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Hose Assembly, Polytetrafluoroethylene, Heavy Duty, Metallic Reinforced,
400 °F, 5000 psi Hydraulic and Pneumatic

RATIONALE

AS4098A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

This Aerospace Standard (AS) defines the requirements for a heavy duty polytetrafluoroethylene (PTFE) lined, metallic reinforced, hose assembly suitable for use in 400 °F 5000 psi, aircraft and missile hydraulic fluid systems.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

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

AMS 4928	Ti Alloy Bars, Forgings and Rings, 6Al - 4V, Anneal 120,000 psi
AMS 4945	Titanium Alloy Tubing, Seamless, Hydraulic 3Al - 2.5V, Texture Controlled, 105,000 psi Yield Strength
AMS 4965	Ti Alloy Bars, Forgings and Rings, 6Al - 4V, Solution and Precipitation Heat Treated
AMS 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 5561	Steel Tubing Welded and Drawn, 9.0Mn - 20Cr - 6.5Ni - 0.28N, High Pressure Hydraulic
AMS 5567	Steel Tubing, Seamless and Welded, Corrosion-Resistant 19Cr - 10Ni (SAE 30304) Hydraulic, Solution Treated

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2.1.1 (Continued):

AMS 5570	Steel Tubing, Seamless, Corrosion and Heat-Resistant 18Cr - 11Ni - 0.40Ti (SAE 30321)
AMS 5571	Steel Tubing, Seamless, Corrosion and Heat-Resistant 18Cr - Ni - 0.70 (Cb + Ta) (SAE 30347)
AMS 5575	Steel Tubing, Welded, Corrosion and Heat-Resistant 18Cr - 10.5Ni - 0.70 (Cb + Ta) (SAE 30347)
AMS 5576	Tubing Welded, 18Cr - 10.5Ni - 0.40Ti Solution Heat Treated
AMS 5636	Steel Bars, Corrosion-Resistant, 18Cr - 9.0Ni (SAE 30302)
AMS 5637	Steel Bars, Corrosion-Resistant, 18Cr - 9.0Ni (SAE 30302)
AMS 5639	Steel Bars, Forgings, Tubing, and Rings, Corrosion-Resistant 19Cr - 10Ni (SAE 30304)
AMS 5643	Steel Bars, Forgings, Tubing and Rings, Corrosion-Resistant 16.5Cr - 4.0Ni - 4.0Cu
AMS 5644	Steel Bars and Forgings, Corrosion and Heat-Resistant 17Cr - 7Ni - 1Al
AMS 5645	Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat-Resistant, 18Cr - 10Ni - 0.40Ti (SAE 30321)
AMS 5646	Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat-Resistant, 18Cr - 11Ni - 0.60 (Cb + Ta) (SAE 30347)
AMS 5647	Steel Bars, Forgings, Tubing and Rings, 18Cr - 8Ni
AMS 5659	Steel Bars, Forgings and Rings, Corrosion-Resistant 15Cr - 4.5Ni - 0.30 (Cb + Ta) - 3.5 Consumable Electrode Melted
AMS 5743	Steel Bars and Forgings, Corrosion and Moderate Heat-Resistant 15.5Cr - 4.5Ni - 2.9Mo - 0.10N, Solution Heat-Treated, Sub-Zero Cooled, Equalized and Over-Tempered
AS611	Tetrafluoroethylene Hose Assembly Cleaning Methods
ARP908	Hose Fitting - Installation and Qualification Test Torque Requirements
AS1055	Fire Resistance and Fire Test
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies
AS2078	Test Methods, Hose Assemblies, Polytetrafluoroethylene (PTFE)
AS4488	Tubular Assemblies, Fusion Welded, Inspection Process and Acceptance Standard

2.1.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 262	Detecting Susceptibility to Intergranular Attack on Stainless Steel
ASTM A 580	Stainless and Heat-Resistant Steel Wire - Type 304 or 316, Condition B

2.1.3 NAS Standards: Available from National Standards Association, Inc., 1200 Quincy Orchard Blvd., Gaithersburg, MD 20878.

