurized to the proof pressure as specified in Table I with the temperature still at -67°F (-55°C) for a minimum of 5 min (first cycle only).

c. Flexing shall begin while the test assemblies are at the proper combination of bend radius and operating pressure as specified in Table I with the temperature still at -67°F (-55°C) for a minimum of 4000 flexure cycles.

d. With the pressure reduced to zero lbf/in^2, flexing shall continue for 1000 flexure cycles at -67°F (-55°C).

e. Increase the temperature to 275°F (135°C) and flex for 1000 cycles with pressure at zero lbf/in^2. The pressure shall then be increased to the operating pressure specified in Table I with the temperature held at 275°F (135°C). Flexing shall continue until an accumulated total of 80 000 cycles is reached.

f. Steps a., c., d., and e. shall be repeated for a total of five test sequences (that is, 400 000 flexing cycles).

g. After completion of step f., and with no flexing, the test assemblies shall be pressurized to the proof pressure specified in Table I with the temperature still at 275°F (135°C) for a minimum of 5 min (last cycle only).

Any leakage from the hose or fittings, hose burst, fitting blow-off, or other evidence of malfunction during the test, shall constitute failure.

4.6.11 Stress Degradation Test: Two hose assemblies of each size shall be subjected to the following test sequence:

a. The hose assemblies shall be filled with one of the specified high-temperature test fluids and placed in an oven which shall be maintained at a temperature of 275°F (135°C). Precautions shall be taken to ensure that the hose assemblies do not come in contact with parts of the oven that are at higher temperatures. A pressure equal to the maximum operating pressure specified in Table I shall be applied to the hose assemblies.

b. After a minimum of 20 h at 275°F (135°C), the pressure shall be gradually released and the assemblies removed from the oven, drained, and cooled to room temperature.

c. The hose assemblies shall then be refilled with fluid conforming to MIL-H-83282. A pressure equal to the maximum operating pressure specified in Table I shall be applied and held for a minimum of 2 h at room temperature.

d. The procedure specified in steps a., b., and c. shall be repeated a total of three times.

e. After the final 2 h pressurization period, the hose assemblies shall be drained and flushed with trichloroethylene, conforming to MIL-T-81533, and placed in an oven for one hour. The temperature of the oven shall be maintained at 160 ± 10°F (71 ± 5°C).

f. The hose assemblies shall be removed from the oven, cooled to room temperature, and then subjected to an air under water test. To conduct this test, the hose assemblies shall be installed in an apparatus constructed similar to that shown in Fig. 3.

g. The apparatus with the hose assembly installed, shall be immersed in water containing no wetting agent. A pressure equivalent to the maximum operating pressure specified in Table I shall be applied for 15 min to allow any entrapped air in the hose to escape.

h. The pressure shall be held an additional 5 min period, during which time the effused gas shall be collected from the test sample, including the juncture of the hose and the fitting, but not including the "B" nut. After the 5 min period of pressurization, the average rate of effusion through the hose and two fittings shall be computed into cc/in/min). If the average rate of effusion exceeds 2.0 cc/in/min (0.78 cc/cm/min) for any size, it shall be cause for rejection and considered failure to qualify.

4.6.12 Pneumatic Surge Test: Two hose assemblies that were subjected to the stress degradation (4.6.11) shall be used for this test. The hose assemblies shall be installed in the test apparatus in accordance with Fig. 4. The assemblies shall be tested using compressed gas to the maximum rated operating pressure specified in Table I, for 25 min at room temperature. After this period of pressurization, the exhaust valve shall be opened within 50 ms to permit rapid discharge of the compressed gas. After 5 min, the valve shall be closed and the pressure recycled. This sequence of 25 min at operating pressure and 5 min at zero lbf/in^2 shall be repeated a total of 16 times. At the end of this period, the hose shall be sectioned and examined along with the downstream filter for evidence of tube collapse, sponging of the innertube or tube debris. Evidence of the innertube degradation noted above shall constitute failure.

4.6.13 Pneumatic Effusion Test: Two hose assemblies of each size shall be used for this test. The assemblies shall be subjected to maximum operating pressure specified in Table I for 1 h at room temperature. Air effusion shall be collected, using the water displacement method and an air collecting device similar to that depicted in Fig. 3. The total amount of effusion through the hose and the two fittings shall be collected over the last 1/2 h of testing. Total effusion shall not exceed 8.0 cc/ft (26 cc/m) of hose assembly for any size hose.

4.6.14 Repeated Assembly Test: Specimens shall be screwed together and unscrewed eight times. Each of the eight cycles shall include the complete removal of the hose fitting from the manifold union. Fitting nuts shall be tightened to the torques specified in ARP 908, one half shall be tested to the minimum, one half to the maximum tightening torques. Following the first, fourth and eighth installation, proof tests shall be conducted. Following the eighth installation, the hose fittings shall be pressure tested with air or nitrogen for 5 min at the nominal system pressure. See 3.5.2.12.

