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INTERNATIONAL
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AEROSPACE STANDARD

SAE AS1975 | REV. A

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Submitted for recognition as an American National Standard

HOSE ASSEMBLIES, POLYTETRAFLUOROETHYLENE, ARAMID REINFORCED, 275 °F, STANDARD DUTY, 4000/3000 lbf/in², HYDRAULIC, AIRCRAFT SYSTEMS

1. SCOPE:

This document defines the requirements for a PTFE lined, aramid reinforced assembly suitable for use up to 275 °F and up to 4000 lbf/in² aircraft and missile hydraulic and pneumatic systems.

1.1 Product Classification:

For service to 3000 lbf/in², this hose assembly is suitable for use at reduced bend radius per Table 1.

1.2 Field of Application:

1.2.1 For use with phosphate ester, silicate ester, and CTFE hydraulic fluids, the oil immersion samples in 3.5.2.5 and 3.5.2.7 must be preconditioned per 4.5.2.3 using the specific system fluid. Due precaution must be taken in handling any toxic hydraulic fluid.

1.2.2 This is not recommended for gaseous service where minor effusion is detrimental.

2. REFERENCES:

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

TABLE 1 - Physical and Performance Requirements

Hose Size in	Operating Pressure (Max) lbf/in^2	Proof Pressure (Min) -0 +1000 lbf/in^2	Burst Pressure (Min) Room Temp lbf/in^2	Burst Pressure (Min) High Temp lbf/in^2	Bend Radius Min Inside of Bend 3000 lbf/in^2 in	Bend Radius Min Inside of Bend 4000 lbf/in^2 in	Volumetric Expansion (Max) cc/in	Hose Wt. (Max) lb/in
-04	4000	8000	16 000	12 000	1.50	3.00	.089	0.006
-06	4000	8000	16 000	12 000	2.50	5.00	.132	0.008
-08	4000	8000	16 000	12 000	2.88	5.75	.187	0.012
-10	4000	8000	16 000	12 000	3.25	6.50	.383	0.020
-12	4000	8000	16 000	12 000	4.00	7.75	.493	0.025
-16	4000	8000	16 000	12 000	7.50	12.00	1.134	0.040
-20	4000	8000	16 000	12 000	15.00	21.00	TBD	0.050
-24	To be determined							

NOTE: For 3000 lbf/in^2 service, 12 000 lbf/in^2 minimum room temperture and 9000 lbf/in^2 minimum high temperature is acceptable.

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 4928	Bars and Forgings - 6Al 4V, Annealed - 120 000 psi
AMS 4945	Titanium Alloy 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 5536	Steel Bars, Corrosion Resistant, 18Cr - 8.5Ni (SAE 30302) Cold Drawn, 100 000 psi (690 MPa)
AMS 5556	Steel Tubing, Seamless or Welded, Corrosion and Heat Resistant 18Cr - 11Ni - (Cb+Ta) (SAE 30347) Hydraulic
AMS 5557	Steel Tubing, Seamless or Welded, Corrosion and Heat Resistant 18Cr - 11Ni - Ti (SAE 30321) Hydraulic
AMS 5567	Steel Tubing, Seamless or 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 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 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	Hose Fitting - Installation and Qualification Test Torque Requirements
AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings and Similar System Components
AS1072	Sleeve Hose Assembly, Fire Protection
ARP1153	Method for Determining Relative Specific Gravity, Polytetrafluoroethylene Tubing

2.1 (Continued):

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
AS4488	Tubular Assemblies, Fusion Welded, Inspection Processes and Acceptance Standards for
AS4568	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, Straight to Straight
AS4569	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, Straight to 45°
AS4570	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, Straight to 90°
AS4571	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, 45° to 90°
AS4572	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, 45° to 45°
AS4573	Hose Assembly, PTFE, Aramid Reinforced, Standard Duty, 4000/3000 psi, 275 °F, Titanium Fittings, Flareless, 90° to 90°
AS4658	Fitting End, External Thread, Short, Flareless
AS4659	Fitting End, Bulkhead, External Thread, Short, Flareless
AS4660	Nut, Short, Flareless
AS4700	Installation Procedures and Torques for Short Flareless Fittings
AS4702	Nut, Swivel, Wired On, Short, Flareless
AS4703	Fitting End, Acorn, Short, Flareless