NAS 1760	Fitting End, Flareless Acorn, Standard Dimensions for
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- 2.1.4 U.S. Government Publications: Available from DODSSP, Subscription Services 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
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-F-85720	Fittings, Tube, Fluid Systems, Separable, High Pressure Beam Seal
MIL-F-85720/1	Fittings, Tube, Fluid Systems, Separable, High Pressure, Beam Seal, Design Standard for Male End
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-H-83282	Hydraulic Fluid, Fire-Resistant, Synthetic Hydrocarbon Base Aircraft
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter
MIL-T-8504	Tubing, Steel, Corrosion-Resisting (304) Aerospace Vehicle Hydraulic Systems, Annealed, Seamless and Welded
MIL-T-8808	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized) Aircraft Hydraulic Quality
MIL-STD-100	Engineering Drawing Practices for Inspection
MIL-STD-105	Sampling Procedures and Tables by Attributes
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of
MIL-STD-2219	Fusion Welding for Aerospace Application
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
H4/H8	Cataloging Handbook

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

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

3.2 Materials:

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

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

a. Bars and Forgings:

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

b. Tubing:

- | | | |
|-----|------------|--|
| (1) | MIL-T-8504 | Comp. 304 (AMS 5567) |
| (2) | MIL-T-8808 | Type I or Type II, Comp. 321 (AMS 5557, AMS 5570, or AMS 5576) |
| (3) | MIL-T-8808 | Type I or Type II, Comp. 347 (AMS 5571, AMS 5575, or AMS 5556) |
| (4) | AMS 4945 | Titanium 3Al 2.5V Texture Controlled |
| (5) | AMS 5561 | Welded and Redrawn Stainless Steel Tubing, 21-6-9 |

c. Wire:

- | | | |
|-----|------------|--|
| (1) | ASTM A 580 | Specification for Stainless and Heat-Resisting Steel Wire, Type 304 or 316 Condition B |
|-----|------------|--|

3.3 Construction:

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

- 3.3.1 Inner Tube:** The inner tube shall be of a seamless construction of virgin PTFE resin of uniform gauge. It shall have a smooth bore and shall be free from pitting, deep scratches, or projections on the inner surface. Additives may be included in the compound from which the tube is extruded.
- 3.3.2 Reinforcement:** The reinforcement shall consist of corrosion-resistant steel wires conforming to the applicable specifications listed in 3.2.1. The wires shall be so arranged over the inner tube as to provide sufficient strength to ensure conformance with the requirements specified herein. Broken reinforcing wires shall be cause for rejection. Crossed-over reinforcing wires shall not be cause for rejection of the hose assembly.

- 3.3.3 Interlayers: Interlayers, if used, shall be of a suitable material and shall be resistant to pressure pounding and to all fluids with which the hose may come in contact during normal service. They shall be capable of withstanding temperatures of -65 to 400 °F and shall not extrude through the outer braid during testing or in service.
- 3.3.4 Fittings: All fittings shall be proven to meet the requirements herein. Standard hose assemblies shall have a reconnectable configuration of beam seal fittings to mate with MIL-F-85720/1, MS flareless per NAS1760 to mate with MS33514, or other suitable end connections. Fitting hex portions shall fit standard wrench openings.
- 3.3.4.1 Straight Fittings: Straight fittings shall be of one piece construction. Weld or braze joints must not be located in the fluid paths.
- 3.3.4.2 Other Fittings: Other fittings including elbow fittings shall be of one piece construction to the maximum extent possible. However, those made with other than one piece construction can use stainless steel welded and redrawn tubing per AMS 5561 or titanium seamless tubing per AMS 4945. When weld joints are required the butt weld will be per MIL-STD-2219 or AMS 4488. If welding is used, a stabilized grade of stainless steel shall be used.
- 3.3.4.3 End Fitting Collars (Sockets): All end fitting collars (sockets) crimped or swaged, fabricated from Type 304 stainless steel are required to be capable of passing an embrittlement test as specified in ASTM A 262 Practice E, prior to assembly to the nipple or swaging operation. Sockets fabricated from stabilized austenitic steel (304L, 321, or 347) are acceptable without being subjected to the embrittlement test. Titanium sockets are not recommended.
- 3.3.5 Dimensions: The hose assembly dimensions, except for length, shall be as specified in Figure 4 and Table 5.
- 3.3.6 Hose Weight: Hose consisting of inner tube, reinforcement, and interlayers as outlined in 3.3.1 through 3.3.3 shall not exceed the maximum hose weights covered in Table 1A.
- 3.4 Performance:
- The hose assembly shall meet the following performance requirements:
- 3.4.1 Tube:
- 3.4.1.1 Tube Roll and Proof Pressure Test: The tube shall not leak, split, burst, or show any evidence of malfunction when rolled to the flattening and rounding gaps of AS2078 (3000 psi and higher) values. The test method is specified in 4.6.2.1.
- 3.4.1.2 Tube Proof Pressure: The tube, without reinforcing wires, shall not leak, burst, or show any evidence of malfunction when tested to the AS2078 (3000 psi and higher) proof pressure values for 1 min. The test method is specified in 4.6.2.1.

