

MIL-H-5593C
3 April 1981

SUPERSEDING
MIL-H-5593B
23 August 1965

MILITARY SPECIFICATION

HOSE, AIRCRAFT, LOW PRESSURE, FLEXIBLE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers one type of low-pressure flexible hose for use in aircraft application.

1.2 Specification part number for items described in this specification will be formulated as shown in section 6.6.

2. APPLICABLE DOCUMENTS

- * 2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

TT-S-735 Standard Test Fluids, Hydrocarbon

MILITARY

MIL-P-775 Packaging of Hose, Hose Assemblies, Rubber, Plastic, Fabric, or Metal (Including Tubing, Fittings, Nozzles, and Strainers)

MIL-H-5606 Hydraulic Fluid, Petroleum Base, Aircraft Missile, and Ordinance

MIL-M-6002 Marking, Standard Hose, Aircraft

MIL-A-38726 Adaptor Assembly, Reusable, Flexible Hose, Low Pressure

STANDARDS

FEDERAL

FED-STD-595 Colors

FED-STD-671 Rubber, Sampling and Testing

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ AFLC CASO/LODS, Federal Center, Battle Creek, MI 49016 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 4720

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MIL-STD-129 Marking for Shipment and Storage
 MIL-STD-1523 Age Control of Age-Sensitive Elastomeric Material

(Copies of specifications, standards, drawings and publications required by contractors in connections with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Qualification. The hose furnished under this specification shall be a product which has passed the qualification tests specified herin and has been listed on or approved for listing on the applicable qualified products list.

3.2 Material. The hose shall be uniform in shape, free from defects in material and of the quality described in 3.3.

3.3 Design and construction.

3.3.1 Design. The hose shall be designed for assembly with adapter conforming to MIL-A-38726. The physical requirements shall be as specified in Table 1.

* 3.3.2 Construction. The hose shall consist of an inner tube which is adequately reinforced and an outer cover fabricated to withstand all the test requirements of this specification.

* 3.3.3 Inner tube. The inner tube shall consist of a nonblooming compound of seamless construction, uniform in gage and resistant to aromatics. It shall be free from pitting, dirt, foreign material and mandrel lubricants consistent with good manufacturing practices.

3.3.4 Reinforcement. The reinforcement shall consist of yarn, cotton or other suitable material, to provide the necessary added strength for the hose to meet all the test requirements of this specification.

3.3.5 Outer cover. The cover shall be of abrasion-resistant compound of uniform thickness, free from cuts and brakes and shall be resistant to fuel and oil. The cover may incorporate longitudinal corrugations not exceeding 1/32 inch in depth and spaced no more than 1/32 inch apart around the entire periphery of the hose. Surface irregularities, such as mold marks and laps, as distinguished from cracks or cuts, shall not be cause for rejection.

3.4 Dimensions.

3.4.1 Length. Unless otherwise specified, hose shall be furnished in lengths from 20 to 65 feet, except that on such orders, 10 percent may be furnished in random lengths over 10 feet. An additional 10 percent may be furnished in random lengths over three feet. When hose is ordered in specified lengths, a tolerance of +1 percent of the length shall be allowed.

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3.4.2 Concentricity. The inside diameter (ID) and outside diameter (OD) shall be concentric within 0.030 total indicator reading on the -2 and -3 sizes; on sizes -4, -6, -8 and -10 the ID and OD shall be concentric within 0.040 total indicator reading. All readings are to be made on the end of lengths as supplied.

3.4.3. Tube bore. The ID of the hose shall not be reduced by more than 0.020 inch less than the nipple ID after installation of adapters conforming to MIL-A-38726.

