SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS604 REV. D

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Reaffirmed 2007-01

Superseding AS604C

Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, 3000 psi, 400 °F, Heavyweight, Hydraulic

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

This Aerospace Standard (AS) defines the requirements for a heavy braid polytetrafluoroethylene (PTFE) lined, metallic reinforced, hose assembly suitable for use in high temperature, 400 °F, high pressure, 3000 psi, aircraft hydraulic fluid systems, also for use in pneumatic systems which allow some gaseous diffusion through the PTFE wall. The -20 size operating temperature is limited to 275 °F maximum.

2. REFERENCES:

2.1 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.

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

AMS 5556	Steel, Corrosion and Heat Resistant, Seamless or Welded Tubing, 18Cr 11Ni 0.70(Cb+Ta) (SAE 30347), Hydraulic, Solution Heat Treated
AMS 5557	Steel Tubing, Seamless and Welded, Corrosion and Heat Resistant, 18.5Cr 10.5Ni 0.40Ti (SAE 30321), Hydraulic, Solution Heat Treated
AMS 5567	Steel Tubing, Seamless or Welded, Corrosion Resistant, 19Cr 10Ni (SAE 30304), Hydraulic, Annealed
AMS 5561	Steel Tubing, Welded and Drawn, Corrosion and Heat Resistant, 9.0Mn 20Cr 6.5Ni 0.28N (SAE 21-6-9), High-Pressure Hydraulic
AMS 5570	Steel, Corrosion and Heat Resistant, Seamless Tubing, 18Cr 11Ni 0.40Ti (SAE 30321), Solution Heat Treated

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2.1.1 (Continued):

AMS 5571	Steel, Corrosion and Heat Resistant, Seamless Tubing, 18Cr 10.5Ni 0.70(Cb+Ta) (SAE 30347), Solution Heat Treated
AMS 5573	Steel, Corrosion and Heat Resistant, Seamless Tubing, 17Cr 12.5Ni 2.5Mo (SAE 30316), Solution Heat Treated
AMS 5575	Steel, Corrosion and Heat Resistant, Welded Tubing, 18Cr 10.5Ni 0.70(Cb+Ta) (SAE 30347), Solution Heat Treated
AMS 5581	Nickel Alloy, Corrosion and Heat Resistant, Seamless or Welded Tubing, 62Ni 21.5Cr 9.0Mo 3.7(Cb+Ta) (SAE Inconel 625), Annealed
AMS 5639	Steel Bars, Wire, Forgings, Tubing and Rings, Corrosion Resistant, 19Cr 10Ni (SAE 30304), Solution Heat Treated
AMS 5643	Steel, Corrosion Resistant, Bars, Wire, Forgings, Tubing and Rings, 16Cr 4.0Ni 0.30(Cb+Ta) 4.0Cu (SAE 17-4PH), Solution Heat Treated, Precipitation Hardenable
AMS 5644	Steel Bars and Forgings, Corrosion Resistant, 17Cr 7.0Ni 1.0Al (SAE 17-4PH)
AMS 5645	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing and Rings, 18Cr 10Ni 0.40Ti (SAE 30321), Solution Heat Treated
AMS 5646	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing and Rings, 18Cr 11Ni 0.60(Cb+Ta) (SAE 30347), Solution Heat Treated
AMS 5647	Steel, Corrosion Resistant, Bars, Wire, Forgings, Tubing and Rings, 19Cr 9.5Ni (SAE 304L), Solution Heat Treated
AMS 5648	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing and Rings, 17Cr 12Ni 2.5Mo (SAE 30316), Solution Heat Treated
AMS 5653	Steel, Corrosion and Heat Resistant, Bars, Wire, Forgings, Tubing and Rings, 17Cr 12Ni 2.5Mo (SAE 30316L), Solution Heat Treated
AMS 5659	Steel, Corrosion Resistant, Bars, Wire, Forgings, Rings and Extrusions, 15Cr 4.5Ni 0.30Cb 3.5Cu (SAE 15-5PH), Consumable Electrode Melted, Solution Heat Treated, Precipitation Hardenable
AMS 5666	Nickel Alloy, Corrosion and Heat Resistant, Bars, Forgings, Extrusions and Rings, 62Ni 21.5Cr 9.0Mo 3.65(Cb+Ta)(SAE Inconel 625), Annealed
AMS 5688	Steel, Corrosion Resistant, Wire, 18Cr 9.0Ni (SAE 30302) Spring Temper
AMS 5689	Steel, Corrosion and Heat Resistant, Wire 18Cr 10.5Ni 0.40Ti (SAE 30321), Solution Heat Treated
AMS 5690	Steel, Corrosion and Heat Resistant, Wire 17Cr 12Ni 2.5Mo (SAE 30316), Solution Heat Treated
AMS 5697	Steel, Corrosion Resistant, Wire 19Cr 9.5Ni (SAE 30304), Solution Heat Treated
AMS 5743	Steel, Corrosion and Heat Resistant, Bars and Forgings 15.5Cr 4.5Ni 2.9Mo 0.10N (SAE AM-355), Solution Heat Treated, Sub-Zero Cooled, Equalized, and Over-Tempered
AMS-QQ-P-35	Passivation Treatments for Corrosion-Resistant Steels
AMS-QQ-S-763	Steel Bars, Wire Shapes, and Forgings, Corrosion-Resisting
AS150	Hose Assembly, Type Classifications of, Basic Performance and Fire Resistance
AS611	Hose Assembly and Tubing, Polytetrafluoroethylene, Cleaning Methods
ARP908	Hose Fitting - Installation and Qualification Test Torque Requirements