TABLE 1 - Hose Weights and Pressures

TABLE 1A - Physical Requirements

Hose Size	Tube Size Nominal	Hose Weight Max ¹ lb/in	Bend Rad Min Inside of Bend in	Volumetric Expansion Max cm ³ /in
-04	.250	.022	3.000	.10
-06	.375	.037	5.000	.15
-08	.500	.045	5.750	.23
-10	.625	.070	6.500	.35
-12	.750	.095	7.750	.48
-16	1.000	.160	9.625	.75
-20	1.250	.220	12.000	1.25

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

TABLE 1B - Pressure Requirements (psig)

Operating Max	Proof Min	Burst Min Room Temperature	Burst Min Elevated Temperature
5000	10 000	20 000	15 000

- 3.4.1.3 Tensile Strength: The longitudinal tensile strength for all sizes of tubes shall be 2200 psi minimum. The transverse tensile strength for sizes -10 and larger shall be 1800 psi minimum. For sizes -8 and smaller the transverse tensile strength need not be tested. The test method is specified in 4.6.2.2.
- 3.4.1.4 Elongation: Elongation shall be a minimum of 200%. The test method is specified in 4.6.2.3.
- 3.4.1.5 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.
- 3.4.2 Hose Assembly: The hose, complete with reinforcing wires and assembled with end fittings, shall meet the following performance requirements:
- 3.4.2.1 Proof Pressure: The hose assembly shall withstand the proof pressure listed in Table 1B without malfunction or leakage. The test method is specified in 4.6.3.
- 3.4.2.2 Elongation and Contraction: The hose assembly shall not change in length by more than $\pm 2\%$ inch in 10 inches of hose length when subjected to the operating pressure in Table 1B for a minimum of 5 min. The test method is specified in 4.6.4.
- 3.4.2.3 Volumetric Expansion: The volumetric expansion of the hose assemblies shall not exceed the limits specified in Table 1A. The test method is specified in 4.6.5.

- 3.4.2.4 Leakage: The hose assembly shall not leak (no external wetting) when subjected to two pressure cycles of 70% of minimum room temperature burst pressure. The test method is specified in 4.6.6.
- 3.4.2.5 Room Temperature Burst Pressure: The hose assembly shall not leak nor burst at any pressure below the burst value specified in Table 1B. The test method is specified in 4.6.7.
- 3.4.2.6 Thermal Shock: The hose assemblies shall not leak nor show any evidence of malfunction when subjected to the Table 1B proof and high temperature burst pressure after being thermally shock tested per AS2078. The test method is specified in 4.6.8.
- 3.4.2.7 Impulse: The hose assemblies shall show no evidence of leakage from hose or fitting prior to completion of 100 000 pressure impulse cycles. The test method is specified in 4.6.9.
- 3.4.2.8 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 1B proof pressure after 400 000 flexure cycles. The test method is specified in 4.6.10.
- 3.4.2.9 Stress Degradation (Air Leakage): The air leakage rate from the hose and two end fittings (not including "B" nuts) when held at the Table 1B operating pressure after completion of the stress degradation test shall not exceed $4.0 \text{ cm}^3/\text{in}/\text{min}$. The test method is specified in 4.6.11.
- 3.4.2.10 High Temperature Burst Test: The hose assembly shall not leak nor burst at any pressure below the high temperature burst value specified in Table 1B. The test method is specified in 4.6.8.
- 3.4.2.11 Effusion: The effusion rate for any hose size shall not exceed $12 \text{ cm}^3/\text{ft}$ of hose length. The test method is specified in 4.6.12.
- 3.4.2.12 Repeated Assembly Torque: The beam seal fitting shall withstand the repetitive torque values specified in MIL-F-85720, and MS flareless fitting per ARP908, without failure or leakage. There shall be no leakage, galling, or other malfunction of the fitting nut and interface connection during the specified pressure test. The test method is specified in 4.6.13.
- 3.4.2.13 Electrical Conductivity: Hose assembly sizes up to -8 shall conduct a direct current equal to or greater than $6 \mu\text{A}$ and sizes -10 and above a direct current equal to or greater than $12 \mu\text{A}$ with a test potential of 1000 V DC. The test method is specified in 4.6.14.
- 3.4.3 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.
- 3.4.4 Tolerances on hose assembly lengths shall be as follows:
- ± 1.25 in for lengths under 18 in
 - ± 2.50 in for lengths from 18 to 36 in exclusive
 - ± 5.00 in for lengths from 36 to 50 in exclusive
 - $\pm 1\%$ for lengths of 50 in and over

