



AEROSPACE STANDARD

AS1501™**REV. D**

Issued 1978-11
Reaffirmed 2013-01
Revised 2020-06

Superseding AS1501C

Hose, Air Duct, Flexible, Nonmetallic, Aircraft

RATIONALE

Add new form 3 that applies to grade E. Add new grade "E" that allows negative internal pressure and increases diameter to 12 inches to expand the usage of AS1505 in the industry. Replace MS33660 (obsolete) with AS5131 (equal replacement).

1. SCOPE

This document covers flexible and semiflexible, reinforced and unreinforced air hoses fabricated from laminated and impregnated fabric, intended for use in aircraft heating, air conditioning, ventilating, defrosting, and/or deicing systems.

1.1 Classifications

Hoses furnished under this document shall be of the following operating temperature classifications and constructions shown in Table 1.

Table 1 - Operating temperature range and construction

Type	Operating Temperature Range	Construction
I	-65 to +250 °F	Chloroprene rubber impregnated fiberglass
II	-65 to +500 °F	Silicone rubber impregnated fiberglass, wire support
III	-65 to +176 °F	Polyurethane rubber impregnated nylon cloth
IV	-65 to +250 °F	Silicone rubber impregnated fiberglass /1/
V	-65 to +250 °F	Chloroprene rubber impregnated Meta-Aramid cloth
VI	-65 to +500 °F	Silicone rubber impregnated Meta-Aramid cloth
/1/ Silicone rubber hoses with nonmetallic wire shall not be used over 250 °F.		

1.2 Grades

Grades shall be designated by a letter code as shown in Table 2, and utilized as required on standards and drawings to differentiate hose operating pressures, and to specify hose classification.

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1.3 Forms

The hose shall be wire reinforced in one of the following forms:

- a. Form 1: Helical - wire (metallic or nonmetallic) reinforcement which can be axially compressed, but not elongated beyond its free length.
- b. Form 2: Helical convoluted - wire (metallic) reinforcement, if specified, which can be axially compressed and elongated.
- c. Form 3: Annular convoluted - wire ring reinforcement if required for pressure, which can be axially compressed and elongated.
- d. Form 4: Sleeve - no reinforcement other than fabric which cannot be axially compressed or elongated.

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 +1 724-776-4970 (outside USA), www.sae.org.

AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AS1502	Hose, Air Duct, Flexible, Helical, Metallic Wire, Supported (Exposed), Self Extinguishing
AS1503	Hose, Air Duct, Flexible, Helical, Metallic Wire, Supported (Covered), Self Extinguishing
AS1504	Hose, Air Duct, Flexible, Helical, Nonmetallic Wire, Supported (Exposed), Self Extinguishing
AS1505	Hose, Air Duct, Flexible, Annular Convoluted, Self Extinguishing
AS1506	Hose, Air Duct, Semiflexible, Sleeve Section, Unreinforced, Self Extinguishing
AS1541	Hose, Air Duct, Flexible, Helical Convoluted, Metallic Wire Supported (Covered), Self Extinguishing
AS1542	Hose, Air Duct, Flexible, Helical Convoluted, Self Extinguishing
AS1543	Hose, Air Duct, Semiflexible, Sleeve Section Unreinforced, Self Extinguishing, Nomex
AS1544	Hose, Air Duct, Flexible, Helical, Nonmetallic Wire Supported (Covered), Silicone Rubber, Self Extinguishing
AS1591	Hose, Air Duct, Flexible, Polyurethane-Coated Fabric, 1 psi, External Nylon Helix, Self Extinguishing
AS4546	Hose, Air Duct, Flexible, Silicone Coated Fabric, 1 to -.5psi, External Nylon Helix, Self Extinguishing
AS4774	Hose, Air Duct, Flexible, Silicone-Coated Fabric, 1 psi, External Nylon Helix, Self Extinguishing
AS4804	Hose, Air Duct, Flexible, Silicone-Coated Fabric, External Nylon Helix, Low Noise

2.2 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 A313 Chromium Nickel Stainless and Heat Resisting Steel, Spring Wire
- ASTM A853 Wire, Steel, Carbon (Round, Bare, and Coated)
- ASTM B117 Salt Spray (Fog) Testing, Method of Test for (ANSI Z118.1-74)
- ASTM B194 Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar (Copper Alloy Numbers 170 and 172)