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 262	Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM B 348	Titanium Alloy
ASTM D 380	Rubber Hose for Automotive Hydraulic Brake Systems
ASTM D 412	Rubber, Determination of Tension Characteristics
ASTM D 638	Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High Temperature Service, Standard Specification for
ASTM D 792	Specific Gravity and Density of Plastics by Displacement
ASTM D 1457	TFE - Fluorocarbon Resin Molding and Extrusion Materials

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

P-D-680	Dry Cleaning Solvent
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-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)

2.3 (Continued):

MIL-T-8808	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized), Aircraft Hydraulic Quality
MIL-F-8815	Filter and Filter Elements, Fluid Pressure, Hydraulic Lines, 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-H-83282	Hydraulic Fluid, Fire-Resistant, Synthetic, Hydrocarbon Base, Aircraft
MIL-F-85421	Dynamic Beam Fitting
MIL-L-46010	Dry Film Lubricant
MIL-STD-100	Engineering Drawing Practices for Inspection
MIL-STD-105	Sampling Procedures and Tables by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of
MIL-STD-1595	Qualification of Aircraft, Missile and Aerospace Fusion Welders
MIL-STD-1839	Calibration and Measurement Requirements
MIL-STD-2219	Fusion Welding for Aerospace Applications
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 NAS Publications: Available from AIA, 1250 Eye Street N.W., Washington, DC 20005.

NAS 1760	Fitting End, Flareless Acorn, Standard Dimensions for
ANSI/ASME B46.1	Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

The hose assemblies furnished under this document shall be products which are qualified by meeting all the requirements covered by this document.

3.2 Materials:

The hose assembly materials shall be uniform in quality, free from defects, consistent with good manufacturing practice and shall conform to applicable specifications and the requirements specified herein and 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:

a. 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 Bars and Forgings
AMS 4965 - TI 6AL 4V Heat Treated Bars, Forgings and Rings
ASTM B 348 - Grade 2 - Titanium Alloy

b. Tubing

MIL-T-8504 - Comp. 304 (AMS 5567)
MIL-T-8606 - Type I, Comp. 321 (AMS 5570)
MIL-T-8808 - Type I or Type II, Comp. 321 (AMS 5557, AMS 5570, or AMS 5576)
MIL-T-8808 - Type I or Type II, Comp. 347 (AMS 5571, AMS 5575, or AMS 5556)
AMS 4942 - Titanium Tubing, Seamless, Annealed, 40 000 psi (275 MPa) Yield Strength
AMS 4943 - Titanium Alloy Tubing, Seamless, Hydraulic 3.0 Al - 2.5V Annealed
AMS 4945 - Titanium Alloy Tubing, Seamless, Hydraulic, 3Al 2.5V, Texture Controlled, 105 000 psi (724 MPa) Yield Strength

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.

3.2.3 Finish:

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

3.2.3.2 If titanium fluoride phosphate conversion coat is used, it will be per AMS 2486.

3.3 Design and Fabrication:

The hose assembly shall consist of a seamless polytetrafluoroethylene inner tube, treated aramid reinforcement, polyester braid, or polybenzimidazol/aramid blend braid cover with optional PTFE tape interlayer 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 aramid braid and/or wraps with optional PTFE tape interlayer and 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 inner tube to provide sufficient strength and protection for ensuring conformance with the requirements specified herein. Broken reinforcing cords shall be cause for rejection. The outer braid shall provide 100% coverage to protect the aramid from exposure to ultraviolet light. A continuous lay line interrupted with AS1975 and hose manufacturer's name or trademark shall be permanently marked in contrasting color along hose length.

