

MIL-H-8794D
 4 February 1971
 SUPERSEDING
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 4 December 1964

MILITARY SPECIFICATION

HOSE, RUBBER, HYDRAULIC, FUEL, AND OIL RESISTANT

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

1. SCOPE

1.1 Scope. This specification covers hose suitable for use in hydraulic, fuel, and oil lines.

1.2 Classification. This hose is of one type used with detachable hose adapters conforming to MIL-A-5070 to fabricate hose assemblies conforming to MIL-H-8795, and shall be of the sizes listed in Figure 1.

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 the specification to the extent specified herein.

SPECIFICATIONS

Federal

TT-S-735 Standard Test Fluids: Hydrocarbon

Military

MIL-H-775 Hose, Rubber, Plastic, Fabric, Or Metal (Including Tubing); And Fittings, Nozzles And Strainers, Packaging Of Adapter, Hose To Tube, Pipe And Flange, Reusable: Hydraulic, Fuel And Oil Lines
 MIL-A-5070
 MIL-H-5606 Hydraulic Fluid, Petroleum Base, Aircraft And Ordnance
 MIL-L-6082 Lubricating Oil: Aircraft Reciprocating Engine (Piston)

STANDARDS

Federal

FED. STD. 595 Colors
 FED. STD. 601 Rubber: Sampling And Testing

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Military

MIL-STD-130

Identification Marking Of US Military Property

MIL-STD-831

Test Reports, Preparation Of Straight Flange Assembly Adapter, Hose To Tube, Reusable, Hydraulic, Fuel And Oil Lines

MS27232

PUBLICATIONS

Air Force-Navy Aeronautical Bulletin

No. 438

Age Controls Of Age-Sensitive Elastomeric Items

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

2.2 Other publications. The following document forms 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 proposal shall apply.

AMERICAN SOCIETY FOR TESTING MATERIALS STANDARD METHOD OF TEST DESIGNATION

ASTM D571-55T

Standard Methods Of Testing Automotive Hydraulic Brake Hose

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

3. REQUIREMENTS

3.1 Qualification. The hose furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3).

3.2 Materials. The hose shall be uniform in quality and free from defects in material. Materials shall conform to applicable specifications and to the requirements specified herein. All materials which are not specifically described herein shall be of the highest quality and suitable for the purpose intended.

3.3 Design. The hose shall be so designed that when used with adapters conforming to MIL-A-5070, the assemblies will be suitable for use in hydraulic, fuel, and oil systems at the applicable pressure listed in Table I.

3.4 Construction.

3.4.1 Hose construction. The hose shall consist of a seamless compounded inner tube, reinforcement and cover, impregnated with a synthetic material, so constructed as to meet the requirements of this specification and to retain the specified adapters without slipping or leaking when tested as specified herein.

TABLE I. Physical Requirements of Hose with Adapters Attached

Size No.	Length of samples for all tests inches $\frac{1}{2}$	Bend radius at inside of band minimum inches	Hydraulic		Fuel		Oil			Burst pressure psi
			Operating pressure psi	Proof pressure psi	Operating pressure psi	Proof pressure psi	Operating pressure psi	surge pressure psi	Proof	
-3	14	3	3,000	6,000	1,000	1,500	50	400	600	12,000
-4	14	3	3,000	6,000	1,000	1,500	50	400	600	12,000
-5	16	3 3/8	3,000	5,000	1,000	1,500	50	400	600	10,000
-6	18	4	2,000	4,500	1,000	1,500	50	400	600	9,000
-8	21	4 5/8	2,000	4,000	1,000	1,500	50	400	600	8,000
-10	23 1/2	5 1/2	1,750	3,500	1,000	1,500	50	400	600	7,000
-12	27 1/2	6 1/2	1,500	3,000	1,000	1,500	50	400	600	6,000
-16	18	7 3/8	800	1,600	750	1,000	50	400	600	3,200
-20	18	9	600	1,250	500	750	50	400	600	2,500
-24	18	11	500	1,000	250	375	50	400	600	2,000
-32	18	13 1/4	350	700	200	300	50	400	600	1,400
-40	18	24	-----	-----	200	300	-----	-----	-----	1,000
-48	18	33	-----	-----	200	300	-----	-----	-----	800

1/ Except as otherwise specified.

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3.4.2 Inner tube. The inner tube shall consist of a compound of seamless construction and uniform gage. It shall have a smooth bore, shall be free from pitting, dirt, foreign material, or mandrel lubricants as is consistent with good manufacturing practice.