4.6.15 Conductivity Test: Select one sample from 4.6.16 and prepare it as shown in Fig. 5 and test as follows:

a. The test specimen shall be a length of hose (with braid and one end fitting) as shown in Fig. 5. The inner surface of the tube shall be washed with solvent conforming to P-D-680, and isopropyl alcohol conforming to TT-I-735 to remove surface contamination, then thoroughly dried at room temperature. The aramid braid shall flare out as shown in Fig. 5 to prevent contact with the end of the polytetrafluoroethylene tube. One MS21900 steel adapter of appropriate size shall be assembled to the hose end fitting as shown on Fig. 5.

b. The test specimen shall be arranged vertically as shown on Fig. 5. The relative humidity shall be kept below 70% and room temperature between 60°F (16°C) and 90°F (32°C). A maximum of 1000 V DC shall be applied between the upper electrode (salt water solution or mercury) and the lower electrode (MS21900 adapter). The salt water solution shall have a maximum of 450 grams sodium chloride (NaCl) in one liter of chemically pure water.

4.6.15 (Continued):

c. The current shall be measured with an instrument with a sensitivity of at least 1 µA (1 x 10^{-6} A). The current measured shall be equal to or greater than, 6 µA for sizes -4 through -8 and equal to or greater than, 12 µA for sizes -10 through -16. The current shall not exceed 10 000 µA.

4.6.16 Push/Pull Test: Two hose assemblies of each size shall be subjected to the following test sequence.

The two samples shall be unaged and have free hose lengths specified in Table VIII. They shall be installed on a test fixture per Fig. 7a. The initial installed length of the hoses shall be compressed 2 in along the center line per Fig. 7b. This is the neutral position for running the test. The assemblies shall be continuously pushed and pulled along the centerline 1.75 in on each side of the neutral plane with a total stroke of 3.50 in at a rate of 40 ± 20 cycles per minute while filled with MIL-H-83282 oil and pressurized to the rated operating pressure per Table I. The testing shall be run in such a manner that the assemblies experience a minimum of 10 000 cycles at -65 ± 2°F, a minimum of 20 000 cycles at 275 ± 5°F, with an allowance of 20 000 cycles maximum during transition, for a total of 50 000 cycles, minimum.

During the test, evidence of leakage or any malfunction of the assemblies shall constitute failure.

5. PREPARATION FOR DELIVERY:

5.1 Preservation and Packaging: Preservation and packaging shall be level A or C, as specified (See 6.2).

5.1.1 Level A: Hose assemblies shall be preserved in accordance with method III of MIL-P-116. All openings shall be sealed with caps or plugs conforming to MIL-C-5501. Hose assemblies shall be unit packaged in containers conforming to PPP-B-566, PPP-B-636, PPP-B-665, or PPP-B-676. The gross weight of the boxes shall not exceed the weight limitations of the applicable container specification.

5.1.2 Level C: Hose assemblies shall be preserved and packaged in accordance with the manufacturer's commercial practice.

5.2 Packging: Packing shall be level A, B or C, as specified (See 6.2).

5.2.1 Level A: Hose assemblies preserved and packaged to meet 5.1.1 shall be packed in exterior type shipping containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636 or PPP-B-576. Insofar as practical, exterior containers shall be of uniform shape and size, of minimum cube and tare consistent with the protection required, and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 lb (90 kg). Containers shall be closed and strapped in accordance with the applicable specification or appendix. Containers shall be provided with a case liner conforming to MIL-L-10547 and shall be sealed in accordance with the appendix. The case liner will not be required when the unit, intermediate, or exterior container conforms to PPP-B-636 and is sealed at all joints and seams, including manufacturer's joint, with tape conforming to PPP-T-60.

5.2.2 Level B: Hose assemblies preserved and packaged in accordance with 5.1.1 shall be packed in domestic-type exterior containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636 or PPP-B-576. Exterior containers shall be of minimum cube and tare consistent with the protection required. Insofar as practicable, exterior containers shall be of uniform size and shape, and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 lb (90 kg). Containers shall be closed and strapped in accordance with the applicable container specification of the appendix. When fiberboard containers are used, the fiberboard shall conform to the special requirements table of PPP-B-636.

5.2.3 Level C: Packages which require over-packing for acceptance by the carrier, shall be packed in exterior-type shipping containers in a manner that will ensure safe transportation at the lowest rate to the point of delivery. Containers shall meet Uniform Freight Classification Rules or regulations of other common carriers, as applicable to the mode of transportation.

5.3 Marking: Interior and exterior containers shall be marked in accordance with MIL-STD-129.

5.3.1 Packing Date: The date of packing shall be marked on all interior and exterior containers.