2.1.1 (Continued):

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)
AS4375	Fitting End, External Thread, Flareless Design Standard
AS4395	End Fitting - Flared Tubing Connections, Design Standard
AS7003	National Aerospace and Defense Contractors Accreditation Program (NADCAP)
AS7112	National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components
AS8879	Screw Threads - UNJ Profile, Inch
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

2.1.2 ASTM Publications: Available from ASTM, 100 Barr Harbor, West Conshohocken, PA 19428-2959.

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 A 580	Specification for Stainless and Heat Resisting Steel Wire

2.1.3 NAS Standards: Available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005.

NAS 847	Caps and Plugs, Protective, Dust and Moisture Seal
NAS 1760	Fitting End, Flareless Acorn, Standard Dimensions for

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
MIL-HDBK-831	Preparation of Test Reports
MIL-H-5606	Hydraulic Fluid, Petroleum Based; Aircraft; Missile and Ordnance
MIL-PRF-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-F-85421/1	Fitting End, Standard Dimensions for Dynamic Beam Seal, Male
MIL-PRF-87257	Hydraulic Fluid, Fire Resistant; Low Temperature, Synthetic Hydrocarbon Base, Aircraft and Missile
MIL-STD-100	Engineering Drawings
MIL-STD-130	Identification Marking of U.S. Military Property

2.1.4 (Continued):

2.1.5 ASME Publications: Available from ASME, 22 Law Drive, Box 2900, Fairfield, NJ 07007-2900.

ASME B46.1 Surface Texture

2.1.6 PRI Publications: Available from Performance Review Institute, 161 Thornhill Road, Warrendale, PA 15086-7527 (www.pri.sae.org).

PD2001 Qualified Product Management Council Procedures for Qualified Products Group
PD2101 Aerospace Quality Assurance, Product Standard, Qualification Procedures, Fluid Systems

2.2 Hose Assembly Procurement Specifications:

Refer to AS604SUP1 for a listing of applicable hose assembly procurement 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 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 Performance Review Institute (PRI) Qualified Parts List (QPL).