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 (for -20 and larger configuration may be per AS4703 to mate with AS4658 or AS4659 with nuts AS4660 or AS4702) or dynamic beam fittings to mate with male end per MIL-F-85421 in accordance with applicable documents (see Section 2). Antitorque hexes/flats shall be provided and shall fit standard wrench openings. Titanium nut threads and bearing shoulders will be lubricated with dry film per MIL-L-46010 Type I. External coating is permitted.

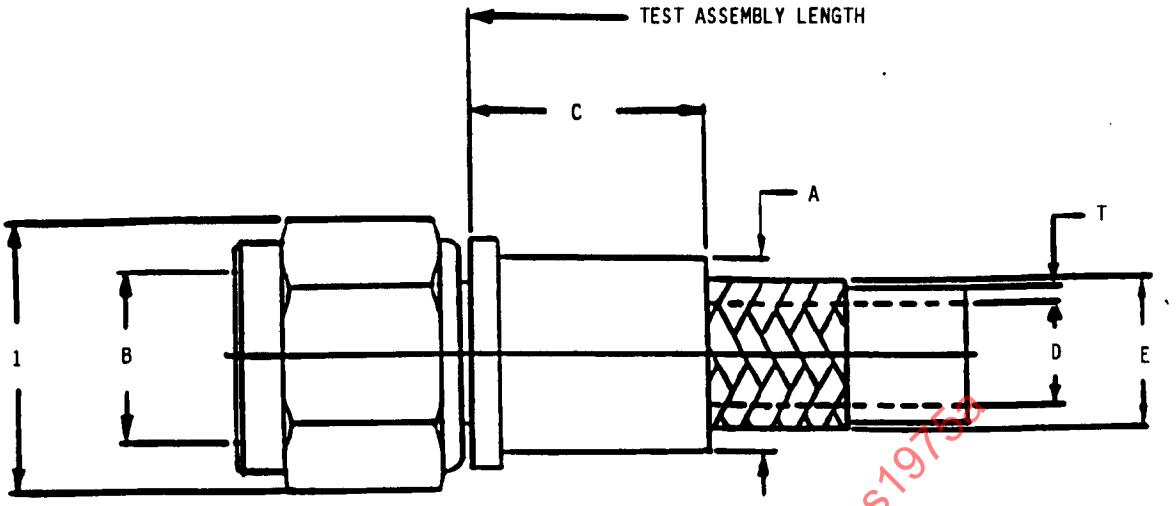
3.3.3.1 Straight Fittings: Straight fittings shall be of one piece construction. Welded or brazed joints must not be located in the fluid paths, except welded and redrawn tubing, in accordance with MIL-T-8504, or MIL-T-8808 may be used. Elbow fittings may be classified per 3.3.3.2 for construction.

3.3.3.2 Other Fittings: Other fittings are preferred to be of one piece construction. If stainless steel tubes are used, they shall be welded and drawn per MIL-T-8504 or MIL-T-8808. If titanium tubes are used, they shall be seamless per AMS 4945. Fitting welds will be butt welds per MIL-STD-2219 or AS4488.

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) or 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 2.



[1] Cross corners of hex may exceed "A" dimension.

FIGURE 1 - Hose and Fitting Dimensions

TABLE 2 - Hose and Fitting Dimensions

Hose Size	Rigid Tube OD (Ref)	Fitting OD A Max in	Fitting ID B [2] Min in	Socket Length C Max in	Hose ID D Min in	Hose OD E Min in	Hose OD E Max in	Unbraided PTFE Wall Thickness T Min in	Unbraided PTFE Wall Thickness T Max in
04	.250	.690	.135	1.25	.212	.405	.465	.035	.046
06	.375	.800	.240	1.45	.298	.495	.555	.035	.046
08	.500	.970	.340	1.78	.391	.655	.715	.040	.051
10	.625	1.150	.410	2.25	.485	.850	.920	.045	.056
12	.750	1.380	.510	2.50	.602	.995	1.075	.045	.056
16	1.000	1.660	.760	3.00	.852	1.285	1.365	.045	.056
20	1.250	2.320	.925	3.55	1.100	1.580	1.660	.052	.062
24	To be determined								

NOTES:

1. Cross corners of hex may exceed "A" dimension.
2. Minimum specified inside diameter shall be verified by passing the applicable MS19059 spherical ball through the hose assembly as shown in Table 3.