3.4.3 Reinforcement. The reinforcement shall consist of an inner cotton braid and a wire braid, braided under proper tension, in order to limit the cubical expansion of the hose to a minimum, and to provide sufficient strength to meet the other requirements of this specification. The wire braid shall be protected against corrosion. No length of hose shall contain broken, spliced, or omitted reinforcing wires.

3.4.4 Cover. The cover shall consist of a synthetic rubber impregnated, oil-resistant, cotton braid. The cover impregnation shall contain a mildew inhibitor.

3.4.5 Dimensions.

3.4.5.1 Concentricity. The outer surface shall be concentric with the inside bore of the hose within 0.020-inch total indicator reading for size -8 and smaller. Sizes larger than the -8 shall be within 0.030-inch total indicator reading. The variation in concentricity between the inside diameter of the inner tube and the outside diameter of the reinforcing material shall not exceed these same values.

3.4.5.2 Diameter. The inside diameter (ID) and outside diameter (OD) of the hose shall be as specified in Figure 1.

3.4.5.3 Length. Unless otherwise specified, hose shall be furnished in lengths of from 20' to 65 feet, except that on such orders, up to 10 percent may be furnished in random lengths over 10 feet, and an additional 10 percent may be furnished in random lengths over 3 feet. When hose is ordered in specified lengths, a tolerance of ± 1 percent of the length shall be allowed.

3.5 Performance.

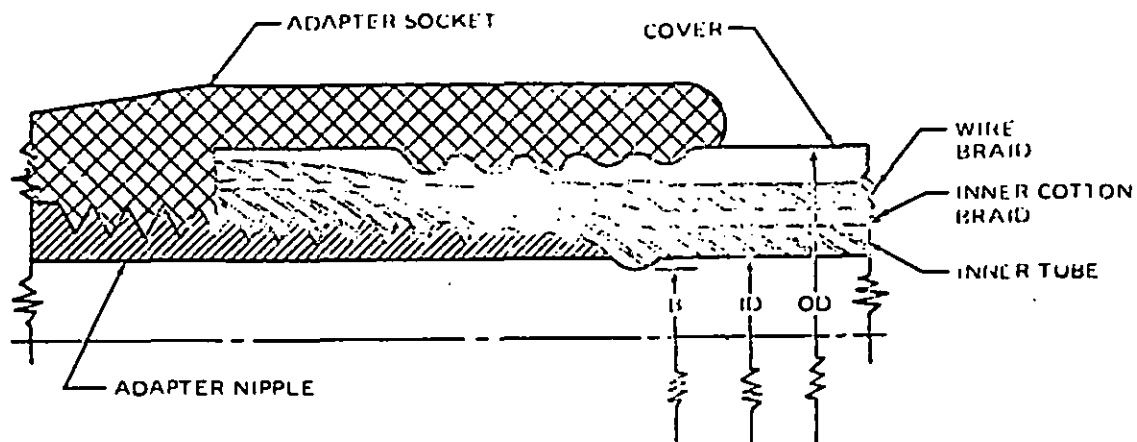
3.5.1 Performance of hose. The hose shall satisfy the following requirements when subjected to the applicable tests of Section 4. Approved adapters qualified to MIL-A-5070 may be used in these tests, except for sizes -40 and -48 which shall conform to MS27232.

3.5.1.1 Proof pressure. Each length of hose shall withstand the hydraulic proof pressure given in Table I without indication of imperfections or leakage when tested as specified in 4.5.1.2.

3.5.1.2 Cubical expansion. The cubical expansion of the -3 and -4 size hose shall be not greater than 0.060, and the -5 size hose shall be not greater than 0.080 cubic centimeter per inch of free length at 1,000 pounds per square inch pressure when tested as specified in 4.4.3.2.

3.5.1.3 Elongation and contraction. The hose, when subjected to the applicable hydraulic operating pressure of Table I, shall not change in length more than +2 or -4 percent. (See 4.4.3.3)

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HOSE SIZE NO.	ADAPTER SIZE NO.	ID INNER TUBE		OD OUTER COVER		"B" MIN DIA
-3	-3	.125	+0.019 -0.000	29/64	+3/128 -1/64	.080
-4	-4	.188	+0.026 -0.000	33/64		.132
-5	-5	.250	-0.031 -0.000	37/64		.200
-6	-6	.313		43/64		.260
-8	-8	.406		49/64	±3/128	.350
-10	-10	.500	+0.039 -0.000	59/64		.450
-12	-12	.625	+0.042 -0.000	1-5/64	±1/32	.575
-16	-16	.875		1-15/64		.781
-20	-20	1.125	+0.047 -0.000	1-1/2		1.015
-24	-24	1.375		1-3/4	1.250	
-32	-32	1.812		2-7/32	±3/64	1.719
-40	-40	2.375	+0.062 -0.000	2-7/8		2.178
-48	-48	3.		3-9/16		2.803

∩ "B" DIA INDICATES MAX PERMISSIBLE BULGE OF INNER TUBE WHEN HOSE IS ASSEMBLED WITH ADAPTERS.

