SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS1946 | REV. C

Issued 1990-07
Reaffirmed 1994-04
Revised 2013-01

Superseding AS1946B

Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, Up to 1500 psi and 450 °F, Hydraulic and Pneumatic

RATIONALE

Added periodic testing requirements for fire resistant hose assemblies.

1. SCOPE

1.1 Application

This SAE Aerospace Standard (AS) defines the requirements for polytetrafluoroethylene (PTFE) lined, metallic reinforced, hose assemblies suitable for use in aerospace hydraulic, fuel and lubricating oil systems at temperatures between -67 °F and 450 °F for Class I assemblies, -67 °F and 275 °F for Class II assemblies, and at nominal pressures up to 1500 psi. The hose assemblies are also suitable for use within the same temperature and pressure limitations in aerospace pneumatic systems where some gaseous diffusion through the wall of the PTFE liner can be tolerated.

The use of these hose assemblies in pneumatic storage systems is not recommended. In addition, installations in which the limits specified herein are exceeded, or in which the application is not covered specifically by this standard, for example oxygen, shall be subject to the approval of the procuring activity.

1.2 Classification

1.2.1 Hose assemblies furnished under this document shall be of the following classes:

a. Class I: All corrosion resistant steel, or nickel alloy or titanium combination fittings, 450 °F

b. Class II: Combination aluminum alloy and corrosion resistant steel fittings, 275 °F, size -08 and larger

1.2.2 Hose assemblies furnished under this document may be of the following types. If no type is defined, then Type A shall prevail.

a. Type A: Permanently attached fittings

b. Type B: Field attachable (re-usable) fittings, size -04 and larger

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2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2486 Conversion Coating of Titanium Alloys, Fluoride-Phosphate Type

AMS4069 Aluminum Alloy, Drawn, Round Seamless Tubing, Close Tolerance, 2.5Mg - 0.25Cr (5052-0) Annealed

AMS4082 Aluminum Alloy, Seamless Drawn Tubing, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6) Solution and Precipitation Heat Treated

AMS4117 Aluminum Alloy, Rolled or Cold Finished Bars, Rods, and Wire and Flash Welded Rings, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061; -T6, -T651) Solution and Precipitation Heat Treated

AMS4121 Aluminum Alloy, Bars, Rods, and Wire, Rolled or Cold Finished, 4.5Cu - 0.85Si - 0.80Mn - 0.50Mg (2014-T6) Solution and Precipitation Heat Treated

AMS4127 Aluminum Alloy, Forgings and Rolled or Forged Rings, (6061-T6) Solution and Precipitation Heat Treated

AMS4339 Aluminum Alloy, Rolled or Cold Finished Bars and Rods, 4.4Cu - 1.5Mg - 0.60Mn (2024-T851) Solution Heat Treated, Cold Worked, and Artificially Aged

AMS4928 Titanium Alloy, Bars, Wire, Forgings, Rings, and Drawn Shapes, 6Al - 4V, Annealed

AMS4944 Titanium Alloy Tubing, Seamless, Hydraulic, 3.0Al - 2.5V, Cold Worked, Stress Relieved

AMS4945 Titanium Alloy Tubing, Seamless, Hydraulic, 3Al - 2.5V, Controlled Contractile Strain Ratio, Cold Worked, Stress Relieved

AMS4965 Titanium Alloy, Bars, Wire, Forgings, and Rings, 6.0Al - 4.0V, Solution Heat Treated and Aged

AMS5556 Steel, Corrosion and Heat-Resistant, Seamless or Welded Tubing, 18Cr - 11Ni - 0.70Cb (SAE 30347) Solution Heat Treated

AMS5557 Steel, Corrosion and Heat-Resistant, Seamless or Welded Hydraulic Tubing, 18.5Cr - 10.5Ni - 0.40Ti (SAE 30321), Solution Heat Treated

AMS5561 Steel, Corrosion and Heat-Resistant, Welded and Drawn or Seamless and Drawn tubing, 9.0Mn - 20Cr - 6.5Ni - 0.28N, High-Pressure Hydraulic

AMS5567 Steel, Corrosion Resistant, Seamless or Welded Hydraulic Tubing, 19Cr - 10Ni (SAE 30304), Solution Heat Treated

AMS5573 Steel, Corrosion and Heat-Resistant, Seamless Tubing, 17Cr - 12Ni - 2.5Mo (SAE 30316), Solution Heat Treated