2.3 AIA Publications

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

- NAS1922 Clamp, Hose, Band, Tangential Worm, Lightweight

2.4 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>

- FAR 25.853 Federal Aviation Regulation, Volume III, Part 25
- MIL-H-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance
- MIL-L-6082 Lubricating Oil, Aircraft Reciprocating Engine (Piston)
- MIL-L-6085 Lubricating Oil, Aircraft Instrument, Low Volatility
- MIL-L-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
- MIL-L-23699 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
- MIL-P-5425 Plastic, Sheet Acrylic, Heat Resistant
- MIL-S-18729 Steel Plate, Sheet and Strip, Alloy 4130, Aircraft Quality
- 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-810 Environmental Test Methods
- MIL-T-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5
- MIL-Y-1140 Yarn, Cord, Sleeving, Cloth, and Tape-Glass
- MS21920 Clamp, Hose (Flat Band, 500 °F)
- MS33660 Tubing End, Hose Connection, Standard Dimensions For
- MS35842 Clamp, Hose: Low Pressure, Type "F"
- QQ-A-250/4 Aluminum Alloy, Plate and Sheet, 2024

QQ-P-35	Passivation Treatments for Corrosion-Resisting Steel
QQ-P-416	Plating, Cadmium (Electrodeposited)
TT-I-735	Fluid, Anti-Icing (Isopropyl Alcohol)
TT-S-735	Standard Test Fluids, Hydrocarbon

3. REQUIREMENTS

3.1 Qualification

Any hose assembly furnished under this document shall be a product identical in construction to the specimens which have been tested and passed the qualification tests specified herein.

3.2 Materials

The hose assembly materials shall be uniform in quality, free from defects, suitable for its intended use, consistent with good manufacturing practices, and in conformance with the applicable specifications and requirements specified herein. Materials used in these hose assemblies shall be selected from those listed in Table 3.

3.3 Design and Construction

Hose furnished under this document shall be in accordance with requirements of AS1502, AS1503, AS1504, AS1505, AS1506, AS1541, AS1542, AS1543, AS1544, AS1591, AS4546, AS4774, and AS4804 and shall comply with the grades of construction and forms of manufacture as specified on the individual standards.

3.3.1 Soft End Couplings (Cuffs)

Soft end couplings (cuffs) shall be formed by omitting the reinforcement wire (metallic or nonmetallic) from the end portion of the hose. See 3.3.3 for termination of wire ends. The inner layer of fabric of the hose shall be continuous for the entire length of the hose and couplings. The soft ends shall have sufficient resilience for a snug fit over a rigid tube end conforming to Type A of AS5131 but shall be resistant to flow deformation to prevent clamp loosening and hose blowoff during service.

3.3.1.1 Cuff External Configuration

For high pressure hose assemblies, a bead shall be added to the soft ends when specified on applicable standard or drawing. The width of the bead shall be 0.12 inch or 0.19 inch for hose diameters 4.00 inches and smaller and 0.25 inch to 0.38 inch for hose diameters 4.25 inches and larger. Height of the bead shall be 0.04 inch minimum above the cuff with shape optional.

3.3.1.2 Cuff Internal Configuration

Internally molded seal rings shall be added to soft ends when specified on standard or drawing to reduce joint leakage.

3.3.2 Cut Ends

Cut or plain ends shall be the same as the hose body. Reinforcement wire (metal or nonmetallic) ends shall be crimped and/or terminated in such a manner as to prevent damage to the hose. Cut ends shall be used to a minimum extend possible and shall be used in lower pressure systems and where higher joint leakage can be tolerated.