3.5 Marking:

3.5.1 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.

3.5.2 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:

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

3.5.2.2 Assembly: A permanent marking on the fitting or a permanent band on the hose shall be used. 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 AS4098
- b. Cage code and complete hose assembly part number
- c. Operating pressure "5000 psi"
- d. Operating temperature "400 °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 (required only when hose manufacturer is different than hose assembly manufacturer)

3.6 Workmanship:

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

3.6.1 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.

3.6.2 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.

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 2. All specimens for each hose size are required for qualifying each of the methods of end fitting attachment and for each method of end fitting construction, bent tube, or forged. Simultaneous qualification of beam seal and MS flareless fittings may be accomplished by having fittings on one hose end beam seal and MS flareless fittings on the other end. If a supplier qualifies one end fitting outlet design and at a later date desires to qualify the other, two hose assemblies of each size 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 3 and, if applicable, 4.5.2.2.

TABLE 2 - Length of Hose Assemblies for Test (in inches)

Hose Assy Size	Six Assemblies for Impulse Test (4.6.9)	Two Assemblies for Flex Test (4.6.10)	Six Assemblies for Other Tests (4)
-4	15	19	18
-6	22.5	26.5	18
-8	26.5	30.0	18
-10	30.5	34.0	18
-12	36.0 (24.0*)	39.0	18
-16	44.0 (31.0*)	47.0	18
-20	55 (36.0*)	55.0	18

NOTES:

1. End fitting outlet design shall have beam seal fitting to mate with MIL-F-85720/1 or flareless fitting according to NAS 1760 to mate with MS33514.
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 end. All remaining test samples shall have straight-to-straight end fittings. (*) Reduced assembly length if testing is performed at 90° bend.
3. One additional sample of each size in lengths as shown in Figure 5 shall be used for examination and conductivity tests (Sample No. 16 Table 3).
4. Two additional samples of each size are required if tests in accordance with 4.5.2.2 are conducted.

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 be in accordance with MIL-STD-831 which shall include a report of all tests and outline description of the tests and conditions.
- b. Test Samples: Test samples when requested by the procuring activity. Samples subjected to qualification testing shall not be shipped as part of contract or order.
- c. Drawings: Three sets of assembly and subassembly drawings. The assembly drawings shall have a cut-away section showing all details in their normal assembly position and shall define all details and subassemblies.
- d. Sources: List of sources of hose or hose components, including source's name and product identification for inner tube, hose, and assembly.

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.

TABLE 3 - Qualification Test Schedule

Sample No.	Tube 1	Assemblies 2	Assemblies 3	Assemblies 4	Assemblies 5	Assemblies 6	Assemblies 7	Assemblies 8	Assemblies 9	Assemblies 10-15	Assemblies 16
Paragraph	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	4.6.14
		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	
		4.6.10	4.6.10	4.6.12	4.6.12	4.6.8	4.6.8	4.6.7			
		4.6.13	4.6.13	4.6.7	4.6.7						

NOTE:

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

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-H-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, 3.6.2).

