

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

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

AS 620

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REV.
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Submitted for recognition as an American National Standard

Supersedes AS 620B

HIGH TEMPERATURE HOSE ASSEMBLY, CONVOLUTED TETRAFLUOROETHYLENE-, FOR AIRCRAFT

1. **SCOPE:** This Aerospace Standard covers hose assemblies intended for use in aircraft high temperature fluid systems. The specified temperature range is -65°F (-54°C) to +400°F (204°C). Operating pressures are listed in Table I.

1.1 Classification:

- 1.1.1 The assemblies shall be of the following types:

Type I - Non-conductive Inner Tube
Type II - Conductive Inner Tube

- 1.1.2 The hose assemblies shall be of the following classes:

Class 1 - Liquid Proof Test
Class 2 - Pneumatic Proof Test

2. **APPLICABLE DOCUMENTS:** The following documents of the issue in effect on date of invitation for bids or request for proposals form a part of this specification to the extent specified herein.

2.1 Specifications:

2.1.1 Federal:

PPP-T-60 - Tape, Packaging, Waterproof
QQ-W-423 - Wire, Steel, Corrosion-Resisting
PPP-B-566 - Boxes, Folding, Paperboard
PPP-B-576 - Box, Wood, Cleated, Veneer, Paper Overlaid

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2.1.1 Cont'd

- PPP-B-585 - Boxes, Wood, Wirebound
- PPP-B-591 - Boxes, Shipping Fiberboard, Wood-Cleated
- PPP-B-601 - Boxes, Wood, Cleated-Plywood
- PPP-B-636 - Boxes, Shipping, Fiberboard
- PPP-B-665 - Boxes, Paperboard, Metal-Edged and Components
- PPP-B-676 - Boxes, Set-Up
- P-D-680 - Dry Cleaning Solvent
- QQ-S-763 - Steel Bars, Wire Shapes, and Forgings, Corrosion-Resisting
- TT-I-735 - Isopropyl Alcohol
- TT-S-735 - Standard Test Fluids, Hydrocarbons

2.1.2 Military:

- MIL-P-116 - Preservation - Packaging, Methods of
- MIL-C-5501 - Caps and Plugs, Protective, Dust and Moisture Seal, General Specification for
- MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
- MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5
- MIL-L-7808 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
- 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-S-8879 - Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification of
- MIL-L-10547 - Liners, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
- MIL-H-83282 - Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft

2.2 Standards:2.2.1 Military:

- MIL-STD-100 - Engineering Drawing Practices
- MIL-STD-129 - Marking for Shipment and Storage
- MIL-STD-130 - Identification Marking of U.S. Military Property
- MIL-STD-831 - Test Reports, Preparation of
- MS 21900 - Adapter, Flareless Tube to AN Flared Tube
- MS 33514 - Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
- MS 33656 - Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal

(Copies of documents required by suppliers in connection with specific procurement functions shall be obtained from the procuring activity or as directed by the Contracting Officer)

- 2.3 Other Publications: The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposals shall apply:

Uniform Classification Committee
Uniform Freight Classification Rules

(Application for copies of the above publications should be addressed to the Uniform Classification Committee, 202 Chicago Union Station, Chicago, IL 60606.)

American Society for Testing and Materials:

A 262 - Detecting Susceptibility to Intergranular Attack in Stainless Steels

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

Society of Automotive Engineers:

- AMS 5556 - Steel Tubing, Seamless or Welded, Corrosion and Heat Resistant
18 Cr - 11 Ni - 0.70 (Cb & Ta) (SAE 30347) Hydraulic
- AMS 5557 - Steel Tubing, Seamless and Welded, Corrosion and Heat Resistant
18.5 Cr - 10.5 Ni - 0.40 Ti (SAE 30321) Hydraulic
- AMS 5567 - Steel Tubing, Seamless and Welded, Corrosion Resistant
19 Cr - 10 Ni (SAE 30304) Hydraulic, Solution Treated
- AMS 5570 - Steel Tubing, Seamless, Corrosion and Heat Resistant
18 Cr - 11 Ni - 0.40 Ti (SAE 30321)
- AMS 5571 - Steel Tubing, Seamless, Corrosion and Heat Resistant
18 Cr - 11 Ni - 0.70 (Cb + Ta) (SAE 30347)
- AMS 5575 - Steel Tubing, Welded, Corrosion and Heat Resistant
18 Cr - 10.5 Ni - 0.70 (Cb + Ta) (SAE 30347)
- AMS 5636 - Steel Bars, Corrosion Resistant
18 Cr - 9.0 Ni (SAE 30302) Cold Drawn, 100,000 psi (690 MPa)
Tensile Strength
- AMS 5637 - Steel Bars, Corrosion Resistant
18 Cr - 9.0 Ni (SAE 30302), Cold Drawn, 125,000 psi (860 MPa)
Tensile Strength
- AMS 5639 - Steel Bars, Forgings, Tubing, and Rings, Corrosion Resistant
19 Cr - 10 Ni (SAE 30304)
- AMS 5643 - Steel Bars, Forgings, Tubing and Rings, Corrosion Resistant
16 Cr - 4.0 Ni - 0.30 (Cb + Ta) - 4.0 Cu
- AMS 5644 - Steel Bars and Forgings, Corrosion Resistant
17 Cr - 7 Ni - 1Al
- AMS 5645 - Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 18 Cr - 10 Ni - 0.40 Ti (SAE 30321)
- AMS 5646 - Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 18 Cr - 11 Ni - 0.60 (Cb + Ta) (SAE 30347)

- AMS 5688 - Steel Wire, Corrosion-Resistant
18 Cr - 9.0 Ni (SAE 30302) Spring Temper
- AMS 5689 - Steel Wire, Corrosion and Heat Resistant
18 Cr - 9.5 Ni - Ti (SAE 30321) Solution Heat-Treated
- AMS 5690 - Steel Wire, Corrosion and Heat Resistant
18.5 Cr - 13 Ni - 2.5 Mo (SAE 30316)
- AMS 5697 - Steel Wire, Corrosion-Resistant
19 Cr - 9.5 Ni (SAE 30304)
- AMS 5743 - Steel Bars and Forgings, Corrosion and Moderate Heat-Resistant
15.5 Cr - 4.5 Ni - 2.9 Mo - 0.10 N, Solution Heat-Treated,
Sub-zero Cooled, Equalized, and Over-Tempered
- ARP 611 - Tetrafluoroethylene Hose Assembly Cleaning Methods
- ARP 908 - Hose and Tube Fitting - Installation and Qualification Test
Torque
- AS 1633 - Hose Assembly, Convolute, Nonmetallic, TFE, Flareless, Straight
to Straight
- AS 1634 - Hose Assembly, Convolute, Nonmetallic, TFE, Flareless,
Straight to 45°
- AS 1635 - Hose Assembly, Convolute, Nonmetallic, TFE, Flareless,
Straight to 90°
- AS 1055 - Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings
and Similar System Components

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

National Aerospace Standards:

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

(Application for copies should be addressed to National Aerospace Standards Committee, 1725 DeSales Street, N.W., Washington, DC 20036.)

3. REQUIREMENTS:

- 3.1 Qualification: The hose assemblies furnished under this specification shall be products which are qualified by meeting all the requirements covered by this document.
- 3.2 Material: The hose assembly materials shall be uniform in quality, free from defects, consistent with good manufacturing practice and shall conform to applicable specifications and the requirements specified herein. All materials not specifically described herein shall be of the highest quality and suitable for the purpose intended.
- 3.2.1 Metals: Metals used in the hose and fittings shall be corrosion-resistant and shall conform to the following specifications:

Bars and Forgings:

QQ-S-763	Class 302 - Cond. A and Cond. B (AMS 5636 and AMS 5637)
QQ-S-763	Class 304 - Cond. A and Cond. B (AMS 5639)
QQ-S-763	Class 321 - Cond. A (AMS 5645)
QQ-S-763	Class 347 - Cond. A (AMS 5646)
AMS 5643	17-4 PH
AMS 5644	17-7 PH
AMS 5743	AM-355

Tubing:

MIL-T-8504	Comp. 304 (AMS 5567)
MIL-T-8808	Type I or Type II, Comp. 321 (AMS 5570 or AMS 5557)
MIL-T-8808	Type I or Type II, Comp. 347 (AMS 5571 or AMS 5575, AMS 5556)

Wire:

QQ-W-423	Comp. 302 (AMS 5688)
QQ-W-423	Comp. 304 (AMS 5697)
QQ-W-423	Comp. 316 (AMS 5690)
AMS 5689	Comp. 321 (QQ-W-423, Form 1, Comp. 321)