Table 2 - Hose assembly data

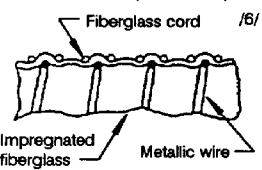
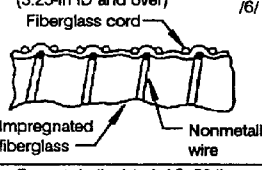
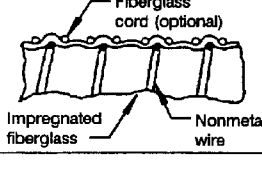
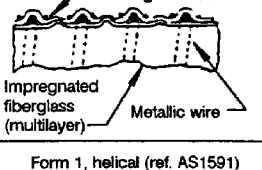
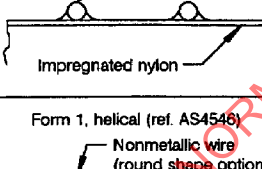
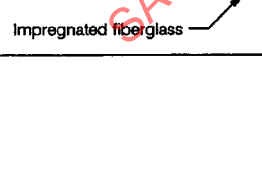
Construction	Maximum weight, lb/ft/in dia	Minimum inside bend radius, in	Crush resistance	Maximum hose leakage, SCFM/ft/in dia	Maximum total joint leakage, SCFM/in hose dia	/3/	/4/	Available types
Form 1, helical (ref. AS1502) 	0.10 Grades A and B	0.50 x hose ID	N/A	0.02	0.20	6	N/A	I & II
Form 1, helical (ref. AS1504) (3.25-in ID and over) 	0.07 Grades A and B	2.0 x hose ID	/5/	0.02	0.10	6	N/A	I
Form 1, helical (ref. AS1504) (3.00-in ID and under) 	0.07 Grades A and B	1.0 x hose ID	/5/	0.02	0.10	6	N/A	I
Form 1, helical (ref. AS1503) 	0.16 Grades A and B 0.12 Grades C and D 0.20 Grades E and F	1.0 x hose ID	N/A	0.01 0.02 0.02	0.10	6	N/A	I & II
Form 1, helical (ref. AS1591) 	.042 Size 2, 5-6, 0 /9/ Grade A	.075 x hose ID	/5/	0.015	0.10	6	N/A	III
Form 1, helical (ref. AS4546) 	.051 Size 4, 0-6, 0 /9/ Grade A	0.75 x hose ID	/5/	0.015	0.10	6	N/A	IV

Table 2 - Hose assembly data (continued)

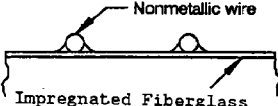
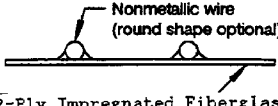
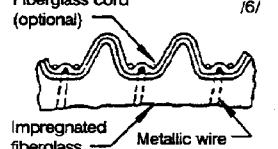
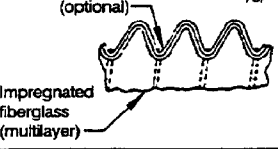
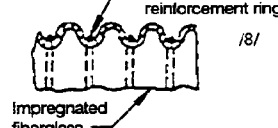
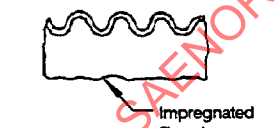
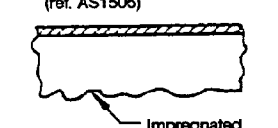
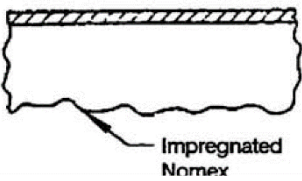
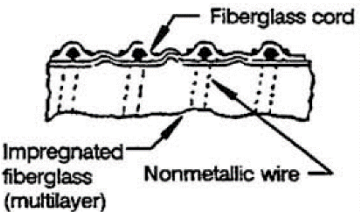
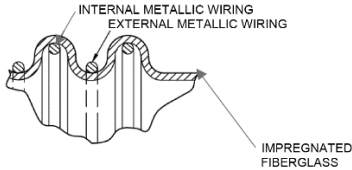
Construction	Maximum weight, lb/ft/in dia	Minimum inside bend radius, in	Crush resistance	Maximum hose leakage, SCFM/ft/in dia	Maximum total joint leakage, SCFM/in hose dia	/3/	/4/	Available types	
Form 1, helical (ref. AS4774)  Nonmetallic wire Impregnated Fiberglass	.048 up to 10 in .051 up to 12 in /9/ Grade A	.075 x hose ID	/5/	0.015	0.10	6	N/A	IV	(R)
Form 1, helical (ref. AS4804)  Nonmetallic wire (round shape optional) 2-Ply Impregnated Fiberglass	.06 up to 4 in .21 up to 12 in /9/ Grade A	1.0 x hose ID	/5/	0.015	0.10	6	N/A	IV	(R)
Form 2, helical (ref. AS1541)  Fiberglass cord (optional) Impregnated fiberglass Metallic wire	0.17 Grades A and B	1.5 x hose ID	N/A	0.01	0.10	6	6	I & II	
Form 2, helical (ref. AS1542)  Fiberglass cord (optional) Impregnated fiberglass (multilayer)	0.09 Grade A	1.0 x hose ID (3-in ID and under) 2 x hose ID (3.25-in ID and over)	N/A	0.02	0.20	20	20	II	(R)
Form 3, annular convoluted (ref. AS1505)  Metallic reinforcement ring Impregnated fiberglass	0.24 Grade A	2.0 x hose ID	N/A	0.01	0.10	6	6	II	(R)
Form 3, annular convoluted (ref. AS1505)  Impregnated fiberglass	0.12 Grades C and D	0.75 x hose ID	N/A	0.015	0.10	10	10	I & II	
	0.18 Grade B	1.0 x hose ID	N/A	0.01	0.10	10	10	II	
Form 4, sleeve (semi-rigid) (ref. AS1506)  Impregnated fiberglass	0.075 Grades C and D	N/A	/7/	0.02	0.10	N/A	N/A	I & II	
	0.10 Grades A and B			0.01	0.10				