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 manufactured under essentially the same conditions, but not necessarily during one continuous run. One hose assembly tested from each lot of 375 hose assemblies is also permitted.

- a. Internal cleanliness (AS611, Class 0)
- b. Leakage tests (see 4.6.6)
- c. Room - temperature burst pressure test (see 4.6.7)
- d. Specific gravity tests (apparent and relative) (see 4.6.2.4)

4.4.3 Periodic Control Tests: The following inspections and tests shall be performed as indicated on eight hose assemblies manufactured from bulk hose lengths selected at random from each periodic control lot. The periodic control lot shall consist of not more than 20 000 ft of hose, all of one dash number size, 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 2 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)

NOTE: Impulse test assemblies may have straight fittings on both ends.

4.4.3.2 Four hose assemblies or one hose assembly from a lot of 5000 ft in accordance with Table 2 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), before it can be resubmitted for tests, full particulars concerning the cause of previous rejection and the action taken to correct the defects in the lot shall be furnished, in writing, by the contractor.

4.4.5 Inspection Procedure: All inspection plans shall be single sample plans with an accept number of zero.

4.4.6 Destructive Test Sample: Prior to testing, a letter "D" shall be permanently marked on each end fitting of those 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 test sequence specified in Table 3 on test sample configurations as specified in Table 2. Satisfactory completion of qualification tests shall also constitute qualification approval for hose assemblies having other 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 2.:

4.5.2.2 If test samples have all one type end fitting (beam seal or flareless) and qualification approval is desired for other type end fitting, two additional hose assemblies with the other type fitting end and of the 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. Repetitive torque test (see 4.6.13)
- e. Room temperature burst pressure test (see 4.6.7)

4.5.2.3 Oil Aging: In all tests using oil aged samples, the hose assemblies shall be filled with a high temperature test fluid and soaked in an air oven at a temperature of 400 °F 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 400 °F 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 specified, the test fluid shall be MIL-H-83282 hydraulic fluid, MIL-L-7808 lubricating oil, or equivalent, unless otherwise specified by the user.

Unless otherwise specified, all pressures shall have a tolerance of -0/+5%.

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 male fitting end in accordance with MIL-F-85720/1 or MS 33514, and utilizing the installation torque range specified in MIL-F-85720 or ARP908 (as applicable), the use of test fluid as a lubricant for MS flareless fitting is permitted.

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 reinforcing wires or any evidence of malfunction which shall be cause for rejection. Crossed over reinforcing wires 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 AS2078, 3.3. The flattening gap, rounding gap, and proof pressure values shall be as specified for 3000 psi and higher. The test media shall be air or water (see 3.4.1.1 and 3.4.1.2).
- 4.6.2.2 Tensile Strength: The tube shall be subjected to the tensile strength test in accordance with AS2078, 3.2 (see 3.4.1.3).
- 4.6.2.3 Elongation: The tube shall be subjected to the elongation in accordance with AS2078, 3.2 (see 3.4.1.4).
- 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 AS2078, 3.1 (see 3.4.1.5).
 - 4.6.2.4.2 Relative Specific Gravity: Relative specific gravity shall be determined in accordance with AS2078, 3.1 (see 3.4.1.5).

NOTE: When test samples are prepared from braided hose, the braid impression must be removed prior to testing.

- 4.6.3 Proof Pressure Test: All hose assemblies shall be pressure tested to the values specified in Table 1B in accordance with AS2078, 4.8. 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 other evidence of malfunction, shall constitute failure (see 3.4.2.1).
- 4.6.4 Elongation and Contraction Test: Two hose assemblies of each size shall be subjected to the elongation and contraction test in accordance with AS2078, 4.5 (see 3.4.2.2).