AMS5581	Nickel Alloy, Corrosion and Heat-Resistant, Seamless or Welded Tubing, 62Ni - 21.5Cr - 9.0Mo - 3.7Cb (Nb), Annealed
AMS5639	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 19Cr - 10Ni, Solution Heat Treated
AMS5643	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 16Cr - 4.0Ni - 0.30Cb - 4.0Cu, Solution Heat Treated, Precipitation Hardenable
AMS5644	Steel Bars and Forgings, Corrosion Heat Resistant, 17Cr - 7Ni - 1Al
AMS5645	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing, and Rings, 18Cr - 10Ni - 0.40Ti (321), Solution Heat Treated
AMS5646	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 18Cr - 11Ni - 0.60Cb(Nb) (347), Solution Heat Treated
AMS5647	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 19Cr - 9.5Ni, Solution Heat Treated
AMS5648	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 17Cr - 12Ni - 2.5Mo (316), Solution Heat Treated
AMS5653	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 17Cr - 12Ni - 2.5Mo (0.030 Max C) (316L), Solution Heat Treated
AMS5656	Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, and Rings, 9.0Mn - 20Cr - 6.5Ni - 0.27N Solution Heat Treated
AMS5659	Steel, Corrosion-Resistant, Bars, Wire, Forgings, Rings, and Extrusions, 15Cr - 4.5Ni - 0.30Cb (Nb) - 3.5Cu, Consumable Remelted, Precipitation Hardenable
AMS5666	Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, Extrusions, and Rings, 62Ni - 21.5Cr - 9.0Mo - 3.65 (Cb [Nb]+Ta), Annealed
AMS5689	Steel, Corrosion and Heat Resistant, Wire, 18Cr - 10.5Ni - 0.40Ti (SAE 30321), Solution Heat Treated
AMS5690	Steel, Corrosion and Heat Resistant, Wire, 17Cr - 12Ni - 2.5Mo (SAE 30316), Solution Heat Treated
AMS5697	Steel, Corrosion-Resistant, Wire, 19Cr - 9.5Ni (SAE 30304), Solution Heat Treated
AMS5743	Steel, Corrosion and Heat-Resistant, Bars and Forgings, 15.5Cr - 4.5Ni - 2.9Mo - 0.10N, Solution Heat Treated, Sub-Zero Cooled, Equalized, and Over-Tempered
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steels
AS150	Hose Assembly, Type Classifications of, Basic Performance and Fire Resistance
AS611	Hose Assembly and Tubing, Polytetrafluoroethylene, Cleaning Methods for
ARP908	Torque Requirements, Installation and Qualification Test, Hose and Tube Fitting
AS1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings, and Similar System Components
AS1072	Sleeve, Hose Assembly, Fire Protection
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies

AS2078 Test Methods, Hose Assemblies, Polytetrafluoroethylene (PTFE)

AS4207 Fitting End, External Thread, Beam Seal, Design Standard

AS4209 Fitting End Assembly, Internal Thread, Beam Seal, Design Standard

AS4375 Fitting End, Flareless, Design Standard

AS4395 Fitting End, Flared, Tube Connection, Design Standard

AS7003 Nadcap Program Requirements

AS7112 National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components

AS8879 Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

AS33514 Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal

AS85421 Fittings, Tube, Fluid Systems, Separable, Beam Seal, 3000/4000 psi, General Specification for

AS85421/1 Fitting End, Standard Dimensions for Dynamic Beam Seal, Male

2.2 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture

ASME Y14.24 Types and Applications of Engineering Drawings

ASME Y14.34M Parts Lists, Data Lists, and Index Lists: Associated Lists

ASME Y14.35M Revision of Engineering Drawings and Associated Documents

ASME Y14.100 Engineering Drawing Practices

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 262 Standard Recommended Practices for Detecting Susceptibility to Intergranular Attack in Stainless Steel

ASTM A 313 Standard Specification for Stainless Steel Spring Wire

ASTM D 471 Standard Test Method for Rubber Property - Effect of Liquids

ASTM A 580 Specification for Stainless and Heat Resisting Steel Wire

2.4 NAS Standards

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS 847 Caps and Plugs, Protective, Dust and Moisture Seal

NAS 1760 Fitting End, Flareless Acorn, Standard Dimensions for

2.5 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2001 Qualified Product Management Council Procedures for Qualified Products Group

PD2101 Aerospace Quality Assurance, Product Standard, Qualification Procedures, Fluid Systems

2.6 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-9495, https://assist.daps.dla.mil/quicksearch/.

MIL-A-8625 Anodic Coatings for Aluminum and Aluminum Alloys

MIL-HDBK-831 Preparation of Test Reports

MIL-PRF-680 Degreasing Solvent

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft; Missile and Ordnance

MIL-PRF-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537

MIL-PRF-87257 Hydraulic Fluid, Fire Resistant; Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile

MIL-STD-130 Identification Marking of U.S. Military Property

2.7 Order of Precedence

In the event of a conflict between the text of this specification and the reference cited herein, the text of this specification shall take precedence.

2.8 Hose Assembly Procurement Specifications

Refer to AS1946SUP1 for a listing of applicable hose assembly part standards applicable to this document.

3. TECHNICAL REQUIREMENTS

3.1 Qualification

Hose assemblies supplied in accordance with this document shall be representative of products which have been subjected to and which have successfully passed the qualification tests specified in this standard.

3.1.1 Manufacturer Qualification

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of PD2101, AS7003 and AS7112, and shall be listed in a Performance Review Institute (PRI) Qualified Manufacturers List (QML).

3.1.2 Product Qualification

All products shall conform to the requirements of this procurement specification and shall be approved in accordance with the requirements of PD2001 and PD2101 for listing in a PRI Qualified Products List (QPL).

3.2 Material

The hose assemblies shall be uniform in quality and free from defects in material as is consistent with good manufacturing practice, and shall conform to the applicable specifications and requirements specified in this standard. All materials not specifically described herein shall be of the highest quality and suitable for the purposes intended.