3.2 Material:

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 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)	AMS-QQ-S-763	Class 304 - Cond. A or Cond. B (AMS 5639)
(2)	AMS-QQ-S-763	Class 304L - Cond. A (AMS 5647)
(3)	AMS-QQ-S-763	Class 316 - Cond. A (AMS 5648)
(4)	AMS-QQ-S-763	Class 316L - Cond. A (AMS 5653)
(5)	AMS-QQ-S-763	Class 321 - Cond. A (AMS 5645)
(6)	AMS-QQ-S-763	Class 347 - Cond. A (AMS 5646)
(7)	AMS 5643	17-4PH
(8)	AMS 5644	17-7PH
(9)	AMS 5659	15-5PH
(10)	AMS 5743	AM-355
(11)	AMS 5666	Nickel Alloy Type 625

b. Tubing:

(1)	AMS 5567	Type 1 or Type 2 Stainless Steel Tubing, 304
(2)	AMS 5573	Seamless Stainless Steel Tubing, 316
(3)	AMS 5557	Type 1 or Type 2 Stainless Steel Tubing, 321
(4)	AMS 5570	Seamless Stainless Steel Tubing, 321
(5)	AMS 5571	Seamless Stainless Steel Tubing, 347
(6)	AMS 5575	Welded Stainless Steel Tubing, 347
(7)	AMS 5556	Type 1 or Type 2 Stainless Steel Tubing, 347
(8)	AMS 5561	Welded Stainless Steel Tubing, 21-6-9
(9)	AMS 5581	Type 1 or Type 2 Nickel Alloy Tubing, 625

c. Wire:

(1)	ASTM A 580/ A 313	Comp. 302 (AMS 5688)
(2)	ASTM A 580/ A 313	Comp. 304 (AMS 5697)
(3)	ASTM A 580/ A 313	Comp. 316 (AMS 5690)
(4)	ASTM A 580/ A 313	Comp. 321 (AMS 5689)

3.3 Design and Construction:

The hose assembly shall consist of a seamless PTFE inner tube, corrosion-resistant steel-wire reinforcement, and corrosion-resistant steel or nickel alloy end fittings as required to meet the construction and performance requirements of this specification 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 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 Fittings: All fittings shall be permanently attached and proven to meet the requirements herein. Standard hose assemblies shall have flared fittings to mate with AS4395; flareless fittings according to NAS 1760 to mate with AS33514 or AS4375; or beam seal fittings per AS85421. Fitting hex portions shall fit standard wrench openings.

3.3.3.1 Straight Fittings: Straight fittings shall be of one piece construction. Weld or braze joints must not be located in the fluid paths, except welded and redrawn corrosion-resistant steel tubing in accordance with 3.2.1 may be used.

3.3.3.2 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 welded and redrawn corrosion-resistant steel tubing in accordance with 3.2.1 and shall employ a butt weld joint method.

3.3.3.3 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.

3.3.3.4 Fitting Finish:

3.3.3.4.1 Corrosion Resistant Steel Parts: Unless otherwise specified, corrosion resistant steel parts shall be passivated in accordance with AMS-QQ-P-35.