TABLE 3 - ID Ball Size

Hose Size	Spherical Ball Size for Determining Minimum ID MS19059 Dash No.	Spherical Ball Size for Determining Minimum ID in
04	4807	0.109
06	4812	0.188
08	4816	0.313
10	4818	0.375
12	4821	0.469
16	4829	0.719
20	4834	0.875
24	--	--

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 1.

3.5 Performance:

The hose assembly shall meet the following performance requirements:

3.5.1 Tube:

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

TABLE 4 - Tube Roll Gap and Proof Pressure

Size	Flattening Gap - Max in	Rounding Gap - Max in	Proof Pressure lbf/in^2
-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	1.000	95
-24			

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 4 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 lbf/in^2 minimum at 77 °F ± 2 °F. The transverse tensile strength for sizes -10 and larger shall be 1800 lbf/in^2 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 °F shall be a minimum of 200%. Test method is specified in 4.6.2.3.

3.5.1.5 Specific Gravity: The specific gravity values of the hose inner tube shall not exceed 2.155 apparent and 2.190 relative. The test method is specified in 4.6.2.4.

3.5.2 Hose Assembly: The 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 1 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 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 1. 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 1. 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 1. 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 1 proof and high temperature burst pressure after being thermally shocked by rapidly increasing hose temperature from -65 °F to 275 °F. 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 or 100 000 impulse cycles for 4000 lbf/in^2 as applicable. The test method is specified in 4.6.9.

NOTE: For -20 size, 100 000 impulse cycles is acceptable in 3000 psi service.

3.5.2.8 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 1 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 1, 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 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 1 maximum operating pressure to 0 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 cm^3/ft of hose length. The test method is as specified in 4.6.13.

3.5.2.12 Repetitive Assembly Torque: The fitting shall withstand repetitive assembly overtightening torque values specified in ARP908. Test method is specified in 4.6.14. There shall be no leakage, galling, or other malfunction of the fitting nut and interface connection during the pressure tests specified in 4.6.14.

3.5.2.13 Conductivity: Hose assembly shall conduct a minimum DC equal to 900 μA with a test potential 1000 v DC. The test method is specified in 4.6.15.

3.5.2.14 Push-Pull Test: The hose assembly shall withstand 50 000 push-pull cycles without leakage, kinking, or other failure when tested per 4.6.16.

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. For inspection purposes, all threads are categorized "other threads" per 3.1 and 6.2.7 of MIL-S-8879 unless otherwise required by the purchaser.

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 through 36 in, not less than .250 in
c. Over 36 through 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 diameter" to "gage diameter".

3.7 (Continued):

Tolerances on hose assembly lengths shall be as follows:

a. ±.125 in for lengths under 18 in
b. ±.250 in for lengths from 18 through 36 in
c. ±.500 in for lengths from over 36 through 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 band on the hose shall be used. If a metallic band is used on the bare hose, it shall be covered with a translucent shrink sleeve per AS1073 Code "A" and extend beyond the edges of the band by approximately 1/8 in. 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 AS1975

b. CAGE code and manufacturer's assembly part number

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

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 CAGE code number 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 125 μin Ra maximum per ANSI/ASME B46.1 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 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 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 5. 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 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.

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

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 cutaway section showing all details in their normal assembly position and shall identify all details and subassemblies as applicable.

d. Sources: A list of sources of hose or hose components, including 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).