- 4.6.5 Volumetric Expansion Test: Two hose assemblies of each size shall be tested in accordance with AS2078, 4.6 (see 3.4.2.3).
- 4.6.6 Leakage Test: Two hose assemblies of each size shall be leakage tested in accordance with AS2078, 4.7. Any evidence of leakage from hose or fitting, hose burst, fitting blow-off, or any other evidence of malfunction shall constitute failure (see 3.4.2.4).
- 4.6.7 Room Temperature Burst Pressure Test: Three hose assemblies of each size shall be subjected to a room temperature burst test in accordance with AS2078, 4.9 and 4.9.1. The assemblies shall be observed throughout the test and the type of failure and the pressure where failure occurred shall be recorded (see 3.4.2.5).
- 4.6.8 Thermal Shock Test: The thermal shock test shall be as follows:
- 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 thermal shock test in accordance with AS2078, 4.17 (see 3.4.2.6)
- 4.6.9 Impulse Test: Impulse testing shall be performed on six straight-to-90° elbow hose assemblies of each size.
- Two assemblies shall be oil aged, two shall be air aged, and two shall be unaged. The assemblies shall then be subjected at room temperature to the proof pressure specified in Table 1B for a minimum of 5 min.
 - The hose assemblies shall then be pressurized to 5000 psi and while maintaining this pressure at room temperature, the hose assemblies shall be immersed in a 3.5% \pm 0.1% U.S.P. Grade NaCl solution by weight 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. (See Note a.)
 - The test assemblies shall be connected to rigid supports and bent in a U-shape as per Figure 1 with a bend radius at the apex of the bend as specified in Table 1A, except that size -12 and larger may be bent in a 90° shape at a reduced length as noted in Table 2 to reduce fluid volume.
 - Assemblies shall be impulse tested in accordance with AS2078, 4.10 (see 3.4.2.7).

NOTES:

- The U.S.P. Grade sodium chloride (NaCl) shall contain on a dry basis not more than 0.1% sodium iodine and not more than 0.5% total impurities.
- It is preferred that testing be continuous with a minimum number of shutdowns to accommodate shift schedules and maintenance.

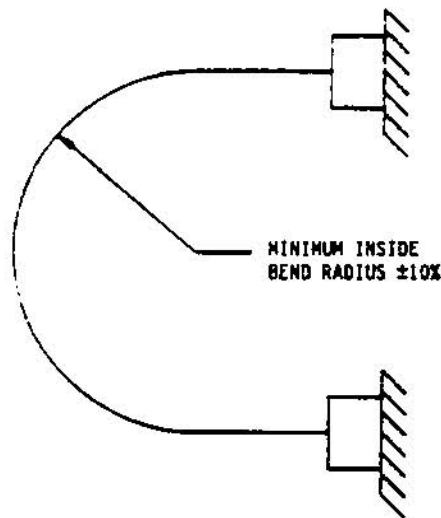


FIGURE 1 - Impulse Test Setup

- 4.6.10 Assembly Flexure Test: Two hose assemblies of each size shall be mounted in the assembly flexure test setup as defined in Figure 2 and subjected to the flexure testing in accordance with AS2078, 4.11 (see 3.4.2.8).
- 4.6.11 Stress Degradation Test: Two hose assemblies of each size shall be subjected to the stress degradation test in accordance with AS2078, 4.1.1 except that the assemblies shall be flushed with solvent per PD 680 in lieu of trichlorotrifluoroethane (see 3.4.2.9).
- 4.6.12 Pneumatic Effusion Test: Two hose assemblies of each size shall be used for this test. The assemblies shall be subjected to the pneumatic effusion test in accordance with AS2078, 4.2 (see 3.4.2.11).

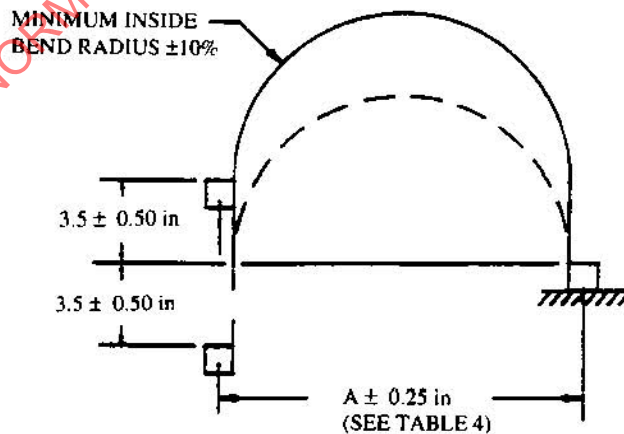


FIGURE 2 - Flexure Test Setup