3.2.1 Metals

Metals used in the hose shall be corrosion-resistant steel, and fittings shall be aluminum alloy, corrosion-resistant steel, titanium, or nickel alloy suitably treated to resist corrosion when in storage or during normal service use. Metals used in the hose and fittings shall be as listed below:

a. Bars and Forgings:

Corrosion resistant steel, austenitic, annealed or as rolled

1. AMS5639 304
2. AMS5647 304L

Heat stabilized corrosion resistant steel, austenitic, annealed or as rolled

3. AMS5645 321
4. AMS5646 347
5. AMS5648 316
6. AMS5653 316L
7. AMS5656 21-6-9

Precipitation hardening corrosion resistant steel - resolution heat treated and artificially aged condition

8. AMS5659 15-5PH
9. AMS5643 17-4PH
10. AMS5644 17-7PH
11. AMS5743 AM-355

Titanium

12. AMS4928 6Al-4V Annealed

13. AMS4965 6Al-4V Solution Heat Treated and Aged

Nickel Alloy

14. AMS5666 Type 625

Aluminum Alloy

15. AMS4121 2014-T6

16. AMS4339 2024-T851

17. AMS4117 6061-T6, -T651

18. AMS4127 6061-T6

b. Tubing:

Aluminum Alloy

1. AMS4069 Seamless, 5052-0

2. AMS4082 Seamless, 6061-T6

Corrosion resistant steel, austenitic, seamless or welded, annealed

3. AMS5567 Type 1 or Type 2, 304

Heat stabilized corrosion resistant steel, austenitic, seamless or welded

4. AMS5557 Type 1 or Type 2, 321

5. AMS5556 Type 1 or Type 2, 347

6. AMS5561 21-6-9

7. AMS5573 Seamless, 316

Titanium

8. AMS4944 3Al-2.5V

9. AMS4945 3Al-2.5V Texture Controlled

Nickel Alloy

10. AMS5581 Type 625

c. Wire:

Corrosion resistant steel, austenitic, cold drawn

1. ASTM A 580/A 313 Comp. 304 (AMS5697)
2. ASTM A 580/A 313 Comp. 316 (AMS5690)
3. ASTM A 580/A 313 Comp. 321 (AMS5689)

3.3 Design and Construction

The hose assembly shall consist of a seamless PTFE inner tube, corrosion-resistant steel-wire reinforcement, and aluminum, corrosion-resistant steel, titanium, or nickel alloy 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 gage. It shall have a smooth bore and shall be free from pitting 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. The wires shall be so arranged over the inner tube as to provide sufficient strength to ensure conformance to the requirements specified herein. Broken reinforcing wires or buckled wires more than 0.06 in above the outside diameter surface shall be cause for rejection. Crossed-over reinforcing wires shall not be cause for rejection of the hose assembly.

3.3.3 Fittings

All fittings shall be proven to meet the requirements herein. The hose attachment fitting shall be of a permanent or of a reusable design, as applicable. Forgings are permitted. Standard hose assemblies shall have flared fittings according to AS1708 (single flared permitted) to mate with AS4395; flareless fittings according to NAS 1760 to mate with AS4375 or AS33514; or beam seal fittings according to AS4209 to mate with AS4207 or AS85421/1. Fitting hex portions shall fit standard wrench openings.

3.3.3.1 Insert Fittings

Insert fittings shall be of one piece construction whenever possible. Those made of other than one piece construction shall have either welded joints using butt-welded or lap-weld design, or braze joints using lap-braze design, and fabricated from annealed corrosion-resistant steel, titanium, nickel alloy, or aluminum alloy tubing. Welded and redrawn tubing may be used for corrosion-resistant steel.

3.3.3.2 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.

3.3.3.3 Fitting Finish

3.3.3.3.1 Aluminum Parts

Unless otherwise specified, aluminum parts shall be finished in accordance with MIL-A-8625, Type II, and dyed yellow on flareless parts and blue on flared parts. The color fastness requirement of MIL-A-8625 does not apply.

3.3.3.3.2 Corrosion-Resistant Steel Parts

Unless otherwise specified, corrosion-resistant steel parts shall be passivated in accordance with AMS-QQ-P-35.

3.3.3.3.3 Titanium Alloy Parts

Unless otherwise specified, titanium alloy fittings and nuts shall be fluoride phosphate coated per AMS2486.

3.4 Inner Tube Requirements

3.4.1 Specific Gravity

The specific gravity values of the hose inner tube shall not exceed 2.155 apparent and 2.210 relative when tested in accordance with AS2078.

3.4.2 Tensile Strength

When tested in accordance with AS2078, the longitudinal tensile strength for all sizes of tubes shall be 3000 psi minimum. The transverse tensile strength for sizes -10 and larger shall be 2500 psi minimum. For sizes under -10, the transverse strength need not be tested.

3.4.3 Elongation

When tested in accordance with AS2078, the elongation shall be a minimum of 200%.

3.4.4 Tube Roll

The tube shall not leak, split, burst, or show any evidence of malfunction, when tested through the sequence as specified in AS2078.

3.4.5 Tube Proof Pressure

Following tube roll test per 3.4.4, the tube, without reinforcing wires, shall not leak, burst, or show any evidence of malfunction when proof pressure tested as specified in AS2078.

3.4.6 Electrical Conductivity

When tested in accordance with AS2078, the electrical current of the inner tube shall be equal to or greater than 10 µA for sizes -03 through -08, and equal to or greater than 20 µA for sizes -10 and over.

3.5 Hose, Dimensional and Physical Requirements

3.5.1 Dimensions

The hose assembly dimensions, except for length, shall be as specified in Figure 1 and Table 1.