TABLE 5 - Length of Hose Assemblies for Test (Refer to Figure 1 and Figure 7A and 7B)

Hose Assembly Size	Six Assemblies For Each Impulse Test (4.6.9) 3000 lbf/in^2 in	Six Assemblies for Each Impulise Test (4.6.9) 4000 lbf/in^2 in	Two Assemblies For Each Flex Test (4.6.10) 3000 lbf/in^2 in	Two Assemblies for Each Flex Test (4.6.10) 4000 lbf/in^2 in	Six Assemblies For Other Tests 3.4 in	Two Assemblies Push/Pull (4.6.16) Max Free Hose Length in
-04	10.5	15.0	14.0	18.5	18	13
-06	14.5	22.5	18.0	26.0	18	15
-08	17.0	26.0	20.5	29.5	18	18
-10	20.5	30.5	24.0	34.0	18	21
-12	24.0	36.0	27.5	39.5	18	24
-16	38.0	52.0	41.5	55.0	18	
-20	39.5 (90°)	48.5 (90°)	68.0	87.0	18	
-24	To be determined					

NOTES:

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 or short flareless per AS4703 to mate with AS4658 or AS4659.
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.
3. Two additional samples of each size in lengths as shown in Table 2 shall be used for examination, push/pull test, and conductivity tests (Sample No. 16 and 17, Table 6A).
4. Two additional samples of each size are required if tests in accordance with 4.5.2.2 are conducted.

TABLE 6A - 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 & 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						

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

TABLE 6B - Paragraph Identification

4.6.1	Examination of Product
4.6.1.2	Hose Assembly
4.6.2	Tube Tests
4.6.3	Proof Pressure Test
4.6.4	Elongation and Contraction Test
4.6.5	Volumetric Expansion Test
4.6.6	Leakage Test
4.6.7	Burst Tests
4.6.7.1	Room Temperature Burst Pressure Test
4.6.7.2	High Temperature Burst Pressure Test
4.6.8	Thermal Shock Test
4.6.9	Impulse Test
4.6.10	Assembly Flexure Test
4.6.11	Stress Degradation Test
4.6.12	Pneumatic Surge Test
4.6.13	Pneumatic Effusion Test
4.6.14	Repeated Assembly Test
4.6.15	Conductivity Test
4.6.16	Push/Pull Test

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 sufficient for protracted or small assembly run conditions.

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 4.6.12.4)

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.

4.4.3.1 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. Elongation and contraction test (see 4.6.4)
b. Impulse test (see 4.6.9) (unaged samples only and may incorporate straight fittings both ends)

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 4.6.15)

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: Changing 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 6A 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 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 preconditioned in MIL-H-83282 or AS1241 Type IV or other system fluid, as applicable. Preconditioning shall be done in two phases:

1. The hose assemblies shall be filled with applicable system fluid and then be pressurized to 4000 lbf/in^2 and, while maintaining this pressure at room temperature, the hose assemblies shall be immersed in applicable or system fluid for 8 to 10 min, then allowed to air dry for the remainder of 1 h. This sequence of immersion and air drying shall be repeated no less than 50 times.

2. After completing item (1) fill hose with applicable system fluid (exclude all air), pressurize to 4000 psi and age at 275 °F in air for 7 days.

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 lbf/in^2.

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 as per 3.3.3, lubricated with either MIL-H-5606 fluid or the test fluid, and with an installation torque range as specified in ARP908, MIL-T-85421, or AS4700 as applicable.

4.6 Inspection Methods:

4.6.1 Examination of Product:

4.6.1.1 Inner Tube (PTFE): 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 kink or other malfunction that shall 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 4. The test fluid shall be air or water.

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 2 in/min. 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 °F ± 2 °F 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 or ASTM D 792, Method A, and shall not exceed 2.155 at 77 °F ± 2 °F. 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 or ASTM 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 1 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 hose or fittings, or any evidence of malfunction shall constitute failure. Proof pressure test of hose assemblies having fire sleeves 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 fire sleeves, 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 1 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 1 for 4000 lbf/in² operating pressure and .75 times Table 1 for 3000 lbf/in² 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 1 and held for 5 min minimum. The pressure shall then be reduced to 0 lbf/in², 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 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: One hose assembly of each size shall be oil aged per 4.5.2.3, then it shall be subjected to a pressure sufficient to burst the assembly with a rate of pressure rise equal to 20 000 lbf/in^2 ± 5000 per minute. The assembly shall be observed throughout the test and the type of failure and the pressure where failure occurred shall be recorded. The assembly shall not leak or show any evidence of malfunction at any pressure below the specified pressure listed in Table 1.