3.4 Dimensions:

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

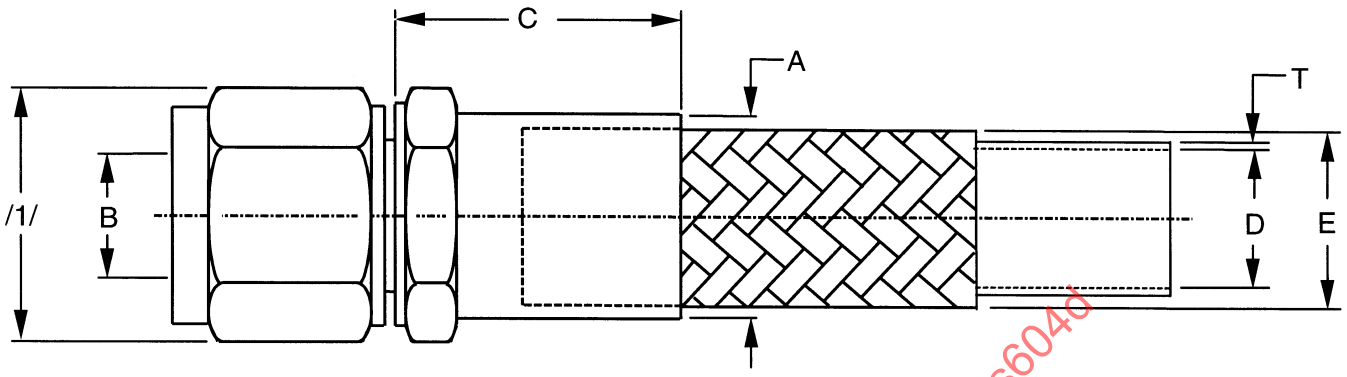

FIGURE 1 - Hose and Fitting Dimensions

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	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
04	.250	.875	.135	2.25	.212	.405	.465	.035	.122	.115
06	.375	1.000	.240	2.50	.298	.535	.595	.035	.216	.204
08	.500	1.200	.340	2.75	.391	.675	.735	.045	.306	.289
10	.625	1.406	.410	3.00	.485	.875	.935	.045	.369	.349
12	.750	1.687	.510	3.25	.602	1.030	1.090	.045	.459	.434
16	1.000	2.000	.760	3.75	.852	1.350	1.410	.050	.684	.646
20	1.250	2.100	.925	3.88	1.101	1.560	1.650	.050	.833	.786

[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.

3.4.1 Hose Weight: Hose consisting of inner tube and reinforcement as outlined in 3.3.1 through 3.3.2 shall not exceed the maximum hose weights specified in Table 2.

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

Hose Size	(Nominal Tube Size)	Hose Weight Max[1] lbs/in	Operating Pressure psi	Proof Pressure psi	Burst Pressure Room Temperature Minimum psi	Burst Pressure High Temperature Minimum psi	Bend Radius at Inside of Bend Minimum in	Volumetric Expansion Maximum cm^3/in
04	.250	.012	3000	6000	16 000	12 000	3.00	.065
06	.375	.028	3000	6000	14 000	10 500	5.00	.085
08	.500	.040	3000	6000	14 000	10 500	5.75	.135
10	.625	.062	3000	6000	12 000	9000	6.50	.220
12	.750	.086	3000	6000	12 000	9000	7.75	.300
16	1.000	.140	3000	6000	12 000	9000	9.63	.750
20	1.250	.180	3000	6000	12 000	9000	12.00	1.000

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

3.5 Performance:

The inner tube and hose assembly shall meet the following performance requirements:

3.5.1 Inner Tube:

3.5.1.1 Tube Roll: 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.

3.5.1.2 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.

3.5.1.3 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 -08 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 shall be a minimum of 200%. The test method is specified in 4.6.2.3.

3.5.1.5 Specific Gravity: The specific gravity values of the hose inner tube shall not exceed 2.155 apparent and 2.210 relative. The test method is specified in 4.6.2.4.

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

3.5.2.1 Proof Pressure: The hose assembly shall withstand the proof pressure listed in Table 2 without malfunction or leakage. The test method is specified in 4.6.3.

3.5.2.2 Elongation and Contraction: The hose assembly shall not change in length by more than ±2% in 10 inches of hose length when subjected to the operating pressure in Table 2 for a minimum of 5 min. The test method is specified in 4.6.4.

3.5.2.3 Volumetric Expansion: The volumetric expansion of the hose assemblies shall not exceed the limits specified in Table 2. The test method is specified in 4.6.5.

3.5.2.4 Leakage: The hose assembly shall not leak (no external wetting) when subjected to two pressure cycles of 70% of minimum room temperature burst pressure. The test method is specified in 4.6.6.