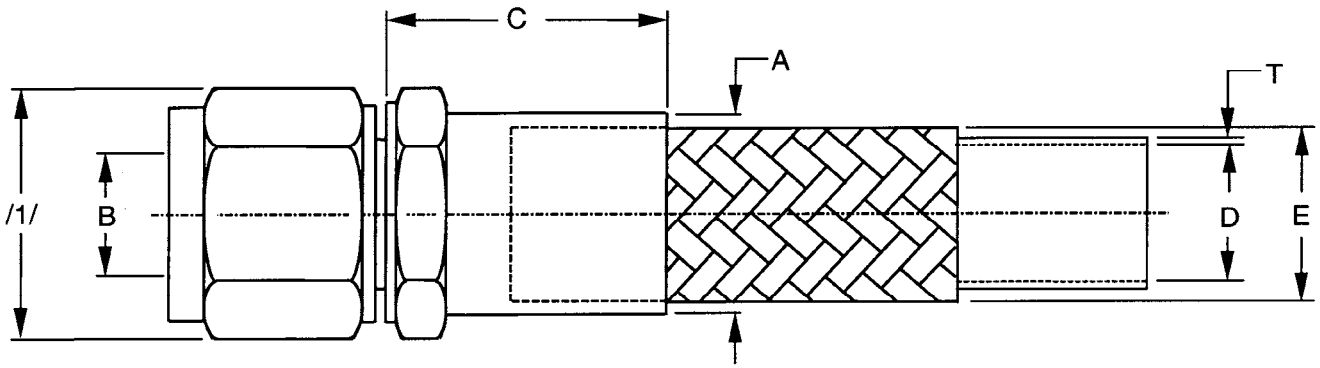


FIGURE 1 - HOSE AND FITTING DIMENSIONS

TABLE 1 - HOSE AND FITTING DIMENSIONS AS SHOWN IN FIGURE 1 (in)

Hose Size	Rigid Tube OD (Ref)	Fitting OD A Max	Fitting ID B[2] Min	Socket Length C Max	Hose ID D Min	Hose OD E Min	Hose OD E Max	Unbraided Inner Tube Wall T Min	Unbraided Inner Tube Wall T Max	Number of Braids	Spherical Ball Size for Determining Min Hose Assy ID[2] in Straight Fittings	Spherical Ball Size for Determining Min Hose Assy ID[2] in Elbow Fittings
03	0.188	0.49	0.080	1.25	0.110	0.234	0.285	0.035	0.047	1	0.072	0.068
04	0.250	0.55	0.132	1.25	0.173	0.304	0.374	0.035	0.047	1	0.119	0.112
05	0.312	0.63	0.193	1.35	0.235	0.367	0.417	0.035	0.047	1	0.174	0.164
06	0.375	0.70	0.256	1.45	0.298	0.430	0.500	0.035	0.047	1	0.230	0.218
08	0.500	0.83	0.340	1.72	0.391	0.546	0.614	0.038	0.050	1	0.306	0.289
10	0.625	0.97	0.430	1.93	0.485	0.641	0.799	0.042	0.054	1	0.387	0.366
12	0.750	1.17	0.548	2.16	0.615	0.766	0.906	0.042	0.054	1	0.493	0.466
16	1.000	1.52	0.778	2.50	0.851	1.078	1.140	0.042	0.054	2	0.700	0.661
20	1.250	2.00	1.000	2.55	1.101	1.328	1.390	0.045	0.057	2	0.900	0.850
24	1.500	2.28	1.250	2.68	1.344	1.637	1.707	0.065	0.077	2	1.125	1.063

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

3.5.2 Physical Requirements

Hose assemblies shall meet the physical and weight requirements specified in Table 2.

TABLE 2 - PHYSICAL REQUIREMENTS OF HOSE ASSEMBLIES AND WEIGHT OF HOSE

Hose Size	Hose Weight[1] Max lb/in	Operating Pressure psig	Proof Pressure psig	Burst Pressure Room Temp Min psig	Burst Pressure High Temp Min psig	Bend Radius at Inside of Bend in	Volumetric Expansion Max cm^3/in	Effusion (per 30 min) Max cm^3/ft	Effusion After Stress Degrad Max cm^3/in/min	Negative Pressure in Hg
03	0.005	1500	3000	12 000	7000	2.00	0.028	4.0	8.0	28
04	0.007	1500	3000	12 000	7000	2.00	0.028	4.0	8.0	28
05	0.008	1500	3000	10 000	6500	2.00	0.040	5.0	8.0	28
06	0.010	1500	3000	9000	6500	4.00	N/A	5.0	8.0	28
08	0.013	1500	3000	8000	6000	4.63	N/A	5.0	4.0	28
10	0.017	1500	3000	7000	5500	5.50	N/A	5.0	2.0	28
12	0.027	1000	2000	5000	3500	6.50	N/A	6.0	2.0	20
16	0.048	1250	2500	5000	3500	7.38	N/A	8.0	2.0	14
20	0.062	1000	2000	4000	3000	11.00	N/A	8.0	2.0	10
24	0.084	1000	2000	4000	3000	14.00	N/A	8.0	2.0	8

3.5.3 Bore Check

When bent to the appropriate minimum bend radius as specified in Table 2, the hose assembly shall permit the free passage of a solid rigid sphere throughout its length. The diameter of the sphere shall be as specified in Table 1 for the applicable end fitting type.