4.6.7.2 High Temperature, Burst Pressure Test: One hose assembly of each size shall be oil aged per 4.5.2.3, then it shall be filled with MIL-H-83282 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 assembly shall be pressurized to proof pressure of Table 1 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. Pressure shall be monitored throughout the test and the pressure recorded when leakage or burst occurs.

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 1 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 °F 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 lbf/in^2. Immediately after the hot oil has filled the assembly, the pressure shall be raised to the proof pressure specified in Table 1 for a minimum of 5 min. Not more than 15 s shall elapse between the introduction of the high temperature oil at 50 lbf/in^2 and the raising of the pressure to proof pressure.

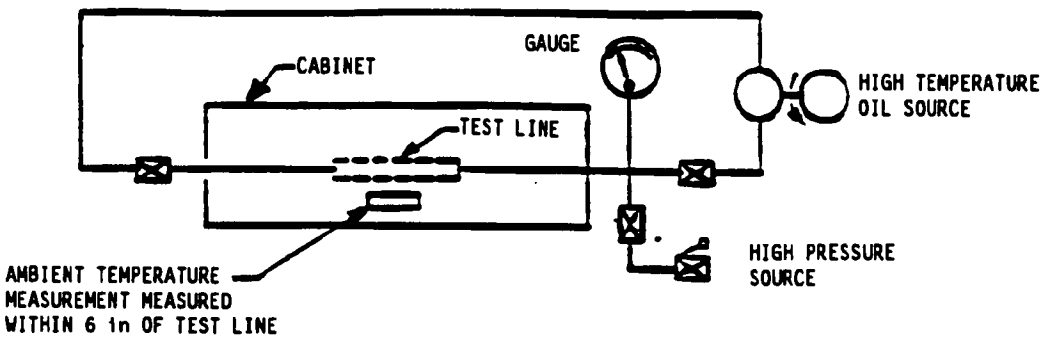


FIGURE 2 - Typical Setup for Thermal Shock Testing

4.6.8 (Continued):

c. The air aged assembly shall then be filled with MIL-H-83282 fluid at a pressure of 75 lbf/in² ± 24 lbf/in² and soaked with ambient and 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 1 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 4.6.7.1 until failure is obtained. The hose assembly pressure shall be under continuous observation during the preceding test, and the pressure when the failure occurred and the type of failure shall be recorded.

d. The unaged assembly at room temperature will be filled with the MIL-H-5606 or MIL-H-83282 fluid and pressurized to the proof pressure specified in Table 1 for a minimum of 5 min. The pressure shall then be released to "0" psi and then increased at the same rate of rise specified in 4.6.7 until failure is obtained. The assembly and the pressure will be under observation during the preceding test and the pressure when failure occurred and the type of failure shall be recorded.

e. During (b) and the proof portion of (c) and (d) 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 (c) and (d), any of the above occurring below the minimum high temperature or room temperature burst pressure respectively of Table 1 shall constitute failure.

4.6.9 Impulse Test: Impulse testing shall be performed as follows on six straight-to-90° elbow hose assemblies of each pressure and size. If the 3000 psi operating bend radius is used with the 4000 psi operating pressure, then only six assemblies need be tested to cover both pressure ranges. The impulse test equipment shall conform to ARP603 and AIR1228.

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 1 for a minimum of 5 min.

b. The test assemblies shall be connected to rigid supports and bent in a U-shape as specified in Figure 3 and bend radius per Table 1 for the 3000 or 4000 lbf/in² as applicable except the -20 size shall be a 90° bend.