- 3.3 Construction: The hose assembly shall consist of a convoluted tetrafluoroethylene inner tube, which may be covered with convoluted woven glass cloth and or other suitable materials, corrosion-resistant steel-wire reinforcement, and corrosion-resistant steel end fittings as required for the intended installation.
- 3.3.1 Inner Tube: The inner tube shall be of a convoluted construction of virgin tetrafluoroethylene resin designed to promote easy bending. It shall be free from pitting or projections on the inner surface. Additives may be included in the compound from which the tube is fabricated.
- 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 all fluids with which the hose may come in contact during normal service. They shall be capable of withstanding temperatures of -65°F (-54°C) to 400°F (204°C) 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 flared fittings to mate with MS 33656 or flareless fittings according to NAS 1760 to mate with MS 33514 in accordance with applicable SAE Standards (see 2.3). Fitting hex portions shall fit standard wrench openings.

- 3.3.4.1 Insert Fittings: Nipples shall be of one-piece construction. Weld or braze joints must not be located in the fluid paths, except welded and redrawn tubing per MIL-T-8504 or MIL-T-8808 may be used.
- 3.3.4.2 Non-Standard Fittings: Non-standard elbow nipples shall be of one-piece construction to the maximum extent possible. When one-piece construction is not used, the joints shall be welded using either butt-weld or lap-weld design. For double elbow assemblies, the elbows may be treated as non-standard.
- 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.
- 3.4 Dimensions: The hose assembly dimensions, except for length, shall be as specified in Figure 3.
- 3.4.1 Hose Weight: Hose consisting of inner tube, reinforcement and interlayers as outlined in paragraphs 3.3.1 through 3.3.3 shall not exceed the maximum hose weights covered in Table I.

TABLE I

PHYSICAL REQUIREMENTS OF HOSE ASSEMBLIES AND WEIGHT OF HOSE

Hose Size	Hose Weight Max.		Operating Pressure Max.		Proof Pressure Min.		Burst Pressure				Bend Radius At Inside of Bend Min.	
	1		PSI	KPa	PSI	KPa	Room Temperature Min.		High Temperature Min.		In.	MM.
	Lbs/In	Kg/M					PSI	KPa	PSI	KPa		
-04	0.007	0.125	1,000	6 895	2,000	13 790	4,000	27 579	2,800	19 305	1.25	32
-06	0.010	0.179	1,000	6 895	2,000	13 790	4,000	27 579	2,800	19 305	2.25	57
-08	0.015	0.268	1,000	6 895	2,000	13 790	4,000	27 579	2,800	19 305	2.88	73
-10	0.020	0.357	1,000	6 895	1,800	12 411	3,600	24 821	2,500	17 237	3.00	76
-12	0.025	0.446	1,000	6 895	1,800	12 411	3,600	24 821	2,500	17 237	3.75	95
-16	0.030	0.536	1,000	6 895	1,800	12 411	3,600	24 821	2,500	17 237	5.00	127
-20	0.050	0.893	1,000	6 895	1,800	12 411	3,600	24 821	2,500	17 237	6.25	159
-24	0.060	1.071	750	5 171	1,500	10 342	3,000	20 684	2,100	14 479	7.50	191
-32	0.090	1.607	250	1 724	500	3 447	1,000	6 895	700	4 826	10.00	254
-40	0.110	1.965	100	689	200	1 379	400	2 758	280	1 931	12.50	318
-48	0.145	2.590	100	689	200	1 379	400	2 758	280	1 931	15.00	381
-64	0.200	3.572	100	689	200	1 379	400	2 758	280	1 931	24.00	610

1 Hose weight shall be determined on a minimum length of 12 inches (305 mm)

- 3.5 Performance: The hose assembly shall meet the following performance requirements:

3.5.1 Proof Pressure:

3.5.1.1 Class 1 hose assemblies shall withstand the proof pressure listed in Table I without malfunction or leakage when tested with water in accordance with 4.6.2.1.

3.5.1.2 Class 2 hose assemblies shall meet the Class 1 proof test requirement and shall withstand 25 percent of the operating pressure listed in Table I without malfunction or leakage in excess of the normal effusion rate of (1) bubble per minute for each inch of Teflon hose length plus (1) bubble per minute for each end fitting when tested pneumatically in accordance with 4.6.2.2.