3.6 Screw Threads

Coupling nut threads shall be in accordance with AS8879. Thread tolerance increase of 10% during assembly or testing shall not be cause for rejection of the hose assembly.

3.7 Length

Tolerances on hose assembly lengths shall be as follows:

a. ±0.125 in for lengths under 18 in

b. ±0.250 in for lengths from 18 to 36 in exclusive

c. ±0.500 in for lengths from 36 to 50 in exclusive

d. ±1% for lengths of 50 in and over

3.8 Part Numbering of Interchangeable Parts

All parts complying with this standard and having the same manufacturer's or standard part number shall be functionally and dimensionally interchangeable. The item identification and part number requirement of ASME Y14.24, ASME Y14.34M, ASME Y14.35M, and ASME Y14.100 shall govern the manufacturer's part numbers and changes thereto.

3.9 Identification of Product

The assembly and its component parts shall be permanently 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 one element of all end fittings.

3.9.2 Assembly

A permanent marking shall be applied on a fitting or on a permanent band or bands securely attached on the hose. Marking bands shall be so designed as to remain tight on the hose to prevent relative movement and resultant chafing. The band shall be no wider than 1 in and shall not impair the flexibility or the performance of the hose. Unless otherwise specified, the marking on the fitting or band shall include the following information:

a. Assembly manufacturer's name or trademark and specification number

b. CAGE code and complete hose assembly part number

c. Operating pressure "1500 psi", or as applicable per Table 2

d. Operating temperature “450 °F” or 275 °F (as applicable)

e. Pressure test symbol "PT"

f. Date of hose assembly manufacture expressed in terms of month and year, or batch number

g. Hose manufacturer's CAGE code number (required only when hose manufacturer is different than hose assembly manufacturer)

h. Fire resistance type per AS1055, Type and Class, or AS150 and Type (when applicable)

3.10 Workmanship

The hose assembly, including all parts, shall be constructed and finished to good quality. All surfaces shall be free from burrs and sharp edges. All sealing surfaces shall be smooth, except that annular tool marks up to 100 µin Ra maximum per 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, moisture, cleaning solvents and other foreign materials, both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned per Class 0 of AS611 using approved alkaline cleaners only. Do not use chlorinated solvents.

3.11 Hose Assembly, Test and Performance Requirements

The hose, complete with reinforcing wires and assembled with end fittings, shall meet the following performance requirements:

3.11.1 Proof Pressure

All hose assemblies shall be subjected to the proof pressure test in accordance with AS2078. The hose assembly shall withstand the proof pressure listed in Table 2 without malfunction or leakage.

3.11.2 Elongation and Contraction

Two sample hose assemblies of each size shall be subjected to the elongation and contraction test in accordance with AS2078. The hose assembly shall not change in length by more than +2% or -3% in 10 in of hose length.

3.11.3 Volumetric Expansion

Two sample hose assemblies each of sizes -03, -04, and, -05 only shall be subjected to the volumetric expansion test in accordance with AS2078. The volumetric expansion of the hose assemblies shall not exceed the limits specified in Table 2.

3.11.4 Pneumatic Effusion

Two sample hose assemblies of each size shall be subjected to the pneumatic effusion test in accordance with AS2078. The hose assemblies shall not exceed the effusion rate as specified in Table 2.

3.11.5 Pneumatic Surge

Two sample hose assemblies of each size shall be subjected to the pneumatic surge test in accordance with AS2078. The inner tube of the hose assembly shall not collapse nor show evidence of degradation.

3.11.6 Fuel Resistance

Two sample hose assemblies of each size shall be subjected to the fuel resistance test in accordance with AS2078. The hose assemblies shall not leak or show evidence of degradation.

3.11.7 Impulse

3.11.7.1 Preconditioning

Six hose assemblies having a 90 degree elbow fitting on one end and a straight fitting on the other end shall be used for this test. If approval is sought for both the bent-tube and the forged-elbow configuration, then one-half of the samples as shown in Table 3 shall use the bent elbows, while the other half of the samples shall have the forged elbows.

TABLE 3 - QUALIFICATION TEST SEQUENCE AND NUMBER OF TEST SPECIMENS IN SAMPLE

Relevant Inspection/Test			Inner Tube	Hose	Sample Hose Assemblies Test Specimen No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
3.3	General Examination[1)]		X	X																							
3.4.1	Density and Relative Density[1)]		X																								
3.4.2	Tensile Strength[1)]		X																								
3.4.3	Elongation[1)]		X																								
3.4.4	Tube Roll[1)]		X	X																							
3.4.5	Proof Pressure[1)]		X	X																							
3.4.6	Electrical Conductivity[1)]		X																								
3.12	Braid Flare			X																							
3.5 to 3.10	General Examination				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.11.1	Proof Pressure				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.11.2	Elongation and Contraction							X							X												
3.11.3	Volumetric Expansion							X							X												
3.11.4	Pneumatic Effusion										X	X															
3.11.5	Pneumatic Surge										X	X															
3.11.6	Fuel Resistance						X	X																			
3.11.7	Impulse	Unaged																X	X								
		Air-aged																		X	X						
		Oil-aged																				X	X				
3.11.8	Stress Degradation												X	X													
3.11.9	Low-Temperature Flexing						X							X	X												
3.11.10	Leakage										X	X															
3.11.11	Corrosion								X	X																	
3.11.12	Repeated Installation				X	X																					
3.11.13	Burst Pressure at Room Temperature								X		X																
3.11.14	Burst Pressure at High Temperature									X		X															
3.11.15	Vacuum						X							X	X												
3.11.16	Pneumatic Leakage															X	X										
3.11.17	Electrical Conductivity																							X			
3.11.18	Fire Resistance (when required)																								X	X	X
Key: - X means one inspection/test																											

[1)] Production lot records may be used to verify conformance to these tests if the PTFE tube or hose assembly being used is an established production item.