3.5.2.5 Thermal Shock: The hose assemblies shall not leak nor show any evidence of malfunction when subjected to the Table 2 proof and high temperature burst pressure, after being thermally shocked by rapidly increasing hose temperature from -65 to 400 °F for sizes -16 and smaller, and -65 to 275 °F for size -20. The test method is specified in 4.6.7.

3.5.2.6 Impulse: The hose assemblies shall show no evidence of leakage from hose or fitting prior to completion of 250,000 pressure impulse cycles. The test method is specified in 4.6.8.

3.5.2.7 Assembly Flexibility: The hose assembly shall not leak nor show any evidence of malfunction when subjected to the Table 2 proof pressure after 400,000 flexure cycles. The test method is specified in 4.6.9.

3.5.2.8 Stress Degradation (Air Leakage): The air leakage rate from the hose and two end fittings (not including "B" nuts) when held at the Table 2 operating pressure after completion of the stress degradation test shall not exceed 2.0 cm^3/in/min. The test method is specified in 4.6.10.

3.5.2.9 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 2 operating pressure to zero psi. The test method is specified in 4.6.11.

3.5.2.10 Pneumatic Effusion: The effusion rate for any hose size shall not exceed 8.0 cm^3/ft of hose length. The test method is specified in 4.6.12.

3.5.2.11 Repetitive Assembly Torque: The flared and flareless fittings shall withstand the repetitive assembly torque values specified in ARP908, and beam seal fittings per AS85421, 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.

3.5.2.12 Room Temperature Burst Test: The hose assembly shall not leak nor burst at any pressure below the room temperature burst value specified in Table 2. The test method is specified in 4.6.14.

3.5.2.13 Electrical Conductivity: 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. The test method is specified in 4.6.15.

3.6 Screw Threads:

Coupling nut threads shall be in accordance with AS8879 (ISO 3161). 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. ±.125 in for lengths under 18 in
b. ±.250 in for lengths from 18 to 36 in exclusive
c. ±.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 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 shall be applied on a fitting or on a permanent band, or bands, securely attached on the hose. 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 assembly specification AS604
b. CAGE code and complete hose assembly part number
c. Operating pressure "3000 psi"
d. Operating temperature "400 °F", as applicable (275 °F for size -20)
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)
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 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 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 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 3. 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 different types of end fittings may be accomplished by having fittings of one type on one hose end and fittings of another type 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 4.5.1.1.

TABLE 3 - Length of Hose Assemblies for Test (in)

Hose Assy Size	Six Assemblies for Impulse Test (4.6.8)	Two Assemblies for Flex Test (4.6.9)	Six Assemblies for Other Tests[1]
04	16	20	18
06	21	27	18
08	24	30	18
10	30	33	18
12	33 (20[2])	37	18
16	41 (25[2])	45	18
20	52 (32[2])	56	18

[1] One additional sample of each size in lengths as shown in Figure 4 shall be used for examination and electrical conductivity tests.

[2] Reduced assembly length if testing is performed at a 90° bend.

4.3.2 Qualification Test Sequence: Test sequence and procedure shall be as specified in Table 4 and, if applicable, 4.5.1.1.

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-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.

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 4A - Qualification Test Sequence and Number of Samples[1] (Inner Tube and Hose Assemblies 1-8)