Table 2 - Hose assembly data (continued)

Construction	Maximum weight, lb/ft/in dia	Minimum inside bend radius, in	Crush resistance	Maximum hose leakage, SCFM/ft/in dia	Maximum total joint leakage, SCFM/in hose dia	/3/	/4/	Available types
Form 4, sleeve (semi-rigid) (ref. AS1543) 	0.045 Grade B	N/A	/7/	0.02	0.20	N/A	N/A	II
	0.007 Grade A			0.01	0.10			
Form 1, helical (ref. AS1544) /6/ 	0.10 Grade A	1.0 x hose ID (2.75-in ID and under) 2.0 x hose (3.00-in ID and over)	N/A	0.02	0.10	6	N/A	I
Form 3, annular convoluted (ref. AS1505) 	0.36 Grade E	2.0 x hose ID	N/A	0.01	0.10	6	6	II

/1/ Maximum operating pressure (psi) specified on "AS" standards or drawings varies with hose construction and diameter.

/2/ Inside diameter range shall be in accordance with "AS" standard or drawing.

/3/ Compressibility percentage = $\Delta L/L \times 100$. (Where L is the convoluted length less 1.50 in for wire termination.)

/4/ Extensibility percentage = $\Delta L/L \times 100$. (Where L is the convoluted length less 1.50 in for wire termination.)

/5/ The hose shall be able to be flattened a minimum of 50% of its diameter over its entire length without damage or permanent set. The hose shall return to its full diameter after removal of deforming force and without being pressurized.

/6/ Twisted.

/7/ Sleeve-type hose shall be deformable without permanent set.

/8/ Wire ring reinforced rings shall be butt welded or brazed with a smooth joint and shall fit snug to hose convolutions. One ring per convolution except none adjacent to soft end.

(R) /9/ For weights in various sizes see standard.

Table 3 - Hose assembly materials

Component	Material Description	Specification	Finish
Coated Fabric	Fiberglass, chloroprene rubber impregnated	MIL-Y-1140 (fabric only)	As manufactured unless specified otherwise
	Fiberglass, silicone rubber impregnated		
	Meta-aramid, silicone rubber impregnated		
	Nylon, polyurethane impregnated		
Cordage	Fiberglass	MIL-Y-1140	
Reinforcement	Carbon steel hard drawn	ASTM A 853	Coppered per ASTM A 853, Finish 2
			Tinned per ASTM A 853, Finish 3
			Zinc-coated per ASTM A 853, Finish 5, Class 2
			Cadmium-plated per QQ-P-416, Type II, Class 2
	300 series cros.	ASTM A 313	Passivate per QQ-P-35
	Nonmetallic material meeting requirements of 3.5.8		Cadmium-plated per QQ-P-416, Type II, Class 2
			As manufactured unless specified

3.3.3 Wire Reinforcement (Metal or Nonmetallic) and Cordage

Wire helical reinforcement shall be inside the hose for one ply construction, except for AS1591, AS4546, AS4774, and AS4804 ducts, and between layers for a multilayered hose. The nonmetallic reinforcement wire shall be flame retardant to meet requirements of 3.5.8. For multilayered hoses and where bonding of layers is critical, the fiberglass cordage shall be placed tight to both sides of the reinforcement wire when specified on applicable standard or drawing. The reinforcement wire shall be securely bonded to the fabric over its entire length. Wire ends shall be secured and shall be terminated between layers at the soft ends to prevent piercing or damage to the hose. When specified on the standard or drawing, external fiberglass cordage (single or multicord) shall be securely bonded for its entire length and shall follow helical troughs formed by wire.

3.3.3.1 Nonmetallic Wire Heat Resistance

The helix reinforcement shall retain its spring characteristic following exposure to the applicable maximum hose operating temperature specified plus 100 °F. When tested as specified in 4.5.3.1, the helix reinforcement shall be within 40% of the original length without load, and within 60% of original length when tested with load.