3.5.2 Elongation and Contraction: The hose assembly shall not change in length by more than plus 0.3 inch (7.62 mm) or minus 0.1 inch (2.54 mm) in 10 inches (254 mm) of hose length, when subjected to the operating pressure in Table I for a minimum of 5 minutes. The hose assembly shall be tested in accordance with 4.6.3.

3.5.3 Leakage: The hose assembly shall not leak when subject to two (2) pressure cycles of 70 percent of minimum room temperature burst pressure, when tested in accordance with 4.6.4.

3.5.4 Room Temperature Burst Pressure: The hose assembly shall not leak nor burst at any pressure below the room temperature burst pressure specified in Table I, when tested in accordance with 4.6.5.

3.5.5 High Temperature Burst Pressure: The hose assembly shall not leak nor burst at any pressure below the high temperature burst pressure specified in Table I, when tested at 400°F (204°C) in accordance with 4.6.6.

3.5.6 Oil Resistance: The hose assembly shall not show evidence of leakage when tested with oil conforming to MIL-L-7808 (or other oils specified by the procuring activity) and with test fluid conforming to TT-S-735, Type III, when tested in accordance with 4.6.7.

3.5.7 Fuel Resistance: The hose assembly shall show no evidence of leakage when pressurized with fluid conforming to MIL-T-5624 (JP4) at the Table I operating pressure. The test shall be conducted in accordance with 4.6.8.

- 3.5.8 Flexibility and Vacuum: A ball of the applicable diameter listed in Table II shall roll through the hose assembly from fitting to fitting after the hose assembly has been maintained for four hours at 400°F (204°C) and the applicable vacuum listed in Table II. Following this, the hose assembly shall show no evidence of leakage nor permanent damage after being tested to the applicable proof pressure specified in Table I. Testing shall be conducted in accordance with 4.6.9.

TABLE II
VALUES FOR VACUUM TEST

Hose Size	Negative Pressure		Ball Size		
	In. Hg	MM Hg	MS19059-Dash No.	In.	MM
-04	28	711	1008	0.125	3.18
-06	28	711	1014	0.250	6.35
-08	28	711	1017	0.344	8.74
-10	28	711	1019	0.406	10.31
-12	28	711	1626	0.625	15.88
-16	28	711	1632	0.812	20.62
-20	20	508	1639	1.062	26.97
-24	12	305	TBD	1.281	32.54
-32	5	127	4851	1.812	46.02
-40	5	127	TBD	2.250	57.15
-48	5	127	TBD	2.750	69.85
-64	3	76	TBD	3.688	93.68

- 3.5.9 Pressure Surge: The hose assembly shall show no evidence of leakage from the hose or end fitting when subjected to 50,000 pressure surges from zero to the Table I operating pressure while maintained at 400°F (204°C), when tested in accordance with 4.6.10.
- 3.5.10 Conductivity: Type II hose assemblies only shall be capable of conducting a direct current equal to or greater than six (6) microamperes for hose sizes -4 through -8 and a direct current equal to or greater than 12 microamperes for hose sizes -10 through -64 with a test potential of 1,000 volts dc, when tested in accordance with 4.6.11.
- 3.5.11 Overtightening Torque: The hose fitting shall withstand the overtightening torque values specified in ARP 908, when tested in accordance with 4.6.12.
- 3.6 Screw Threads: Coupling nut threads shall be in accordance with MIL-S-8879. Thread tolerance increase of 10 percent during assembly or testing shall not be cause for rejection of the hose assembly.
- 3.7 Length: Hose assembly length shall be specified in the following increments only:

Under 18 inches (457 mm), not less than 1/8 inch (3.2 mm)
 18 to 36 inches (457 to 914 mm), not less than 1/4 inch (6.4 mm)
 36 to 50 inches (914 to 1,270 mm), not less than 1/2 inch (12.7 mm)
 Over 50 inches (1,270 mm), not less than 1 inch (25.4 mm)

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

Tolerances on hose assembly lengths shall be as follows:

- +1/8 inch (3.2 mm) for lengths under 18 inches (457 mm)
- +1/4 inch (6.4 mm) for lengths from 18 to 36 inches (457 to 914 mm)
- +1/2 inch (12.7 mm) for lengths from 36 to 50 inches (914 to 1,270 mm)
- +1% for lengths over 50 inches (1,270 mm)