	Inner Tube	Inner Tube	Hose Assembly 1	Hose Assembly 2	Hose Assembly 3	Hose Assembly 4	Hose Assembly 5	Hose Assembly 6	Hose Assembly 7	Hose Assembly 8
4.6.1.1 Examination of Product[2]	0	0								
4.6.2.1 Proof Pressure[2]	0	0								
4.6.2.1 Tube Roll[2]	0	0								
4.6.2.2 Tensile Strength[2]	0	0								
4.6.2.3 Elongation[2]	0	0								
4.6.2.4 Specific Gravity[2]	0	0								
4.6.1.2 Examination of Product			0	0	0	0	0	0	0	0
4.6.3 Proof Pressure			0	0	0	0	0	0	0	0
4.6.4 Elongation and Contraction			0	0						
4.6.5 Volumetric Expansion					0	0				
4.6.6 Leakage							0	0		
4.6.7 Thermal Shock							0	0		
4.6.8 Impulse: Unaged										
Air Aged										
Oil Aged										
4.6.9 Assembly Flexibility			0	0						
4.6.10 Stress Degradation									0	0
4.6.11 Pneumatic Surge									0	0
4.6.12 Pneumatic Effusion					0	0				
4.6.13 Repetitive Assy Torque			0	0						
4.6.14 Room Temp Burst Pressure					0	0				
4.6.15 Electrical Conductivity										
6.1.1 Fire Resistance (when required)										

[1] One circle "0" means one inspection.

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

TABLE 4B - Qualification Test Sequence and Number of Samples[1] (Hose Assemblies 9-18)

	Hose Assembly 9	Hose Assembly 10	Hose Assembly 11	Hose Assembly 12	Hose Assembly 13	Hose Assembly 14	Hose Assembly 15	Hose Assembly 16	Hose Assembly 17	Hose Assembly 18
4.6.1.1 Examination of Product[2]										
4.6.2.1 Proof Pressure[2]										
4.6.2.1 Tube Roll[2]										
4.6.2.2 Tensile Strength[2]										
4.6.2.3 Elongation[2]										
4.6.2.4 Specific Gravity[2]										
4.6.1.2 Examination of Product	0	0	0	0	0	0	0	0	0	0
4.6.3 Proof Pressure	0	0	0	0	0	0		0	0	0
4.6.4 Elongation and Contraction										
4.6.5 Volumetric Expansion										
4.6.6 Leakage										
4.6.7 Thermal Shock										
4.6.8 Impulse: Unaged	0	0								
Air Aged			0	0						
Oil Aged					0	0				
4.6.9 Assembly Flexibility										
4.6.10 Stress Degradation										
4.6.11 Pneumatic Surge										
4.6.12 Pneumatic Effusion										
4.6.13 Repetitive Assy Torque										
4.6.14 Room Temp Burst Pressure										
4.6.15 Electrical Conductivity							0			
6.1.1 Fire Resistance (when required)								0	0	0

[1] One circle "0" means one inspection.

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

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 consist of the following tests:

a. Individual tests (see 4.4.1) (100% inspection)
b. Sampling tests (see 4.4.2)
c. Periodic control tests (see 4.4.3)

4.4.1 Individual Tests: Each hose assembly shall be subjected to the following tests:

a. Examination of product (see 4.6.1)
b. Proof pressure test (see 4.6.3)

NOTE: Production samples that are proof pressure tested with water should be air dried prior to capping (see cleaning requirements, 3.10.2).

4.4.2 Sampling Tests: The following inspections and tests shall be performed in the order indicated on eight hose assemblies with straight fittings at each end selected at random from each inspection lot. The inspection 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 4.6.14)

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 inspection lot. The inspection 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 Assembly: Four hose assemblies or one hose assembly from a lot of 5000 ft in accordance with Table 3 shall be subjected to the following tests in the order indicated:

a. Elongation and contraction test (see 4.6.4)
b. Impulse test (see 4.6.8) (unaged samples only and may have straight fittings on both ends)

4.4.3.2 Assembly and Inner Tube: Four hose assemblies or one hose assembly from a lot of 5000 ft in accordance with Table 3 shall be subjected to the following tests in the order indicated:

a. Stress degradation test (see 4.6.10)
b. Electrical 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 (see 4.4.2 and 4.4.3).

4.5 Test Conditions:

4.5.1 Fitting Ends: Qualification tests shall be conducted on assemblies using straight type swivel ends, except for the impulse test samples requiring 90° elbow fitting at one end. 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.