3.3.3.2 Metallic Wire Corrosion Resistance

External metallic wire and duct constructions with embedded metal wire shall show no evidence of corrosion after it is exposed to saltwater testing. The testing is specified in 4.5.3.2.

3.3.4 Coatings

The surface of the hoses may be coated with a self-extinguishing and/or temperature-resistant material to conform to the requirements of this document or procurement drawing. Hoses may also be coated with a resin to decrease effusion rates and to provide additional rigidity, except that no resin shall be applied over the attachment areas, unless specified on the procurement drawing. The coating material shall not be detachable from the hose surface by the airstream and shall not emit a noxious odor when subjected to any temperature within the design range.

3.3.5 Coated Fabric Abrasion Resistance

There shall be no evidence of fabric exposure in excess of 10% of the abraded area after experiencing abrasion equivalent to the levels defined in 4.5.3.3. Fabric shall not appear abraded to the naked eye.

3.4 Dimensions and Weights

3.4.1 Hose Diameter

The hose diameter is determined by the hose inside diameter and corresponds to the outside diameter or the rigid tube to which it attaches. The tolerance of the inside diameter of convoluted hose assemblies, the hose soft ends, and the sleeve type hoses shall be -0.01 to +0.03 inch. The hose outside diameter at the convolution crest for convoluted hose assemblies shall be specified on applicable standard (or drawing).

3.4.2 Hose Length

The hose length shall be measured in increments and tolerance as specified on standards and drawings. The length shall be measured as described under 4.5.1.1, when the hose is in an undistorted condition and shall include soft and coupling lengths.

3.4.3 Weight

Hose weight shall be kept to a minimum, consistent with good design practices and shall comply with maximum weights specified on applicable standards (or drawings).

3.5 Performance

The hose assembly minimum bend radius, leakage and operating, proof and burst pressure ratings shall be verified by demonstration of meeting or exceeding the following performance requirements through qualification testing specified herein. Confidence in hose assembly performance shall be maintained by adherence to the quality assurance provisions as specified herein. Hose assemblies shall not show evidence of failure, delamination, cracking, collapse in bending, collapse under vacuum, or permanent deformation during demonstration of performance requirements in accordance with 3.5.2, 3.5.3, 3.5.4, 3.5.6, and 3.5.7 as follows:

NOTES:

1. Failure: Any discrepancy that precludes a hose assembly from meeting performance requirements specified herein.
2. Delamination: A bubble of fabric separation exceeding 0.1 in² area in any portion of the hose assembly except immediately adjacent to the reinforcement wire of a multilayered hose assembly or a bubble or fabric separation that grows with continued working of hose material.
3. Cracking: Internal or external separation of hose surface that grows with continued working of hose material.
4. Collapse: Any ovality of the hose that causes a reduction in hose cross sectional area of 5% or greater as defined in 3.5.3.
5. Permanent Deformation: Any change in size or shape in excess of the envelope parameters defined by standard or drawing.
6. Operating Pressure: Specified on part standards.

3.5.1 Examination of Product

Each hose assembly must conform dimensionally and materially to its applicable standard (or drawing) and to all applicable requirements of this document. Examination is specified in 4.6.1.

3.5.2 Proof Pressure

The hose assembly shall withstand a positive proof pressure of twice the operating pressure specified on its applicable standard (or drawing) without failure. Hoses rated for negative pressure shall withstand negative pressure testing without separation of the helix from the duct fabric or other failure. Collapse of the hose does not constitute failure. Testing is specified in 4.6.2.

3.5.3 Bend Radius

The hose assembly (except Form 4 sleeves) shall bend uniformly to its minimum inside bend radius specified in Table 2. There shall be no indication of buckling, collapse, reduction in cross sectional area in excess of 5%—nor segmented bending resulting in buckling, collapse, reduction in cross sectional area in excess of 5%—nor delamination, or any other indication of failure. Duct material between wire reinforcements shall not move inward into the duct to obstruct flow. Reduction in area shall be determined by:

$$1 - (D_{\max} \times D_{\min}) / (D^2(\text{FREE})) \times 100 \leq 5\% \quad (\text{Eq. 1})$$

where:

D = hose assembly outside diameter

Testing is specified in 4.6.3.

3.5.4 Leakage

The hose assembly shall not exceed the maximum allowable leakage rates specified in the applicable standard (or drawing) at room temperature. Testing is specified in 4.6.4.