3.11.7.2 Preparation

Two hose assemblies shall be oil aged, two shall be air aged, and two shall be unaged (see 4.5.2). The assemblies shall then be subjected at room temperature to the proof pressure specified in Table 2 for a minimum of 5 min.

The hose assemblies shall then be pressurized to operating pressure and while maintaining this pressure at room temperature, the hose assemblies shall be immersed in a 3.5% + 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.

NOTE: The U.S.P. Grade sodium chloride (NaCl) solution shall contain on a dry basis not more than 0.1% sodium iodine and not more than 0.5% total impurities

3.11.7.3 Requirement

The hose assemblies shall then be impulse tested in accordance with AS2078, except that sizes -16 and larger shall be tested straight, without bending. The hose assemblies shall show no evidence of leakage from hose or fitting prior to completion of 100 000 pressure impulse cycles.

NOTE: The high temperature portion of the impulse test shall be conducted at 400 °F.

3.11.8 Stress Degradation (Air Leakage)

a. Two hose assemblies of each size shall be subjected to this test. The hose assemblies shall be filled with high temperature test fluid conforming to MIL-PRF-7808 or MIL-PRF-83282.

b. The hose assemblies shall then be placed in an oven which shall be maintained at a temperature of 450 °F ± 10 °F. Precautions shall be taken to assure that the hose assemblies do not come in contact with parts of the oven that are at a higher temperature. A pressure equal to the rated operating pressure specified in Table 2 shall be applied to the hose assemblies.

c. After a minimum of 20 h at 450 °F, the pressure shall be gradually released and the assemblies shall be removed from the oven, drained and cooled to room temperature. The assemblies shall then be flushed with a quantity of new test fluid, equivalent in volume to a least twice the sample volume and drained.

d. The hose assemblies shall then be filled with MIL-PRF-87257 fluid. A pressure equal to the rated operating pressure specified in Table 2 shall be applied and held for a minimum of 2 h at room temperature.

e. The assemblies shall then be emptied and filled with oil or hydraulic fluid as specified in (a). The tests specified in paragraph (b), (c), and (d) shall be repeated.

f. The hose assemblies shall then be filled with ASTM Reference Fluid B (isooctane, 70%; toluene, 30%) as defined in ASTM D 471 fluid and individually capped. While at room temperature, the assemblies shall be bent around a mandrel having a radius equal to the minimum bend radius as specified in Table 2. The assemblies shall be bent around the mandrel and straightened for 20 cycles. The assemblies shall be held by the fitting while the bending is being performed. The tests specified in (a), (b), (c) and (d) shall be conducted for the third time.

g. Within 4 h after the final 2 h pressurization period with ASTM Reference Fluid B, the assemblies shall be drained and flushed with dry cleaning solvent per MIL-PRF-680 and placed in an oven for 1 h. The temperature of the oven shall be maintained at 160 °F ± 10 °F.

h. Within 8 h after completion of the drying process, 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 similar to that shown in Figure 2.

i. This test setup with the hose assembly installed shall be immersed in water containing no wetting agent. A pressure equivalent to the rated operating pressure specified in Table 2 shall be applied for a period of 15 min to allow any entrapped air in the hose to escape.

j. The pressure shall be held for an additional 5 min period. During this time effused gas shall be collected from the test sample which includes the juncture of the hose to the fitting, but not including the fitting nut. If after the 5 min period of pressurization, the average rate of effusion through the hose assembly exceeds the values listed in Table 2, it shall be cause for rejection and considered failure to qualify.

k. At the completion of the tests specified in (b) through (j), the hose assemblies shall be filled with oil and placed in a cold chamber for 8 h while maintained at -67 °F ± 2 °F. After the 8 h cold soak, the assemblies shall be subjected to a pressure equal to the operating pressure specified in Table 2. The pressure shall be held for a minimum of 5 min and then released. This shall be repeated for a total of 10 times with a minimum of 5 min between each pressure application and with the samples still in the -67 °F ± 2 °F cold chamber. At the end of this time oil at a temperature of 450 °F ± 10 °F shall be circulated through the hose assemblies. Within 15 s after introduction of the hot oil, the pressure shall be increased to the rated proof pressure specified in Table 2 and held for a minimum of 2 min. There shall be no evidence of leakage from the hose assembly.