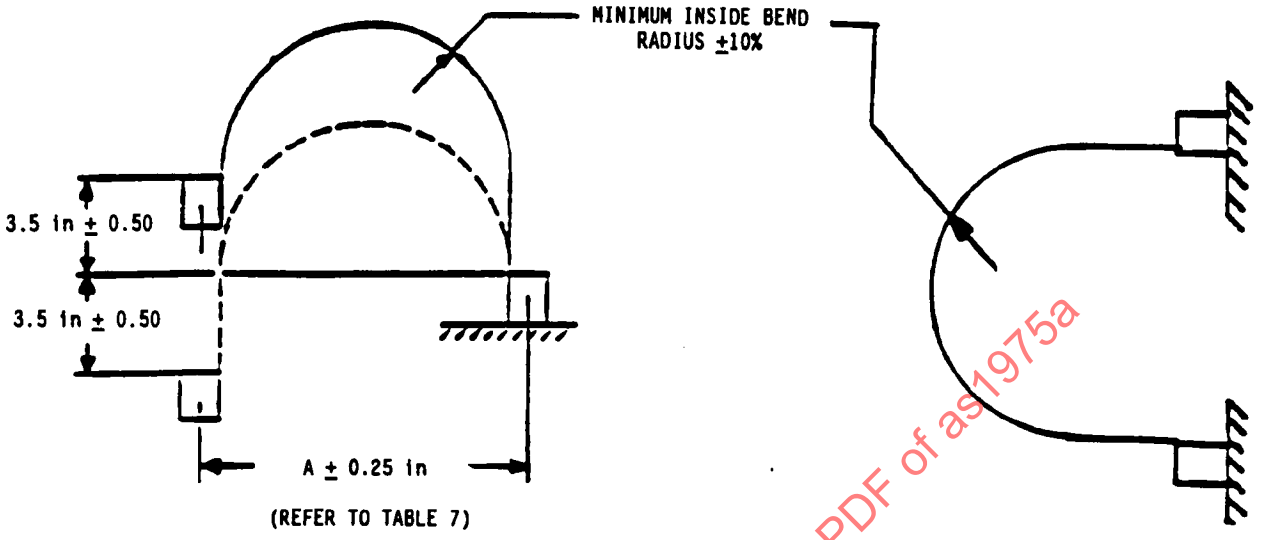


FIGURE 3 - Impulse and Flexure Test Setup

TABLE 7 - Flexure Test Dimensions

Hose Size	A 3000 lbf/in^2 in	A 4000 lbf/in^2 in
-04	3.50	6.50
-06	5.62	10.63
-08	6.50	12.25
-10	7.50	14.00
-12	9.12	16.63
-16	38.00	25.50
-20	31.75	43.65
-24	To be determined	To be determined

4.6.9 (Continued):

c. The impulse pattern shall be 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. The test fluid shall be MIL-H-83282. Fluid temperature shall be maintained at 275 °F for all hose sizes and measured at the test manifold. Ambient temperatures shall be 275 °F, measured at a point within 6 in from the hose assemblies.

d. 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. Any evidence of leakage from the hose or fittings prior to the completion of 250 000 impulse cycles (see Note 1) for 3000 lbf/in² or 100 000 impulse cycles for 4000 lbf/in² as applicable shall constitute failure. (See Note 2.)

NOTE:

1. For -20 size, 100 000 impulse cycles is acceptable.
2. 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 as applicable in 3000 lbf/in² and 4000 lbf/in² shall be mounted in the assembly flexure test setup as illustrated in Figure 3 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 cpm ± 10 cpm during portions (c), (d), and (e). If the 3000 psi operating bend radius is used with the 4000 psi operating pressure, then only two assemblies need be tested to cover both pressure ranges.

a. The test assemblies shall be soaked with no pressure or flexing at a temperature of -67 °F ± 2 °F for a minimum of 1 h at the minimum bend radius for 3000 or 4000 lbf/in² as applicable.

b. With no flexing, the test assemblies shall be pressurized to the proof pressure as specified in Table 1 with the temperature still at -67 °F 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 1 with the temperature still at -67 °F for a minimum of 4000 flexure cycles.

d. With the pressure reduced to 0 lbf/in², flexing shall continue for 1000 flexure cycles at -67 °F.

e. Increase the temperature to 275 °F and flex for 1000 cycles with pressure at 0 lbf/in². The pressure shall then be increased to the operating pressure specified in Table 1 with the temperature held at 275 °F. Flexing shall continue until an accumulated total of 80 000 cycles is reached.