4.5.1.1 Additional Fitting End Designs: If qualification approval is desired for other type end fitting, two additional hose assemblies with the type fittings 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 assembly torque test (see 4.6.13)
e. Room temperature burst pressure test (see 4.6.14)

4.5.2 Preparation of Sample:

4.5.2.1 Unless otherwise specified, length of sample assemblies shall be in accordance with Table 3.

4.5.2.2 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, except the maximum temperature for size -20 shall be 275 °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.

4.5.2.3 Air Aging: Air aged samples shall be kept in air at a temperature of 400 °F, except the maximum temperature for size -20 shall be 275 °F, for seven days.

4.5.2.4 Unaged Samples: Unaged assemblies shall be as manufactured.

4.5.3 Test Fluids: Unless otherwise specified, the pressure test fluid shall be hydraulic oil conforming to MIL-H-5606, MIL-PRF-87257 or water. Where a high temperature test fluid is specified, the test fluid shall be MIL-PRF-83282 hydraulic fluid, MIL-PRF-7808 lubricating oil, or equivalent, unless otherwise specified by the user.

4.5.4 Pressure Measurements: Unless otherwise specified, all pressures shall have a tolerance of ±100 psi.

4.5.5 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.

4.5.6 End Connections: Except as otherwise noted, each hose end shall be connected to a male fitting end in accordance with MIL-F-85421/1, AS4395, AS33514, or AS4375, lubricated with either MIL-PRF-87257 fluid or the test fluid and utilizing the installation torque range specified in AS85421 or ARP908, 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 specification with respect to material, size, workmanship, and dimensions.

4.6.1.2 Hose Assembly: All hose assemblies shall be visually inspected to determine conformance to this document with respect to material, size and workmanship. Broken or missing reinforcing wires or any evidence of malfunction 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. 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.

4.6.2.2 Tensile Strength: The tube shall be subjected to the tensile strength test in accordance with AS2078.

4.6.2.3 Elongation: The tube shall be subjected to the elongation in accordance with AS2078.

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. 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 AS2078.

4.6.3 Proof Pressure Test: All hose assemblies shall be pressure tested to the values specified in Table 2 in accordance with AS2078.

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.

4.6.5 Volumetric Expansion Test: Two hose assemblies of each size shall be subjected to the volumetric expansion test in accordance with AS2078.

4.6.6 Leakage Test: Two hose assemblies of each size shall be subjected to the leakage test in accordance with AS2078.

4.6.7 Thermal Shock Test: Two hose assemblies of each size shall be subjected to the thermal shock test in accordance with AS2078 except the maximum temperature for size -20 shall be 275 °F. One assembly shall be air aged and one assembly shall be unaged.

4.6.8 Impulse Test: Impulse testing shall be performed on six straight-to-90° elbow hose assemblies of each size.

a. Two hose 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 2 for a minimum of 5 min.

b. The hose assemblies shall then be pressurized to 3000 psi 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 iodide and not more than 0.5% total impurities.

c. The test assemblies shall be connected to rigid supports and bent in a U-shape as illustrated in Figure 2 with a bend radius at the apex of the bend as specified in Table 2, except that size -12 and larger may be bent in a 90° shape at a reduced length as noted in Table 3 to reduce fluid volume.

d. Assemblies shall be impulse tested in accordance with AS2078 except the maximum temperature for size -20 shall be 275 °F.

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

4.6.9 Assembly Flexibility Test: Two hose assemblies of each size shall be mounted in the assembly flexure test setup as illustrated in Figure 3 and subjected to the flexibility test in accordance with AS2078 except the maximum temperature for size -20 shall be 275 °F.

4.6.10 Stress Degradation Test: Two hose assemblies of each size shall be subjected to the stress degradation test in accordance with AS2078 except the maximum temperature for size -20 shall be 275 °F and the assemblies shall be flushed with solvent per P-D-680 in lieu of trichlorotrifluoroethane.