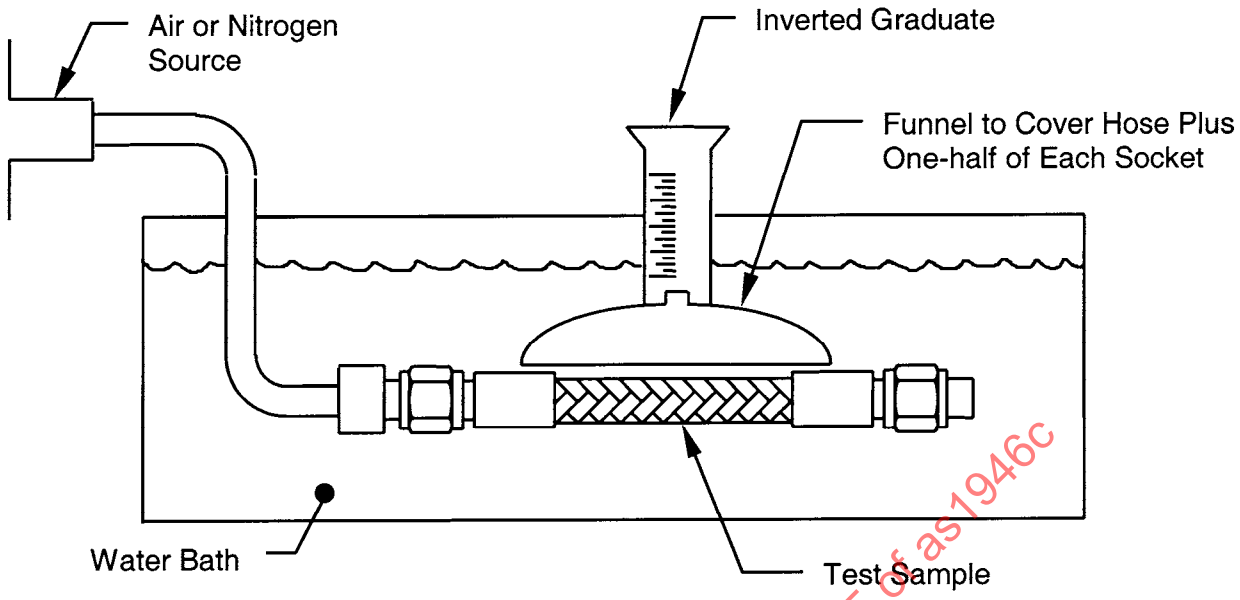


FIGURE 2 - TEST SETUP FOR PNEUMATIC EFFUSION TESTS

3.11.9 Low Temperature Flexibility

Three sample hose assemblies of each size shall be subjected to the low temperature flexing test in accordance with AS2078. The hose assembly shall show no damage after flexing.

3.11.10 Leakage

Two sample hose assemblies of each size shall be subjected to the leakage test in accordance with AS2078. The hose assembly shall not leak (no external wetting).

3.11.11 Corrosion

Two hose assemblies shall be tested in accordance with the following procedure. The hose assembly shall be pressurized to the operating pressure as specified in Table 2, and immersed in a 2.5% ± 0.1 NaCl solution for a period of 5 min then hot air dried at 140 °F for a period of 25 min. This cycle shall be repeated for a total of 172 h. Following completion, one assembly shall be room temperature burst tested per 3.11.13 and one assembly high temperature burst tested per 3.11.14.

3.11.12 Repetitive Assembly Torque

Two hose assemblies of each size shall be subjected to the repetitive torque test procedure per ARP908 with torque values as defined in AS85421 for beam seal fitting design and ARP908 for the flared and flareless design. The fittings shall withstand the repetitive assembly torque values 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.

3.11.13 Room Temperature Burst Test

Two hose assemblies shall be subjected to the room temperature burst pressure test in accordance with AS2078. The hose assembly shall not leak nor burst at any pressure below the room temperature burst value specified in Table 2.

3.11.14 High Temperature Burst Test

Two hose assemblies shall be subjected to the high temperature burst pressure test in accordance with AS2078. The hose assembly shall not leak nor burst at any pressure below the high temperature burst value specified in Table 2.

3.11.15 Vacuum

Three sample assemblies shall be subjected to the vacuum test in accordance with AS2078. The hose assembly shall not collapse or buckle. After completion of the test a spherical ball of a minimum diameter as shown in Table 4 shall be rolled freely through the length of the hose assembly.

TABLE 4 - SPHERICAL BALL SIZE FOR VERIFYING HOSE ID AFTER VACUUM TEST (in)