DIMENSIONS IN INCHES.

FIGURE 1. HOSE DIMENSIONS.

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3.5.1.4 Reduction in diameter. The ID of the hose shall not decrease to less than 90 percent of the minimum ID specified in Figure 1 when tested as specified in 4.5.3.2.

3.5.1.5 Water and alcohol resistance. The loss in tensile strength of the tube shall not exceed 35 percent and shall be based on the original cross-sectional area when tested as specified in 4.5.3.6.

3.5.1.6 Fuel resistance. The tensile strength shall be not less than 1000 pounds per square inch, and the elongation shall be not less than 100 percent when tested as specified in 4.5.3.7.

3.5.1.7 Adhesion. The original adhesion between the inner tube and inner cotton braid, and the inner cotton braid and wire braid shall be at least 10 pounds per inch when tested in accordance with 4.5.2.6, and 5 pounds per inch for an oil aged sample.

3.5.2 Performance of hose when assembled. The hose, assembled with applicable end fittings, shall satisfy the following requirements when subjected to the applicable tests of Section 4.

3.5.2.1 Lubricating oil circulation. There shall be no evidence of leakage of the hose or end fittings when tested as specified in 4.4.3.1.

3.5.2.2 Bending and vacuum. Application of the 28-inch mercury vacuum shall not result in more than an additional 10 percent reduction in OD at any section for all sizes up to and including -24 and an additional 25 percent reduction for size -32. (See 4.5.2.5)

3.5.2.3 Proof pressure of hose assemblies. There shall be no leakage when tested as specified in 4.5.1.2.

3.5.2.4 Burst pressure. The hose shall not burst, the adapters shall not blow off or loosen, and there shall be no external leakage from the hose or end fittings below the burst pressure specified, when tested as specified in 4.5.2.1.

3.5.2.5 Leakage. There shall be no direct leakage from the adapter and no seepage back through the fabric which might produce separation or swelling of the hose, when tested as specified in 4.5.2.2.

3.5.2.6 Coupling. No leakage shall occur to the hose assembly when subjected to the applicable hydraulic proof pressure listed in Table I, when tested as specified in 4.5.2.3.

3.5.2.7 Hydraulic impulse test. There shall be no evidence of leakage, blowoff of adapters or other malfunctioning of the hose assemblies when tested as specified in 4.5.3.3.

3.5.2.8 Cold temperature flexing. After being subjected to the tests specified in 4.5.3.4, the hose assemblies shall be examined for leakage. Any evidence of leakage shall be evidence of failure.

3.5.2.9 Fuel immersion. The assembly shall show no evidence of leakage when tested as specified in 4.5.3.5.

3.5.2.10 Collapse. Hose sizes -3 through -10 shall meet the tests of 4.5.2.4.

3.5.2.11 Corrosion. After testing in accordance with 4.5.3.8, the test samples shall meet the burst pressure test of 4.5.2.1.

3.6 Identification or product. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-130. In addition, the cover of each hose shall be identified with a gasoline, oil, and water resistant marking. This marking shall give the specification number, MIL-H-8794, size number, date of manufacture in quarter of year and year, and a manufacturer's Federal Supply Code number, which shall be legible with normal vision at a distance of 3 feet. The marking shall be yellow color 13538 of FED. STD. 595, and shall be repeated every 12 inches, or less, along the entire length of hose. (Example: MIL-H-8794-6-2Q64-0000-----MIL-H-8794-6-2Q64-0000 designates hose size -6 manufactured during second quarter calendar year 1964 by specific manufacturer.)

3.6.1 Use of MIL designations. MIL designations shall not be applied to a product, except for qualification test samples, nor referred to in correspondence, until notice of approval has been received from the activity responsible for qualification.

3.7 Age control. The age or shelf life of hose covered by this specification and furnished for use by the Government shall not exceed the limits established in ANA Bulletin 438.

3.8 Workmanship. Workmanship shall be of the quality necessary to produce hose free from all defects which affect proper functioning in service.

3.8.1 Cleaning. All hose shall be free from oil, grease, dirt, or other foreign materials both internally and externally as is consistent with good manufacturing practice.

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 in the contract or order, the supplier 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 prescribed requirements.

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

- a. Qualification tests (see 4.4)
- b. Quality conformance inspection (see 4.5)

4.3 Test conditions.

4.3.1 Preparation of specimens.

4.3.1.1 Hose and fitting. Hose used for determining performance shall be assembled with adapters made up with approved adapters conforming to MIL-A-5070.