3.5.5 Blow Off

The hose assembly shall not blow off of a AS5131 beaded rigid tube nor show any evidence of the hose creeping from under the clamp at two times specified applicable standard (or drawing) operating pressure at maximum operating temperature. Testing is specified in 4.6.5.

3.5.6 Burst Pressure

The hose assembly shall not burst nor show evidence of failure at three times the operating pressure specified in the applicable standard (or drawing) at any temperature between the minimum and the maximum operating temperatures. Testing is specified in 4.6.6.

3.5.7 Flexure and Pressure Cycling

Hose assembly shall show no evidence of delamination, cracking, or deterioration and shall satisfactorily pass proof pressure test, 3.5.2, after flexure as stated in 4.6.7.

3.5.8 Self-Extinguishing

The hose assemblies, when tested vertically, shall meet the self-extinguishing requirements of Federal Aviation Regulation, FAR 25-32, paragraph 25.853(b), as follows:

- a. Self-extinguishing: 15 seconds average
- b. Maximum burn length: 8.0 inches average
- c. Drippings self-extinguishing time: 5 seconds average

Testing is specified in 4.6.8.

3.5.9 Odor and Fungus

The hose assembly shall not be a nutrient to fungi, contain any substance which is injurious to the skin, health, or emit a toxic or unpleasant odor when subjected to any temperature within the applicable operating temperature range. Testing is specified in 4.6.9.

3.5.10 Fluid Resistance

The hose assembly shall show no evidence of delamination, wicking, tackiness or structural degradation when exposed to Table 4 fluids. Testing is specified in 4.6.10.

Table 4 - Test fluids

Fluid	Specification
Standard test fluids, hydrocarbon	TT-S-735, Types I and II
Anti-icing (isopropyl alcohol)	TT-I-735
Hydraulic fluid, petroleum base	MIL-H-5606
Hydraulic fluid, phosphate ester	AS1241, high and low density
Fuel	MIL-T-5624, Type JP-5
Lubricating oil, engine	MIL-L-6082
Lubricating oil, instrument	MIL-L-6085
Lubricating oil, turbine engine	MIL-L-7808 or MIL-L-23699
Water	3.51 NaCl solution

3.5.11 Plexiglass Polycarbonate Crazeing

Plasticizer, extracted from hose material(s) shall not craze plexiglass or polycarbonates conforming to MIL-P-5425. Testing is specified in 4.6.11.

3.5.12 Corrosion

Polished metal samples shall show no evidence of corrosion when in contact with hoses. Testing is specified in 4.6.12.

3.6 Hose Clamp

The hose clamp and torque requirements must be specified on installation drawing and/or specification. See design note below. For hose qualification testing, hose installation and clamping shall be in accordance with Figure 1 and Table 5.

DESIGN NOTE: Allowable hose pressure and hose end leakage are dependent on type clamp used, clamp torque, and stiffness and configuration of rigid hose end.

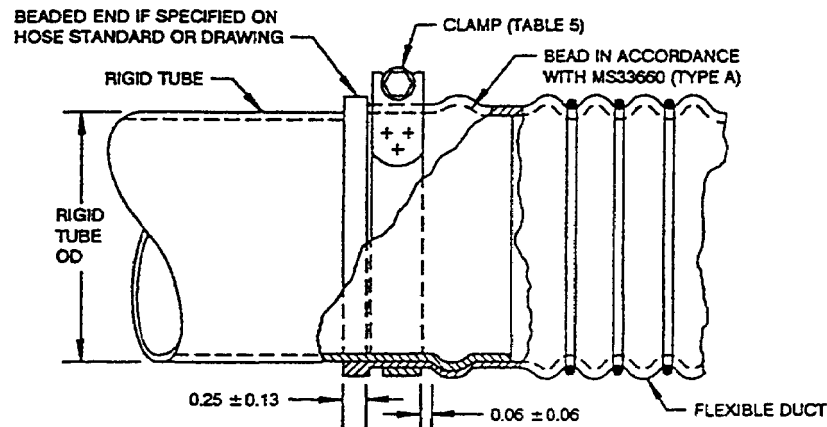


Figure 1 - Hose clamp installation

Table 5 - Tightening torques

Clamp	Torque in-lb	Specimen ^{1/} Diameter in
MS21920	20 - 25	2.50 and 10
MS35842	18 - 22	2 thru 7
NAS1922	18 max	2 thru 10

^{1/} For larger hose diameters assemble in tandem two or more clamps to obtain the required size.