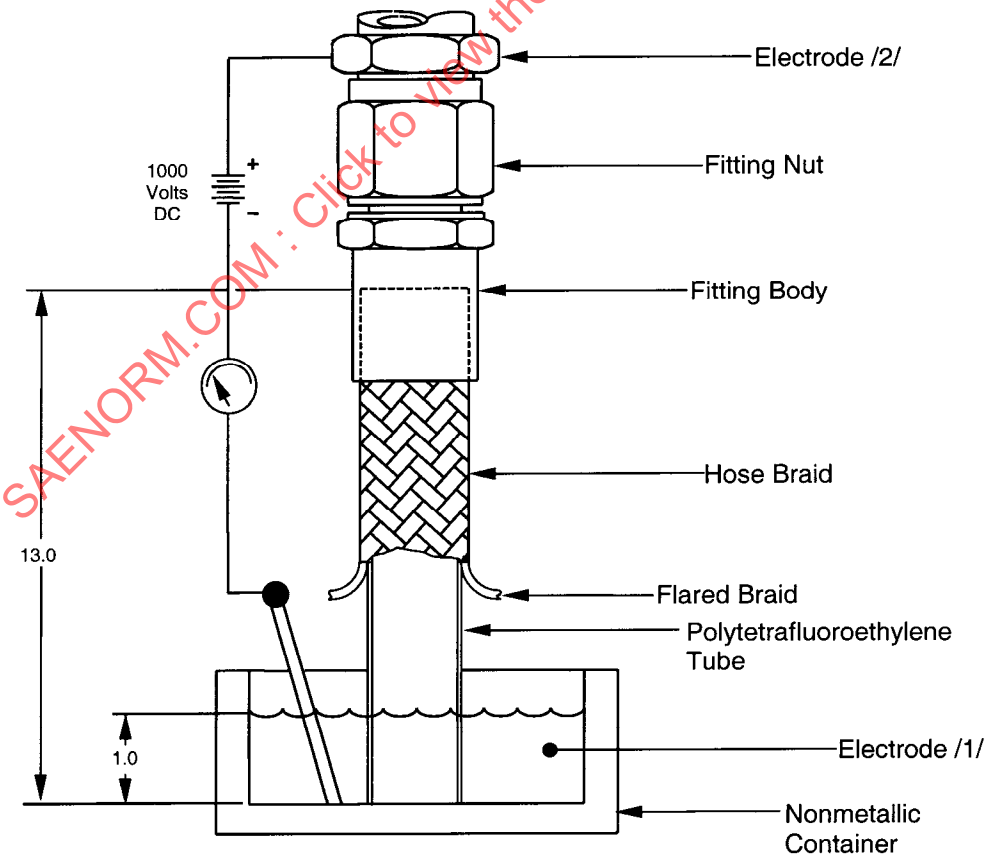
Hose Size	03	04	05	06	08	10	12	16	20	24
Ball Dia	0.075	0.125	0.188	0.250	0.312	0.406	0.531	0.750	1.00	1.25

3.11.16 Pneumatic Leakage

Two hose assemblies shall be subjected to the pneumatic leakage test in accordance with AS2078. Each assembly shall withstand the operating pressure listed in Table 2 without leakage. The test assemblies shall be prepared without the use of any oil during assembly.

3.11.17 Electrical Conductivity

One test specimen shall be subjected to the electrical conductivity test in accordance with AS2078 except that optional method of testing per Figure 3 is allowed. Hose assembly sizes -08 and smaller shall conduct a direct current equal to or greater than 6 µA and sizes -10 and above a direct current equal to or greater than 12 µA with a test potential of 1000 V DC.



NOTES:
/1/ Salt Water Solution
/2/ Mating Fitting Adapter

FIGURE 3 - OPTIONAL ELECTRICAL CONDUCTIVITY TEST DIAGRAM (in)

3.11.18 Resistance to Fire

a. When the hose assemblies are required to withstand a specified resistance to fire, three sample hose assemblies, which may be fitted with fire sleeves per AS1072 or an extrusion silicone fire sleeve, shall be tested in accordance with AS1055. Satisfactory qualification to this document and AS1055 meet the requirements of AS150 Type VII, as applicable.

b. The hose assemblies shall withstand the effects of the flame without leakage for the following periods as appropriate:

1. Fire resistant assemblies: 5 min

2. Fire proof assemblies: 15 min

3.12 Braid Flare. TYPE B

One hose sample of each size shall be sized by expanding the flared-out end over a plug having an expansion diameter as specified in Table 5. The plug shall be inserted into the flared-out end of the hose to a depth of 0.188 in and then removed. After this sizing operation, the sample shall be inserted through a ring that has an inside diameter as specified in Table 5 with the bottom of the flare extending 6 in above the top of the ring. From this position the sample shall pass by its own weight through the ring. The maximum braid flare shall not exceed the maximum flare diameter specified in Table 5.

TABLE 5 - BRAID FLARE DIMENSIONS (in)

Hose Size	Plug Expansion Diameter	Maximum Flare Diameter (Ring ID)
04	0.230	0.500
05	0.300	0.560
06	0.370	0.625
08	0.475	0.750
10	0.585	0.875
12	0.720	1.000
16Z	0.995	1.400
20Z	1.270	1.700
24Z	1.545	1.950

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 examination and testing of hose assemblies shall be classified as:

a. Qualification inspections (see 4.3)

b. Quality conformance inspections (see 4.4)

4.3 Qualification Inspections

4.3.1 Qualification Test Samples

Test samples shall consist of the number of samples specified in Table 3 and the specimen number and lengths shall be as specified in Table 6.

If a supplier qualifies one type end fitting sealing design as defined herein and desires to qualify another sealing design, two hose assemblies of each size to be qualified shall be subjected to the tests specified in 4.5.1.1.

TABLE 6 - LENGTH OF HOSE ASSEMBLIES FOR TEST (in)

Hose Assy Size	Six Assemblies for Impulse Test (3.11.7)	Thirteen Assemblies for Other Tests[1)]	One Hose Sample for Braid Flare Test (3.12)
03	14.0	18	12
04	14.0	18	12
05	16.0	18	12
06	18.0	18	12
08	21.0	18	12
10	23.5	18	12
12	27.5	18	12
16	18.0	18	12
20	18.0	18	12
24	18.0	18	12

[1)] One additional sample of each size in lengths as shown in Figure 3 shall be used for electrical conductivity tests (see 3.11.17).

4.3.2 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 made available if requested by the procuring activity:

a. Test Report: The test report shall be in accordance with MIL-HDBK-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.