- 3.8 Part Numbering of Interchangeable Parts: All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirement of MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.
- 3.9 Identification of Product: Equipment, assemblies and parts shall be marked for identification in accordance with MIL-STD-130. The following special marking shall be added:
- 3.9.1 Fittings: The manufacturer's name or trademark shall be permanently marked on all end fittings.
- 3.9.2 Assembly: A permanent marking on the fitting or a permanent band on the hose shall be used. The band shall be no wider than one inch (25mm) 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
 - b. Complete hose assembly part number
 - c. Operating pressure in PSI
 - d. Operating temperature "400°F"
 - e. Pressure test symbol "PT"
 - f. Assembly specification "AS 620"
 - g. Date of hose assembly manufacture expressed in terms of month and year
 - h. Hose manufacturer's Federal Code Number
 - i. AS 1055, Type and Class (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 microinches (2.5 micrometres) rms maximum will be acceptable.
- 3.10.1 Dimensions and Tolerances: All pertinent dimensions and tolerances, where interchangeability, operation or performance of the hose assembly may be affected, shall be specified on all drawings.
- 3.10.2 Cleaning: All hose assemblies shall be free from oil, grease, dirt or other foreign materials, both internally and externally. Unless otherwise specified, hose assemblies shall be cleaned to Class 0 of ARP 611.

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 Tests: The inspection and testing of hose assemblies shall be classified as follows:
- a. Acceptance tests (see 4.3)
 - b. Qualification testing (see 4.4)
- 4.3 Acceptance Tests: Acceptance tests shall consist of:
- a. Individual Test (see 4.3.1.)
 - b. Sampling Test (see 4.3.2.)
 - c. Periodic Control Test (see 4.3.3)
- 4.3.1 Individual Tests: Each hose assembly delivered under this standard shall be subjected to the following tests:
- a. Examination of Product (4.6.1)
 - b. Proof Pressure Test (see 4.6.2)
- 4.3.2 Sampling Test: The following test shall be performed on hose assemblies picked at random from each lot. A lot is defined as 500 assemblies of a given dash size.
- 4.3.2.1 One hose assembly shall be consecutively subjected to the following tests:
- a. X-Ray or Fluoroscope to determine proper fitting installation
 - b. Elongation and Contraction Test (see 4.6.3), then
 - c. Leakage Test (see 4.6.4)
- 4.3.3 Periodic Control Test: A Fuel Resistance Test (see 4.6.8) shall be performed on at least two assemblies for each test selected from each 5000 hose assemblies for each dash size, not necessarily manufactured during one continuous production run.
- 4.3.4 Rejection and Retest: When one item selected from a production run fails to meet the specification, no items still on hand or later produced shall be accepted until the extent and cause of failure are determined and corrective action, as necessary, taken.

4.3.4.1 Individual Tests May Continue: For operational reasons, the individual tests may be continued pending the investigation of a sampling or periodic control test failure. Final acceptance of items on hand or produced later shall not be made until it is determined that items meet the requirements on which the rejection was based.

4.4 Qualification Inspection:

4.4.1 Qualification Testing: The qualification of hose assemblies shall consist of all the tests described in this specification. Unless otherwise specified by the purchaser, qualification samples shall consist of the number of samples and lengths specified in Table III for each method of fitting attachment (permanent and field attachable). The procedure used shall be as specified in Table IV. The end fitting outlet design for the samples shall have flared fittings to mate with MS 33656 or flareless fittings according to NAS 1760 to mate with MS 33514.

TABLE III
TEST SAMPLES

HOSE SIZE	PART NUMBER	SAMPLE NUMBERS [3]	QUANTITY	HOSE SIZE	PART NUMBER	SAMPLE NUMBERS [3]	QUANTITY
04	AS1633-04-0180	1-7	7	24	AS1633-24-0180	1-4	4
	AS1635-04-0180	8-11	4		AS1633-24-0250 [4]	5-7	3
06	AS1633-06-0180	1-7	7		AS1635-24-0250 [2]	8-11	4
	AS1635-06-0180	8-11	4	32	AS1633-32-0180	1-4	4
08	AS1633-08-0180	1-7	7		AS1633-32-0310 [4]	5-7	3
	AS1635-08-0180	8-11	4		AS1635-32-0310 [2]	8-11	4
10	AS1633-10-0180	1-7	7	40	AS1633-40-0180	1-4	4
	AS1635-10-0180	8-11	4		AS1633-40-0380 [4]	5-7	3
12	AS1633-12-0180	1-7	7		AS1635-40-0380 [2]	8-11	4
	AS1635-12-0180	8-11	4	48	AS1633-48-0180	1-4	4
16	AS1633-16-0180	1-7	7		AS1633-48-0450 [4]	5-7	3
	AS1635-16-0180	8-11	4		AS1635-48-0450 [2]	8-11	4
20	AS1633-20-0180	1-4	4	64	AS1633-64-0180	1-4	4
	AS1633-20-0200 [4]	5-7	3		AS1633-64-0600 [4]	5-7	3
	AS1635-20-0200 [2]	8-11	4		AS1635-64-0600 [2]	8-11	4

[2] Assembly length required for pressure surge test.