3.5 Performance.

3.5.1 Performance of hose. The hose shall satisfy the performance requirements of Section 4 when subjected to the following tests:

a. Proof pressure	4.4.1.1
b. Adhesion	4.4.2.2
c. Tensile strength	4.4.2.3
d. Elongation	4.4.2.4
e. Burst pressure	4.4.2.5
f. Swelling	4.4.3.1
g. Flexibility	4.4.3.2
h. Kinking	4.4.3.3
i. Vacuum collapse	4.4.3.4
j. Low temperature flexibility	4.4.3.5
k. Water and alcohol resistance	4.4.3.6
l. Oil resistance	4.4.3.7

* **3.5.2 Performance of hose assemblies.** Suitable lengths of hose, of each size covered by this specification, shall be assembled with adapters conforming to MIL-A-38726 and subjected to the following tests:

a. Proof pressure	4.3.2.1
b. Burst pressure	4.3.2.2
c. Tensile strength	4.3.2.3

3.6 Marking. The hose shall be marked on the outer surface, parallel to the bore, with the letters "LP", the specification number, a numerical character to indicate the hose size, the date of manufacture in quarter and year and the manufacturer's Federal Supply Code. The marking shall be yellow, color 13538 of FED-STD-595 (gasoline, oil and water resistant), legible with normal vision at a minimum distance of three feet and shall be repeated every 12 inches or less along the entire length of the hose. (Example: LP-MIL-H-5593-6-3065-00000 designates low pressure size -6 manufactured during third quarter calendar year 65 and the manufacturer's specific code number.) The marking shall withstand the test requirements of MIL-M-6002.

* **3.7 Age.** Bulk hose covered by this specification and furnished to the Government shall not exceed the age limit specified in MIL-STD-1523.

3.8 Workmanship. Hose described herein shall be manufactured in accordance with the highest standard practice for products as covered by this specification. Particular attention shall be given to the uniformity of diameter, freedom from cracks and cuts, legibility of marking or other defects which would contribute to the misuse or unsatisfactory operation of the hose.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government 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 the prescribed requirements.

4.2 Classification of tests. The inspection and testing of hose shall be classified as follows:

a. Qualification tests	4.3
b. Acceptance tests	4.4
c. Routine tests	4.4.2

4.2.1 Test conditions. Unless otherwise specified, all test conditions and preparation of test specimens shall be in accordance with FED-STD-601.

4.2.2 Hose assemblies. Hose assemblies used for test purposes shall be made up with adapters conforming to MIL-A-38726.

4.3 Qualification tests.

4.3.1 Sampling instructions. Qualification test samples shall consist of not less than 15 feet of each size hose on which qualification is desired and six hose assemblies fabricated from the same size hose using adapters conforming to MIL-A-38726. For qualification of hose 1/4 inch ID or less, sheets of the same stock and cure as the tube shall be furnished for tensile and elongation tests. All samples shall be identified with the manufacturer's name and this specification number.

4.3.2 Tests. The qualification tests of hose shall consist of all the tests listed herein under qualification tests plus the tests listed under acceptance tests. (The qualification tests may, at the option of the qualifying service, be supplemented by tests under actual service conditions.)

* 4.3.2.1 Proof pressure test of assemblies. All hose assemblies shall be subjected to the applicable proof pressure specified in Table I for a minimum period of 60 seconds and a maximum of five minutes. The test fluid shall be water. There shall be no evidence of permanent deformation, damage or leakage.

* 4.3.2.2 Burst pressure test of assemblies. The hose assemblies shall be subjected to a pressure sufficient to burst the assemblies with rate of pressure equal to 300-1,000 psi per minute. The assemblies shall be observed throughout the test and the type of failure and the pressure at which failure occurred shall be recorded. The assembly shall not leak or show any evidence of malfunction at any pressure below the specified pressure shown in Table I.

4.3.2.3 Tensile strength of assemblies. The end adapters of the hose assembly shall be screwed into the head of the tension testing machine and separated at a speed of approximately one inch per minute. The end adapters shall not pull off nor shall the hose rupture at less than the value for tensile

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TABLE I. Physical requirements.

Size No.	Nominal Inside Diameter	Tolerance Inside Diameter	Outside Diameter	Operating Pressure	Proof Pressure Min.	Burst Pressure Min.	Flexibility Test Weight Max.	Kinking Test Diameter Max.	Tensile Strength of Assembly Min.
	Inch	Inch	Inch	PSI MAX	PSI	PSI	Pounds	Inch	Pounds
2	1/8	± 0.010	.375 \pm .000 -.047	300	600	2,000	0.25	2	100
3	3/16	± 0.016	.438 \pm .000 -.047	250	500	1,700	0.25	2	100
4	1/4	± 0.016	.500 \pm .000 -.047	200	400	1,250	0.25	4	125
6	3/8	± 0.016	.625 \pm .000 -.047	150	300	1,000	0.56	4	150
8	1/2	± 0.023	.781 \pm .000 -.063	150	250	750	1.00	6	200
10	5/8	± 0.023	.906 \pm .000 -.063	150	250	700	2.00	6	200

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strength specified in Table I.