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For qualification tests, only approved adapters shall be used. Qualification will not be required for sizes larger than the -32 size if the material and construction are the same and the -32 size is already approved.

4.3.1.1.1 Approved hose adapters shall be attached to the hose in accordance with the method recommended by the fitting manufacturer.

4.3.1.2 Oil aging. In all of the tests using oil-aged samples in which MIL-H-5606 hydraulic oil is specified, the fluid and hose samples shall be put into a nonpressurized closed-type container or a reflux-type condenser to prevent distillation of the volatile matter in the fluid. A new batch of fluid shall be used for aging each group of test samples during qualification tests. For quality conformance inspection, a new batch of fluid shall be used for each 10 tests, or less. In each case, the volume of oil used shall be sufficient to completely cover the hose. The hose shall be immersed in hydraulic oil 7 days at a temperature of $158^{\circ} \pm 2^{\circ}$ Fahrenheit (F). All air must be excluded from the bore of the tube during this aging test.

4.3.1.3 Air aging. Air-aged samples shall be kept in air at a temperature of $158^{\circ} \pm 2^{\circ}$ F for 7 days.

4.3.1.4 Test fluids. Unless otherwise specified, the lubricating oil test fluid shall conform to MIL-L-6082, grade 1100; hydraulic fluid shall conform to MIL-H-5606; and fuel shall conform to TT-S-735, type III.

4.4 Qualification testing.

4.4.1 Test sample. Test samples as specified in Table II shall consist of a sufficient quantity of each size of hose to conduct the tests specified herein.

TABLE II. Qualification Test Schedule

Sample No.	Type of Sample	Test Sequence - Paragraph Numbers
1 and 2	Strip Specimens	4.5.2.6
3 and 4	Hose	4.5.3.2
5 thru 7	Tube	4.5.3.6
8 thru 10	Tube	4.5.3.7
11 thru 16	Assemblies	4.5.1; 4.5.3.3
17	"	4.5.1; 4.5.2.4
18	"	4.5.1; 4.5.2.5
19 and 20	"	4.5.1; 4.4.3.3; 4.5.3.8; 4.5.2.1
21 and 22	"	4.5.1; 4.5.3.4; 4.5.1.2
23 thru 25	"	4.5.1; 4.5.2.3
26	"	4.5.1; 4.5.3.5
27	"	4.5.1; 4.4.3.1
28	"	4.5.1; 4.4.3.2
29	"	4.5.1; 4.5.2.2

4.4.2 Test report. When the tests are conducted as specified in Section 4, a test report in accordance with MIL-STD-831 shall be furnished to the qualifying activity (see 6.3).

4.4.3 Tests. The qualification tests of hose shall consist of all the tests described herein under quality conformance inspection and, in addition, the following tests. The qualification tests may, at the option of the activity responsible for qualification, be supplemented by tests under actual service conditions.

4.4.3.1 Lubricating oil circulation. A hose assembly shall be subjected to tests in oil conforming to MIL-L-6082, grade 1100, at the operating pressure specified for oil in Table I and at a fluid temperature of $250^{\circ} \pm 5^{\circ}\text{F}$, except that the temperature shall be raised to 325°F for 15 minutes out of every 20 hours of circulation, and that a 400 pounds per square inch surge pressure shall be applied for the first 30 seconds of each 20 hours of circulation. Hose assemblies up to the -24 size shall have 9 inches of free-length hose between adapters. For assemblies of -24 size and larger, the ratio of free-length hose between adapters to nominal hose size in inches shall be 6-1. The following sequence of tests shall be used:

a. The attached assembly shall be installed in a temperature control box. The temperature of the ambient air shall be reduced to $-40^{\circ} \pm 5^{\circ}\text{F}$ and held there for a minimum of 3 hours. Circulation of the fluid at the specified pressure and at a minimum flow of 3 gallons per minute shall then be started.

b. The temperature of the fluid shall then be increased to the specified circulation temperature, $250^{\circ} \pm 5^{\circ}\text{F}$. The ambient air temperature shall be increased to $140^{\circ} \pm 10^{\circ}\text{F}$.

c. Circulation shall be continued for a minimum of 20 hours at which time the above cycle shall be repeated. The assemblies shall be filled with oil conforming to MIL-H-5606 and capped while at room temperature. The assemblies shall remain filled for the remainder of this test. It is recommended that the 15-minute period at 325°F be conducted during the last 30 minutes of the 20-hour cycle. The assembly shall be subjected to 10 such cycles to obtain a minimum of 200 hours fluid circulation.

d. Upon completion of the above test, the assemblies shall be subjected to a static pressure as specified for oil proof pressure in Table I for 5 minutes. The test fluid used for this test shall be MIL-L-6082 oil or MIL-H-5606 hydraulic fluid.