[3] See Table IV for test sequence for each hose sample.

[4] Assembly length for flexure and vacuum test.

4.4.2 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 furnished to that activity:

- a. Test report. Three (3) copies of a test report in accordance with MIL-STD-831, which shall include a report of all tests and outline description of the tests and conditions.

- b. Test Sample. The sample which was tested, when requested by the procuring activity.
- c. Three (3) sets of engineering data in the form of detail and assembly drawings. The assembly drawings shall have a cut-away section showing all details in their normal assembly position and shall carry part numbers of all details and subassemblies.
- d. List of Sources of hose or hose components, including source's name and product identification for inner tube, hose and assembly.

NOTE: Log sheets, containing required test data, shall remain on file at the source test facility and are not to be sent to the qualifying activity unless specifically requested.

4.4.3 Qualification Test Schedule:

TABLE IV
QUALIFICATION TEST SEQUENCE

Assemblies												
Sample No.	1	2	3	4	5	6	7	8	9	10	11	12 
Paragraph No.	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1
	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.11
	4.6.3	4.6.4	4.6.7	4.6.8	4.6.7	4.6.8	4.6.9	4.6.10	4.6.10	4.6.10	4.6.10	
	4.6.4	4.6.12	4.6.5	4.6.5	4.6.9	4.6.9						
	4.6.12	4.6.6										
	4.6.6											

 For Type II assemblies only. Add one additional AS1633-(SIZE)-0180 hose assembly to those listed in Table III for each size to be qualified.

4.5 Test Conditions:

4.5.1 Preparation of Specimens:

4.5.1.1 General: Length of the sample lines shall be in accordance with Table III unless otherwise specified.

4.5.1.2 Oil Aging: In all of the tests using oil-aged samples, the hose assemblies should be filled, with no pressure, with a high temperature test fluid and soaked in an air oven at a temperature of 400°F (204°C) for seven days. All air should be excluded from the bore of the assembly during the test.

4.5.1.3 Air Aging: Air aged samples shall be kept in air at a temperature of 400°F (204°C) for seven days.

4.5.2 Test Fluids: Unless otherwise specified, the test fluid shall be fluid conforming to specification MIL-H-5606, MIL-T-5624, MIL-H-83282 or water. When a high temperature test is performed, the test fluid shall be MIL-L-7808 unless otherwise specified by the procuring activity.

- 4.5.3 Temperature Measurements: Unless otherwise specified, temperature measurements shall be taken within six inches (152 mm) of the hose assemblies under test. Unless otherwise specified, all temperatures shall have a tolerance of +15°F (+8°C) to -5°F (-3°C).
- 4.5.4 Pressure Measurements: Unless otherwise specified, pressure measurements shall have a tolerance of ±20 psi (138 KPa).
- 4.6 Inspection Methods and Performance Tests:
- 4.6.1 Examination of Product: All hose assemblies shall be examined to determine conformance to this specification with respect to material, size and workmanship. Broken or missing reinforcing wires or any other evidence of malfunction shall be cause for rejection. Crossed over reinforcing wires shall not be cause for rejection.
- 4.6.2 Proof Pressure Test:
- 4.6.2.1 All class 1 hose assemblies shall be pressure tested with water to the applicable proof pressure specified in Table I for not less than 30 seconds and not more than five minutes. Failure to meet the requirements of 3.5.1.1 shall be cause for rejection.
- 4.6.2.2 All Class 2 hose assemblies shall be tested in accordance with 4.6.2.1. The assemblies shall then be thoroughly dried and flexed a minimum of four times back and forth to the minimum bend radius and along two perpendicular axes. Following this, the assemblies shall be pneumatically (air or N₂) tested for three minutes under water to 25 percent of the applicable operating pressure specified in Table I. Failure to meet the requirements of 3.5.1.2 shall be cause for rejection.
- 4.6.3 Elongation and Contraction Test: The test assembly shall be held in a straight unpressurized condition and a 10-inch standard length marked off on the hose. It shall then be pressurized to operating pressure for 5 minutes minimum. At the end of this 5-minute period and while still pressurized, the standard length shall be measured and recorded. The standard length of hose should not change in length by more than plus 0.3 inch (7.62 mm) or minus 0.1 inch (2.54 mm).
- 4.6.4 Leakage Test: Two hose assemblies of each size shall be subjected to this test. The assemblies shall be pressurized while at room temperature to 25 psi (172 KPa) for a minimum of 5 minutes. The pressure shall be increased to a value equal to 70% of the rated burst pressure specified in Table I and again held for a minimum of 5 minutes. The pressure shall be completely released and again increased to 70% of the rated burst pressure and held for a minimum of 5 minutes. Any evidence of leakage shall constitute failure.