4.4 Hose acceptance tests. Each individual hose submitted for acceptance under contract shall be subjected to the following tests:

4.4.1 Examination of product. All hoses shall be examined for conformance with this specification with respect to materials, workmanship, size, construction and marking.

* 4.4.1.1 Proof pressure test. All hoses shall be subjected to a proof pressure specified in Table I for a minimum period of 60 seconds and a maximum of five minutes. The test fluid shall be water. Evidence of permanent deformation or leakage shall be cause for rejection.

4.4.2 Routine tests. The following number of samples, taken at random from each 10,000 feet or fraction thereof the same diameter hose furnished on contract, shall be subjected to the following tests:

4.4.2.1 Sampling for tests. Two platten press sheets or two 12-inch lengths of hose shall be taken at random for the tensile and elongation tests, except that for hose 1/4 inch ID or less the platten press sheets will be required. The platten press sheets shall not be less than 6 inch by 6 inch by 1/16 inch thick, but not more than 1/8 inch thick, of the same cure and stock as the inner tube.

4.4.2.1.1 Sampling for burst pressure. One hose, of each diameter, 18 inches long shall be required for the burst pressure test.

4.4.2.2 Adhesion. The adhesion between all adjacent parts shall be not less than six pounds per inch on ring specimen.

4.4.2.3 Tensile strength. The tensile strength of the tube and cover material shall be not less than 1,250 pounds per square inch.

4.4.2.4 Elongation. Percent elongation shall be determined at the time of conducting the tensile test. The ultimate elongation of the tube and cover of the hose shall be not less than 175 percent. (Elongation of 2 inches extended to at least 5 1/2 inches.)

* 4.4.2.5 Burst pressure test. The hose shall be subjected to a pressure sufficient to burst the assemblies with a rate of pressure equal to 300-1,000 psi per minute. The assemblies shall be observed throughout the test and the type of failure and the pressure at which failure occurred shall be recorded. The assemblies shall not leak or show any evidence of malfunction at any pressure below the specified pressure shown in Table I.

4.4.3 Periodic control tests. Five hoses, 12 inches long, of each diameter shall be taken at random from each 100,000 feet of hose or each 10 days production, whichever occurs first; and shall be subjected to the following tests:

* 4.4.3.1 Swelling. Three test specimens, each of tube and cover, shall be prepared and tested in accordance with FED-STD-601, Method 6211, except that volume change will be determined within five minutes after removal from test fluid. The tube specimen shall be subjected to immersion in TT-S-735 Type III for 24 hours at room temperature. The volume change shall be within 0 and +65 percent. The cover specimen shall be subjected to immersion in TT-S-735

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Type I for 24 hours at room temperature. The volume change shall be within 0 and +35 percent.