4.4.3.2 Cubical expansion. This test shall be conducted on -3, -4, and -5 size hose only, in accordance with ASTM Standard Designation D571-55T.

4.4.3.3 Elongation and contraction. The hose assemblies shall be a minimum of 15 inches in length. After fabrication, a measured length, not less than 10 inches, shall be marked on the hose. This length shall be measured and recorded. The percent change in length shall then be calculated and shall not exceed +2 or -4 percent.

4.5 Quality conformance inspection. The quality conformance inspection shall consist of individual tests, sampling tests, and special tests.

4.5.1 Individual tests. All hose submitted for quality conformance inspection under contract shall be subjected to the following tests.

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4.5.1.1 Examination of product. All hose shall be examined to determine conformance with this specification with respect to materials, workmanship, cleanliness, size, and marking.

4.5.1.1.1 Determination of size. When determining the size of the hose, measurements shall be made at least one-half inch from the end of the hose and the hose being held straight at the point measured.

4.5.1.2 Proof pressure test. Each length of hose and hose assembly shall be subjected to the hydraulic proof pressure of Table I. The test shall be made with water or oil conforming to MIL-H-5606. Pressure shall be held not less than 30 seconds and not more than 5 minutes. All hose shall be thoroughly dried after testing.

4.5.2 Sampling tests. The following samples of the hose to be furnished on contract shall be selected at random to represent each 20,000 feet or less, of the same size, manufactured during one continuous production run, and shall be subjected to tests specified below:

- a. Two samples at least 1-1/2 feet long for elongation and contraction (see 3.5.1.3), and burst pressure test. (See 4.5.2.1)
- b. One sample 1 foot long for leakage test. (See 4.5.2.2)
- c. Three samples 1 foot long, two of which are within 0.005 inch of the largest OD in the lot and one of which is within 0.005 inch of the smallest, to be subjected to the coupling test. (See 4.5.2.3)
- d. Sufficient hose stock in lengths as specified in Table I for collapse, and bending and vacuum tests. (See 4.5.2.4 and 4.5.2.5)
- e. Sufficient hose stock for adhesion tests. (see 4.5.2.6)

4.5.2.1 Burst pressure test. This test shall be made on two unaged-hose assemblies which shall be subjected to the hydraulic burst pressure of Table I. Test fluid shall be water or MIL-H-5606 oil. The rate of pressure rise shall be 25,000 +0 -10,000 pounds per square inch per minute until the burst pressure is obtained. During this test, the hose assembly shall be fastened at one end to the source of pressure, the hose shall be extended straight, and the free end shall not be restrained or fastened in any way. The actual pressure at which the samples burst shall be recorded.

4.5.2.2 Leakage test. This test shall be made on a hose assembly using MIL-H-5606 hydraulic oil or water as the test fluid. Seventy percent of the hydraulic burst pressure shown in Table I shall be obtained and held 5 minutes, reduced to 0, after which it shall be raised to 70 percent of the minimum burst pressure for a final 5-minute check. The exposed yarn shall be carefully checked during this period for any wicking or leakage of the test liquid which might indicate leakage of the hose.

4.5.2.3 Coupling test. Three assemblies shall be used for this test. The measurement of the bulging of hose inner tubes caused by attachment of the adapter shall be made with a ball-end type gage. The diameter of the ball shall be within 0.001 inch of the minimum bulge diameter specified. The weight of each gage in ounces shall be equal to the dash number of the adapter being tested. In taking the measurement, the gage shall be placed inside the end of

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the assembly without lubrication and without pushing through. The gage shall fall through the section at the end of the adapter insert under its own weight. The following sequence of tests shall be used:

a. The hose shall be conditioned in air at a temperature of 158 \pm 2°F for a minimum time of 16 hours prior to coupling and testing.

b. The adapters shall be assembled in accordance with the procedures recommended by the manufacturers for hand assembly:

c. The bulge of the inner tube shall be checked as specified herein, and it shall not exceed the value specified in Figure 1. The OD of the corresponding hose sample shall also be recorded.

d. The sample assemblies shall be immersed in oil conforming to MIL-H-5606, in a closed vented container for a period of 20 to 24 hours at a temperature of 158° \pm 2°F. For qualification tests, the immersion period shall be 7 days.

e. The bulge of the inner tubes shall again be measured as specified herein and shall not exceed the value specified in Figure 1.