- 4.6.5 Room Temperature Burst Pressure Test: During this test the assemblies shall be fastened at one end to the source of pressure. They shall be extended straight and the free end shall not be restrained or fastened in any way. The rate of pressure rise shall be 25,000 $\pm$ 10,000 psi per minute until failure is obtained. The hose shall not burst, the fittings shall not blow off or loosen, and there shall be no leakage from the hose or fittings or any other evidence of malfunction below the values specified in Table I. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.
- 4.6.6 High Temperature Burst Pressure Test: Two hose assemblies of each size shall be filled with a suitable test fluid and soaked for one hour with ambient and fluid temperature at 400°F (204°C). After one hour, the pressure shall be raised to the rated operating pressure for 5 minutes. The pressure shall be increased at the rate of 20,000 $\pm$ 5,000 psi/minute until bursting or leakage occurs. Any leakage at pressures below the rated value listed in Table I shall be evidence of failure. The hose assemblies shall be under continuous observation during pressure increase and the type of failure shall be recorded.
- 4.6.7 Oil Resistance Test:
- 4.6.7.1 Two test samples of each size shall be filled with oil conforming to specification MIL-L-7808 or another oil approved for use by the procuring activity and placed in an oven which shall be maintained at 400°F (204°C). Care should be taken to insure against the assembly coming in contact with parts of the oven which are at a higher temperature. The same test fluid shall be used throughout this test, unless otherwise specified. The assembly shall have a pressure applied equal to the rated operating pressure as specified in Table I.
- 4.6.7.2 At the end of a minimum of 16 hours, the assembly shall be removed from the oven, drained and refilled with test fluid in accordance with specification II-S-735, Type III. A pressure shall be applied equal to the rated operating pressure and maintained for a minimum of 2 hours at room temperature.
- 4.6.7.3 The test as specified in 4.6.7.1 and 4.6.7.2 shall be repeated for a total of 3 times.
- 4.6.7.4 At the completion of the above tests, the test samples shall be filled with oil and placed in a cold chamber for 4 hours, while maintained at -67°F $\pm$ 2°F (-55°C $\pm$ 1°C). After the 4-hour cold soak, the samples shall be subjected to a pressure equal to the operating pressure specified in Table I. The pressure shall be held for a minimum of 5 minutes and then released. This shall be repeated for a total of 10 times with a minimum of 5 minutes between each pressure application.