- * 4.4.3.2 Flexibility test. One 12-inch length shall be mounted in a vertical position. The lower end shall be gripped in a vice or other suitable device and a weight equal to the amount specified in Table I attached to the opposite end. The hose shall flex sufficiently to allow the weighted end to drop to a position not less than the fixed end.
- * 4.4.3.3 Kinking. The hose shall be bent around a mandrel with a diameter conforming to the kinking test diameter specified in Table I and exposed to a temperature of $158^{\circ} \pm 1^{\circ}\text{F}$ for three hours. At the end of the three-hour period there shall be no evidence of kinking or hose deterioration.
- * 4.4.3.4 Vacuum collapse. Vacuum shall be applied while the hose is bent around a mandrel having a diameter equal to 10 times the OD of the hose. Hose with ID of less than 1/2 inch shall be subjected to 20 inches of mercury vacuum. Hose with 1/2 inch ID and larger shall be subjected to 10 inches of mercury vacuum. The decrease in OD shall be not more than 20 percent of the original OD in straight configuration.
- * 4.4.3.5 Low temperature flexibility. One air-aged and one oil-aged sample, 12 inches long, shall be used for this test. The test samples shall be placed in an oven at a temperature of $158^{\circ} \pm 2^{\circ}\text{F}$, for a period of seven days. The oil-aged samples shall be filled with oil or immersed in oil conforming to MIL-H-5606. The air-aged samples shall be open to the oven atmosphere. Both test samples shall then be placed in a cold chamber of a temperature of $-67^{\circ} \pm 2^{\circ}\text{F}$ and allowed to remain for 72 hours. After this time and while at $-67^{\circ} \pm 2^{\circ}\text{F}$ the test samples shall be flexed through 180 degrees over a mandrel of the same temperature having a diameter equal to 10 times the OD of the hose, for one cycle. The rate of cycling is one cycle in four seconds. The samples shall then be subjected to proof pressure test specified in Table I. Evidence of leakage or visible cracks shall be cause for rejection.
- * 4.4.3.6 Water and alcohol resistance. Three test specimens, each of tube and cover, shall be prepared and tested in accordance with FED-STD-601, Method 6121, except the tensile test strength shall be determined within 15 minutes after removal from test fluid. The test specimen shall be subjected to immersion in a mixture of 50 percent alcohol and 50 percent water at a temperature of $158^{\circ} \pm 2^{\circ}\text{F}$ for 24 hours. The maximum tensile strength loss of tube or cover shall not exceed 35 percent.
- * 4.4.3.7 Oil resistance. Three specimens of the tube shall be prepared and tested in accordance with FED-STD-601, Method 6121, except that the cooling at room temperature shall be four hours minimum. Using MIL-H-5606 as test fluid, the test specimen shall be immersed at a temperature of $158^{\circ} \pm 2^{\circ}\text{F}$ for a period of seven days. Maximum tensile strength loss shall not exceed 35 percent and the maximum elongation loss shall not exceed 50 percent.

4.4.4 Rejection and retests. Any sample failing to meet the requirements of the routine tests shall be cause for rejecting the lot represented. Any hose failing to meet the requirements of the individual tests shall be cause for rejecting the lot represented. Rejected lots may be replaced or the defects corrected and resubmitted for tests. Full particulars concerning the rejection and the action taken to correct the defects shall be furnished to the procuring agency before resubmitting the lot for tests.

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4.5 Examination of preparation for delivery. The preservation, packaging, packing and marking shall be examined for conformance with the requirements of Section 5.

5. PACKAGING

- * 5.1 Preservation - packaging. Hose units shall be preserved and packaged levels A or C in accordance with MIL-P-775 as specified (see 6.2).
- * 5.2 Packing. Packing shall be levels A, B, or C in accordance with MIL-P-775 as specified (for Army use, fiberboard boxes are not permitted for level A) (See 6.2).
- * 5.3 Marking. In addition to any marking required by the contract or order, interior packaged and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

- 6.1 Intended use. The hose covered by this specification is intended for use as a flexible connection on low pressure air and vacuum instrument systems, automatic pilots and all types of pressure gages in use with these systems.
- * 6.2 Ordering data. Procurement documents shall specify the following:
 - a. Title, number and date of this specification.
 - b. Applicable hose size.
 - c. Selection of applicable levels of preservation, packaging and packing (for Army use, fiberboard boxes are not permitted for level A packing) (see 5.1 and 5.2).
 - 6.3 Qualification. With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the supplier is called to this requirement and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by the specification. The activity responsible for the Qualified Products List is the Engineering Division (99), San Antonio Air Logistics Center, Kelly AFB, Texas, and information pertaining to qualification of products may be obtained from that activity.
 - * 6.4 Reclaimed materials. The use of reclaimed materials shall be encouraged to the maximum extent possible.
 - * 6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any

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inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

6.6 Definitive Specification Part Number.

The specification part number is a definitive part number which will be formulated as follows:

Definitive Military Specification Part Number	M5593 - XX
Military Specification Number	_____
Hose size (see Table 1)	_____

Custodians:
Air Force - 99
Navy - AS

Preparing activity:
Air Force - 99

Project No. 4720-0560

Review activities:
Army - ME
DLA - CS

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