4.5.2.4 Collapse test. This test shall be performed on an oil aged hose assembly. A steel ball of the applicable diameter specified in Table III shall be installed within the hose assembly. The length shall be bent over a form to the radius specified in Table I and a vacuum of 28 inches of mercury applied and held for 5 minutes during which time the hose assembly shall be rotated and rebent over the form at 90 degree intervals throughout 360 degrees. With vacuum still applied the hose assembly shall be straightened and held in a horizontal position and gradually tilted to 30 degrees in each direction. Failure of the ball to roll through the hose assembly shall be cause for rejection. After release of the vacuum, the hose shall be dissected longitudinally and examined for evidence of ply separation, blistering, collapse, or other damage. The test for collapse after oil aging shall be conducted within 1 hour after removal of hose from the test fluid. The hose assembly shall not be dried or washed after oil aging. This test is applicable to sizes -3 through -10 only.

4.5.2.5 Bending and vacuum test. The hose assembly shall be oil aged. The length shall then be bent over a form to the radius specified in Table I and measured at the flattened section. While still bent in this radius, a vacuum of 28 inches of mercury shall be applied and held for 5 minutes during which time the hose shall be checked for additional flattening. After release of the vacuum, the hose shall be dissected longitudinally and examined for evidence of ply separation, blistering, collapse, or other damage. All sizes of hose shall not flatten, or otherwise deform at any section in an amount greater than obtained by 10 percent maximum reduction in outside diameter before the vacuum is applied. This test applies to all sizes with the exception of -40 and -48.

4.5.2.6 Adhesion test. Strip specimens shall be tested for adhesion between the inner tube and inner cotton braid, and inner cotton braid and wire braid in accordance with method 8011 of FED. STD. 601. The test for adhesion after oil aging shall be conducted within 1 hour after removal from the test fluid. This test is applicable to sizes -12 through -48 only.

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TABLE III. Ball Size for Vacuum Test

Hose Dash No.	Ball Dia. \pm .001	Hose Dash No.	Ball Dia. \pm .001
-3	.070	-6	.250
-4	.125	-8	.343
-5	.188	-10	.406

NOTE: Ball shall be adequately perforated to prevent being affected by the vacuum.

4.5.3 Special tests.

4.5.3.1 Periodic control. The following samples of the hose to be furnished on contract shall be selected at random to represent each 100,000 feet or less of the same size, manufactured during one continuous production run, and shall be subjected to the tests specified below:

a. Two lengths 3 inches long for reduction in diameter tests (see 4.5.3.2).

b. Six assemblies of lengths as specified in Table I for hydraulic impulse tests (see 4.5.3.3).

c. Two assemblies of lengths as specified in Table I for -3 through -12 size for cold temperature flexing tests. For -16 and larger the assembly shall be 30 inches in length (see 4.5.3.4).

d. Sufficient tube stock for fuel immersion tests (see 4.5.3.5).

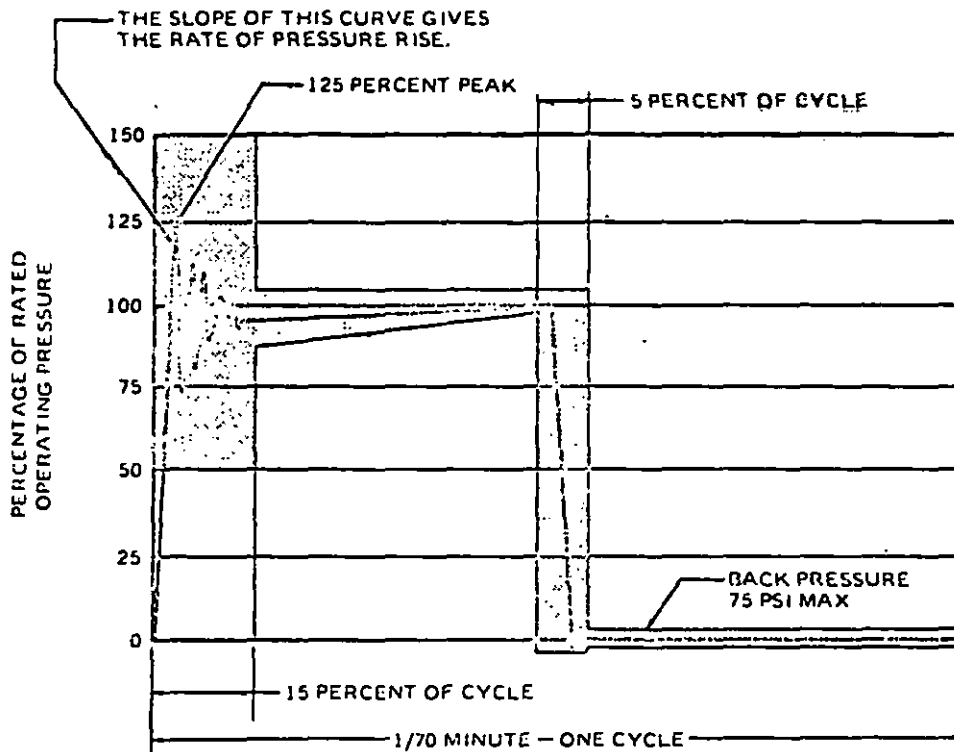
e. Sufficient tube stock for water and alcohol resistance tests (see 4.5.3.6).