- 4.6.7.5 The assemblies shall again be placed in the cold chamber where the temperature is $-67^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($-55^{\circ}\text{C} \pm 1^{\circ}\text{C}$) for 24 hours. At the end of this time, oil at a temperature of 400°F (204°C) shall be circulated through the assemblies. Within 15 seconds after introduction of the hot oil, the pressure shall be increased to the rated proof pressure and held for a minimum of 2 minutes.
- 4.6.7.6 Any leakage of the test fluid from the assemblies during the preceding tests shall be evidence of failure.
- 4.6.7.7 At the conclusion of the above tests, one of the test assemblies shall be used for the burst test of 4.6.5. The other assembly shall be subjected to the flexibility and vacuum test of 4.6.9.
- 4.6.8 Fuel Resistance Test: Two hose assemblies shall be subjected to the test with a fluid conforming to specification MIL-T-5624 (JP4) at the operating pressure as specified in Table I and at a temperature of 260°F (127°C). The following sequence of tests shall be performed:
- 4.6.8.1 The test assembly shall be installed in a controlled temperature box with the fluid and ambient air at room temperature. The pressure at this time shall be raised to operating as specified in Table I and this pressure shall be maintained throughout Paragraphs 4.6.8.1 and 4.6.8.2. The temperature of the ambient air shall then be reduced to $-65^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($-54^{\circ}\text{C} \pm 1^{\circ}\text{C}$) and held for a minimum of one hour.
- 4.6.8.2 The temperature of the fluid and the ambient air shall then be increased to 260°F (127°C). The hose assembly shall remain at the ambient and fluid temperature of 260°F (127°C) and at the rated operating pressure for a minimum of 48 hours.
- 4.6.8.3 Upon the completion of the above test, the assemblies shall then be subjected to a static pressure for 5 minutes at room temperature at the proof pressure as specified in Table I. The test fluid shall be TT-S-735, Type III. The assemblies shall show no evidence of leakage.
- 4.6.8.4 One of the assemblies shall then be subjected to the burst test as specified in Paragraph 4.6.5, and the other assembly shall be subjected to the flexibility and vacuum test in Paragraph 4.6.9.
- 4.6.9 Flexibility and Vacuum Test:
- 4.6.9.1 One test assembly from the fuel resistance test, Paragraph 4.6.8, one from the oil resistance test, Paragraph 4.6.7, and one unaged sample shall be used for this test. The samples shall be filled with test fluid in accordance with TT-S-735, Type I and placed in a cold chamber for 24 hours maintained at a temperature of $-67^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($-55^{\circ}\text{C} \pm 1^{\circ}\text{C}$).

- 4.6.9.2 At the end of this time and while still at this temperature, the samples shall be bent to the extreme around a mandrel with a radius equal to the minimum bend radius specified in Table I. The bend shall then be reversed and returned to the straight position. The bend shall be repeated a total of 5 times allowing about 4 seconds per cycle.
- 4.6.9.3 The assembly shall be drained, a ball of the size listed in Table II shall be inserted in the assembly, and placed in a minimum bend radius in a 400°F (204°C) oven. A negative pressure as shown in Table II shall be applied for each particular size. At the end of 4 hours, the assembly shall be removed from the oven while continually maintaining negative pressure. When the samples have cooled to room temperature, the negative pressure shall be released and the ball will be rolled through the hose assembly from fitting to fitting. Failure to pass the ball shall be evidence of failure.
- 4.6.9.4 Upon completion of the test, the assembly shall be subjected to a static test for 5 minutes at a proof pressure as specified in Table I. The test fluid shall be MIL-L-7808 or water. Assembly shall show no evidence of leakage.
- 4.6.9.5 The assembly shall be dissected and inspected. Permanent damage to the assembly as a result of bending or vacuum shall be evidence of failure.
- 4.6.10 Pressure Surge Test: Four hose assemblies with standard end fittings of the lengths specified in Table I shall be subjected to the pressure surge tests. Assemblies shall be mounted in a 90-degree bend to the minimum bend radius (Table I) condition in an oven with the ambient air and internal fluid temperatures maintained at 400°F (204°C). The test fluid shall be MIL-H-7808. All four hose assemblies shall be pressure cycled from 0 to operating pressure at a rate of not less than 20 cycles per minute or more than 30 cycles per minute, as shown in Figure 1. Any leakage from the hose or hose attachment to the end fittings at less than 50,000 cycles shall be cause for rejection.
- 4.6.11 Conductivity (Type II only): The test specimen shall be a 13-inch (330 mm) length of hose with a fitting attached to one end as shown in Figure 2. The inner surface of the tube shall be washed first with solvent conforming to P-D-680 and then with isopropyl alcohol conforming to TT-I-735 to remove surface contamination and thoroughly dried at room temperature. The reinforcement shall be flared out to prevent contact with the end of the tube. One MS21900 steel fitting of appropriate size shall be assembled to the hose end fitting.

The test specimen shall then be arranged vertically. The relative humidity shall be kept below 70% and room temperature between 60°F (16°C) and 90°F (32°C). One thousand volts, dc, shall be applied between the upper mercury electrode and the lower (MS21900 fitting) electrode.

The current shall be measured with an instrument with a sensitivity of at least 1 microampere (1×10^{-6} ampere). The current measured shall be equal to or greater than 6 microampere for sizes -4 through -8 and equal to or greater than 12 microampere for size -10 through -64.