3.7 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 requirements of DOD-STD-100 shall govern the manufacturer's part number and changes thereto.

3.8 Identification of Product

Each hose assembly shall be durably and legibly marked with an oil-resistant marking fluid in no less than two suitable places, size permitting or tagged in accordance with MIL-STD-130, with the following information:

- Cage code number/manufacturer's part number
- Manufacturer's name or trademark
- Complete standard, specification control, or drawing number
- Date of hose manufacture expressed in terms of month and year

3.9 Workmanship

The hose assembly shall be free of defects and shall be constructed and finished in a thoroughly workmanlike manner.

4. QUALITY ASSURANCE PROVISION

4.1 Supplier's Responsibility

The supplier shall be responsible for the performance of all quality assurance provisions and inspections specified herein. Qualification testing shall be conducted by supplier. Accurate records of the testing shall be kept by the supplier and shall be available to the purchaser on request. The supplier's test data shall be subject to approval by the purchaser. The purchaser reserves the right to perform any of the inspections and tests set forth in this document to assure conformance to this document.

4.2 User's Responsibility

The purchaser should establish adequate inspection procedures to ensure that all requirements of this document are met. Receiving inspections should consist of, but are not limited to, the following verifications:

- a. Dimensional conformance
- b. Material, finish, and workmanship
- c. Marking
- d. Pressure and leakage test

4.3 Classification of Inspections

The examining and testing of the hose assemblies are classified as follows:

- a. Qualification inspections
- b. Quality conformance inspections

4.4 Qualification Inspections

The qualification inspections are intended to qualify the manufacturer's design, materials, and manufacturing processes to produce a hose that meets the performance requirements of this document. The purchaser shall be notified at least 14 days prior to the start of test and shall reply within 7 days prior to start of test of intent to witness the test. Any changes in the manufacturing process, parts of materials that affect the quality assurance provisions of this document shall have prior approval from the purchaser.

4.4.1 Test Specimens

Seven hose assemblies of each grade (defining type, weight, and construction) as specified by each applicable standard (or drawing) shall be used for qualifying performance of the manufacturer's product. The assemblies shall be fabricated according to the manufacturer's production procedures and drawing and shall be the length and diameter specified on Table 6.

Table 6 - Specimen diameter and length (inches)

Specimen Number	1	2	3	4	5	6	7	8	9	10	11
Hose Diameter	2	2	2	4	4	6	6	10	10	14	14
Hose Length (Form 1)	19	12	12	36	16	50	20	82	24	113	28
Hose Length (Form 2)	19	6	6	36	9	50	12	82	18	113	24
Hose Length (Form 3)	19	6	6	36	9	50	12	82	18	113	24
Hose Length (Form 4)	16	N/R	6	6	N/R	15	6	6	N/R	6	N/R

4.4.2 Test Schedule and Sequence

4.4.2.1 Hose Assembly Test

Test specimens shall be subjected to qualification tests in the order indicated in Table 7 (from top to bottom).

4.4.2.2 Materials Test

The material test of 4.5.3 shall be performed on representative samples of the hose materials.

4.5 Quality Conformance Inspections

Quality conformance inspections shall consist of the following inspections:

- Individual tests (100% inspection, except as noted) (4.5.1)
- Sampling tests (4.5.2)
- Material tests (4.5.3)

4.5.1 Individual Tests (Functional Tests)

All production hoses shall be tested as follows:

- Examination of product (4.5.1.1)
- Leakage and proof pressure test (4.5.1.2)
- Bend radius test (4.5.1.3)
- Negative pressure proof test for externally reinforced ducts (4.5.1.4)

4.5.1.1 Examination of Product

Each hose shall be inspected to assure dimensional conformance and product construction in accordance with the applicable standard (or drawing). Lengths shall be measured on a smooth horizontal surface with a 1 pound tensile load applied to the end of the duct. One hose out of each production run shall be weighed to ensure compliance with the weight requirement.

4.5.1.2 Leakage and Proof Pressure Test

One hose assembly out of each production run of hose assemblies having the same diameter, material, and construction shall be tested at room temperature. A leakage test in accordance with 4.6.4 and a proof pressure test in accordance with 4.6.2 shall be conducted. Operations may be combined to facilitate testing. A hose failure to pass either or both of the tests, or collapse in negative pressure testing, is reason for 100% testing (prior to shipment to the purchaser) of the remaining hose assemblies having the same diameter, material, and construction as the failed item in the production run.