f. Sufficient tube stock for fuel resistance tests (see 4.5.3.7).

g. Two samples of lengths at least 1-1/2 feet long for corrosion tests (see 4.5.3.8).

4.5.3.2 Reduction in diameter. Two 3-inch lengths of hose shall be oil aged and measured at each end at least one-half inch inside the hose from the end.

4.5.3.3 Hydraulic impulse test. Six hose assemblies, of the lengths specified in Table I, shall be subjected to the hydraulic impulse tests outlined herein. Two shall be oil aged, two shall be air aged, and two shall be unaged in each case. Oil and air aging shall be accomplished in accordance with 4.3.1.2 and 4.3.1.3, respectively. The test assemblies, in sizes -3 through -16, shall then be connected to a manifold, installed in an impulse test machine which will produce dynamic impulses in the manifold of the magnitude and frequency shown by the graph of Figure 2. Sizes -20 through -32 shall be impulsed in a similar manner, except that they need not be subjected to any peak above the specified operating pressure. The use of electronic pressure measuring devices in determining and controlling the impulse pressure is assumed. All test data and comments shall be recorded with particular reference to the need for retightening adapters, et cetera. The fluid used for the hydraulic impulse tests shall be in accordance with MIL-H-5606, except that up to 25 percent MIL-L-6082, grade 1100 oil may be added to the test fluid and shall be held to



THE CURVE SHOWN ABOVE IS THE APPROXIMATE PRESSURE - TIME CYCLE DETERMINED TO BE OF PROPER SEVERITY FOR IMPULSE TESTING OF HYDRAULIC HOSE. WHILE IT IS MANDATORY ONLY THAT PRESSURE PEAK RISES TO 125 PERCENT OF THE OPERATING PRESSURE AT SOME POINT PRIOR TO LEVELING OFF AT RATED PRESSURE, IT IS CONSIDERED HIGHLY DESIRABLE THAT THE PRESSURE - TIME CURVE BE CONFINED TO THE SHADED AREA INDICATED. ONE VERY DESIRABLE BENEFIT TO BE GAINED IN THIS MANNER IS THAT RESULTS OF TESTS PERFORMED ON DIFFERENT TEST MACHINES WILL BE MORE NEARLY COMPARABLE.

RATE OF RISE IS DEFINED AS THE SLOPE OF THE PRESSURE-TIME CURVE. FOR PURPOSES OF DEFINITION, THE SLOPE SHALL BE DETERMINED BY USE OF A STRAIGHT LINE BETWEEN 10 PERCENT AND 90 PERCENT OF PEAK PRESSURE.

RATE OF RISE WILL BE CALCULATED AS FOLLOWS AND INCLUDED IN TEST REPORT:

P - PEAK PRESSURE IN PSI
 T_1 - TIME AT 10 PERCENT P (SECONDS)

T_2 - TIME AT 90 PERCENT P (SECONDS)

$$\text{RATE OF RISE (PSI/SECOND)} = \frac{.9P - .1P}{T_2 - T_1}$$

FIGURE 2. IMPULSE PRESSURE CURVE.

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a temperature of $120^{\circ} \pm 10^{\circ}\text{F}$ measured at the test manifold. Sizes -3 through -12 hose shall be installed in the hydraulic impulse test machine bent into a U shape, and sizes -16 through -32 may be installed straight. Both ends of the bent samples shall be connected to a rigid support; one end of the straight sample shall be left free. Sizes -3 through -16 shall withstand 200,000 cycles of pressure impulses, and sizes -20 through -32 need only withstand 100,000 impulse cycles.

4.5.3.4 Cold temperature flexing test. Two hose assemblies shall be subjected to the cold temperature flexing tests outlined herein. One assembly shall be oil aged (see 4.3.1.2), and the second one shall be air aged as specified in 4.3.1.3. These assemblies shall be placed in a cold chamber, the temperature of which shall be controlled to -65° to -70°F , and allowed to remain at this temperature for 24 hours (72 hours for qualification test). After this time, and while still at the specified temperature, the two assemblies shall each be flexed through 180 degrees to the bend radius specified in Table I at each extreme of travel, for one cycle, the rate of cycling being approximately one cycle in 4 seconds. Sizes -16 and larger may be tested at -40°F in lieu of -65°F . The hose assemblies shall be subjected to the hydraulic proof pressure after removal from the cold test.