4.5.1.3 Bend Radius Test

One hose out of each production run of hose assemblies of the same diameter, material, and construction shall be tested in accordance with 4.6.3 except at room temperature without prior conditioning and length permitting. A hose failure to pass the bend radius test is reason for 100% testing of the remaining hoses assemblies of the same diameter, material, and construction as the failed item in the production run.

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Table 7 - Test schedule and sequence for qualification testing

Hose Assembly Qualification Test	Specimen Number 1	Specimen Number 2	Specimen Number 3	Specimen Number 4	Specimen Number 5	Specimen Number 6	Specimen Number 7	Specimen Number 8	Specimen Number 9	Specimen Number 10	Specimen Number 11
Examination of Product (4.6.1)	X	X	X	X	X	X	X	X	X	X	X
Leakage Rate Test (4.6.4) /2/	X	X	X	X	X	X	X	X	X	X	X
Proof Pressure Test (4.6.2)	X	X	X	X	X	X	X	X	X	X	X
Bend Radius Test (4.6.3) /1/	X			X		X		X		X	
Leakage Rate Test (4.6.4) /2/	X			X		X		X		X	
Proof Pressure Test (4.6.2)	X			X		X		X		X	
Blow Off Test (4.6.5)	X			X		X		X		X	
Burst Pressure Test (4.6.6)	X			X		X		X		X	
Flexure and Pressure Cycling Test (4.6.7) /1/		X			X		X		X		X
Leakage Rate Test (4.6.4) /1/ /2/		X			X		X		X		X
Proof Pressure Test (4.6.4) /1/		X			X		X		X		X
Self-Extinguishing Test (4.6.8)						X					
Odor and Fungus Test (4.6.9)			X								
Hydraulic Fluid and Water Resistance Test (4.6.10)		X									
Plexiglass and Polycarbonate Cracking Test (4.6.11)							X				
Corrosion Test (4.6.12)											

/1/ Not required for sleeve type (Form 4) hose assemblies.

/2/ Leakage test may be performed in conjunction with proof pressure test.

4.5.1.4 Negative Pressure Collapse Test

One hose out of each production run of hose assemblies of the same diameter, material, and construction shall be tested in accordance with 4.6.13. If the hose fails it will be rejected and the lot will be 100% inspected to this paragraph.

4.5.2 Sampling Test

In a period of time not exceeding 2 years, a self-extinguishing test in accordance with 4.6.8 shall be conducted for each type and form hose assembly constructed by the manufacturer in accordance with this document. The hose assembly to be tested shall be selected at random from production hose assemblies.

4.5.3 Material Tests

4.5.3.1 Nonmetallic Reinforcement, Heat Resistance Test

Heat resistance tests shall be conducted as follows:

- a. Measure a test length in vertical position
- b. Apply a load to extend test length to 4x free length, record weight
- c. Subject reinforcement to operating temperature plus 100 °F for 50 hours
- d. Following heat soak, allow reinforcement to stabilize at room temperature
- e. Measure free length without weight in vertical position
- f. Measure extended length with same load as used before 50 hour heat soak

Testing shall be conducted in intervals not exceeding 5 years.

4.5.3.2 Metal Wire, Salt Spray Test

Samples of externally installed metal wire, and of duct material with embedded wire, as constructed in the duct, shall be subjected to salt spray test for 100 hours in accordance with ASTM B117. Testing shall be conducted in intervals not exceeding 5 years.

4.5.3.3 Abrasion Resistance Test

Samples for this test shall be 4 x 12 inches and shall be of the material representative of the outside surface of the hoses. Type I material shall be subjected to a minimum of 2500 cycles on a Tabor Abrader using a H-22 Calibrase Wheel under a log of 1 kg. An alternate of 20000 cycles minimum under a 1 kg load using a CS-17 Calibrase Wheel. Testing shall be conducted in intervals not exceeding 5 years.

4.6 Test Method

The following notes are applicable as indicated to the qualification tests contained in this paragraph of the document:

NOTES:

1. Specimen shall be mounted in a straight line position on test mounts similar to the mount shown in Figure 2, except that both ends shall be rigidly fixed in respect to each other so hose can neither lengthen nor shorten during test. This note is applicable to tests 4.6.2, 4.6.4, 4.6.5, and 4.6.6.
2. Temperatures, pressures, and other test specifications shall be within +10, -0% of specified values.
3. Specimens must be conditioned to 70 °F $\pm$ 5 °F and at 50% $\pm$ 5% relative humidity until moisture equilibrium is reached or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting to tests, 4.6.8.