4.5.3.5 Fuel immersion test. A hose assembly having 9 inches of free hose between the adapters shall be immersed in fuel conforming to TT-S-735, type III, for 72 hours at room temperature. Upon completion of this period, the assembly shall be subjected to a static pressure for 5 minutes at the proof pressure specified for fuel in Table I. The test fluid used for pressure checking shall be lubricating oil conforming to MIL-L-6002, grade 1100, or MIL-H-5606 hydraulic fluid. The hose shall then be dissected longitudinally, and any indication of disintegration such as ply separation, solubility of component parts, porosity, blistering, or collapse shall be cause for rejection.

4.5.3.6 Water and alcohol resistance test. Three test specimens of the tube shall be immersed in a solution of half alcohol and half water at a temperature of $158^{\circ} \pm 2^{\circ}\text{F}$ for 24 hours. The sample shall be tested as outlined in method 6121 of FED. STD. 601, except that the tensile strength shall be taken within 15 minutes after removal from the solution.

4.5.3.7 Fuel resistance. Three test specimens of the tube shall be immersed in fuel conforming to TT-S-735, type III, for 72 hours at room temperature. The tensile strength and elongation samples shall be tested as outlined in method 6121 of FED. STD. 601, except that the tensile strength, elongation, and volume increase shall be within 5 minutes after removal from the solution. The loss in tensile strength shall be based on the original cross section. The elongation of the tube after aging shall be 100 percent minimum. Specimens of the tube shall be subjected to the swelling tests specified in method 6211 of FED. STD. 601, except that the specimens shall be immersed for 72 hours at room temperature in fuel conforming to type III of TT-S-735. The volume increase shall not exceed 30 percent for sizes -12 and smaller, and 60 percent for sizes -16 and larger.

4.5.3.8 Corrosion test. Fabricate two hose assemblies from each size hose. With the ends plugged, the assemblies shall be immersed, in a vertical position, into a 2-1/2 percent solution of sodium chloride for a period of 5 minutes. The samples shall then be air dried for 25 minutes at a temperature of 140°F . This immersion and drying cycle shall be repeated for a total of 168 hours. Upon completion of this test, the two test samples shall be subjected to the burst pressure test in accordance with 4.5.2.1.

4.5.4 Rejection and retest. When an 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 have been determined and appropriately corrected. The contractor shall explain to the Government representative the cause of failure and the action taken to preclude recurrence. After correction, all of the tests shall be repeated.

4.5.4.1 Individual tests may continue. For production reasons, individual tests or other sampling plans may be continued pending the investigation of a sampling test failure. Final acceptance of items on hand or produced later shall not be made until it is determined that all items meet all the requirements of the specification.

4.5.5 Defects in items already accepted. The investigation of a test failure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all defects likely to be found and the method of correcting them.

4.6 Examination of preparation for delivery. The preservation, packaging, packing and marking shall be examined to determine conformance to requirements of 5.1.

5. PREPARATION FOR DELIVERY

5.1 Unless otherwise specified, the hose assemblies shall be prepared for delivery in accordance with MIL-H-775 (see 6.2).

6. NOTES

6.1 Intended use. The hose covered by this specification is intended for use in hydraulic, fuel, and oil (petroleum base only) systems when assembled with adapters qualified to MIL-A-5070 and at the pressures specified in Table I. Hydraulic and fuel applications shall be limited to a fluid or ambient temperature range from -65° to $+160^{\circ}$ F for sizes -4 through -12. Lubricating oil applications may operate from a temperature of -65° to $+250^{\circ}$ F; for all other applications, sizes -16 and larger, the temperature range is limited to -40° to $+160^{\circ}$ F. The -3 size shall not be used in hydraulic systems ((see MS33620, note (b))).

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Size and length of hose.
- c. Selection of applicable levels of packaging and packing.

6.3 With respect to products requiring qualification, award will be made only for products which are at the time set for opening of bids, qualified 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 suppliers 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 this specification. The activity responsible for the Qualified Products List is the San Antonio Air Materiel Area, Service Engineering Division, ATTN: MSE, Kelly AFB, Texas 78241, and information pertaining to qualification of products may be obtained from that activity.

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6.4 Age definition. Inasmuch as the hose is dated by quarters of the year, it is necessary to judge their age in terms of time after the quarter and year of manufacture. Hose manufactured during the first quarter of any year will not become one quarter old until the end of the second quarter of that year.

6.5 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 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.

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