

MIL-H-13531C  
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SUPERSEDING  
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## MILITARY SPECIFICATION

### HOSE, RUBBER AND HOSE ASSEMBLY, RUBBER (HYDRAULIC, FLEXIBLE)

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

#### 1. SCOPE

1.1 Scope. This specification covers wire-reinforced rubber hydraulic hose and hose assemblies with permanently attached fittings (see 6.1).

#### 1.2 Classification.

1.2.1 Types. Hose or hose assemblies shall be furnished in the following types as specified (see 6.2):

Type I	- Single wire braid reinforcement.
Type II	- Double wire braid reinforcement.
Type III	- Doubled spiral and single wire braid reinforcement.

1.2.2 Classes. Each of Types I, II and III hose shall be furnished in the following classes as specified (see 6.2):

Class A	- With heavy cover.
Class B	- With thin cover.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in

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Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: DRSTIA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

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that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

## SPECIFICATIONS

## FEDERAL

- |          |  |
|----------|--|
| FF-N-836 | - Nut, Square, Hexagon, Cap Slotted, Castel-<br>lated, Clinch, Knurled, Welding and Single<br>Ball Sect. |
| QQ-P-416 | - Plating, Cadmium (Electrodeposited).   |
| QQ-Z-325 | - Zinc Coating, Electrodeposited, Requirements<br>for.   |

## MILITARY

- |             |  |
|-------------|--|
| MIL-H-6083  | - Hydraulic Fluid, Petroleum Base. for Pre-<br>servation and Operation.  |
| MIL-C-81562 | - Coating, Cadmium and Tin-Cadmium and Zinc<br>(mechanically deposited). |

## STANDARDS

## FEDERAL

- |               |  |
|---------------|--|
| FED-STD-H28/2 | - Screw Thread Standards for Federal Services. |
| FED-STD-162   | - Hose, Rubber, Visual Inspection Guide for    |
| FED-STD-601   | - Rubber: Sampling and Testing.                |

## MILITARY

- |             |  |
|-------------|--|
| MIL-STD-190 | - Identification Marking of Rubber Products. |
| MIL-STD-810 | - Environmental test methods                 |

(Copies of Military specifications, standards, drawings, and publications required by contractors 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(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |              |                |
|--------------|----------------|
| ASTM D380-80 | - Rubber Hose. |
|--------------|----------------|

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

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.)

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## 3. REQUIREMENTS

3.1 Qualification. The hose and hose assemblies furnished under this specification shall be products which have been tested and have passed the qualification tests specified herein and have been listed or approved for listing on the applicable qualified products list (see 4.2, 6.3, and 6.4).

3.2 Materials. Materials shall be as specified herein and in referenced specifications, standards and drawings. Material shall be free of defects which adversely affect performance or serviceability of the finished product (see 6.2 and 6.5).

3.3 Construction. Hose shall be constructed with an inner tube, a wire reinforcement, and an outer cover. Hose assemblies shall consist of hose with fittings assembled on each end. Unless otherwise specified, one fitting in each hose assembly shall be of the male type and one of the female type. The female type shall incorporate a swivel. Dimensions and materials of fittings shall conform to the applicable drawings (see 6.2). Steel fittings, except stainless when furnished, shall be zinc plated in accordance with Type II, Class 2 of QQ-Z-325; Type II, Class 2 of MIL-C-81562; or cadmium plated in accordance with Type II, Class 2 of QQ-P-416 (see 6.2 and 6.6).

3.3.1 Inner tube. The inner type shall consist of an oil-resistant compound of seamless construction and uniform gage. The inner tube shall have a smooth bore, shall be free of pitting and other defects, and shall be cleaned free of dirt, foreign material, and mandrel lubricants.

3.3.2 Reinforcement.

3.3.2.1 Type I. Reinforcement of Type I hose shall consist of one braid of high-tensile steel wire.

3.3.2.2 Type II. Reinforcement of Type II hose shall consist of two or more braids or high-tensile steel wire.

3.3.2.3 Type III. Reinforcement of Type III hose shall consist of one braid of high-tensile steel wire covering two spiral plies of high-tensile steel wire.

3.3.3 Outer cover. Outer cover shall utilize polymerized chloroprene as the basic material, and shall be of such strength as to meet the requirements of this specification.

3.4 Dimensions.

3.4.1 Hose.

3.4.1.1 Hose diameters. Inside diameter and outside diameter of the hose and outside diameter of wire braid shall be as specified in Table I for the specified nominal hose size.

3.4.1.2 Hose length. Unless otherwise specified (see 6.2), bulk hose shall be furnished in lengths of 20 to 65 feet, except that not more than 10 percent may be furnished in random lengths between 10 and 20 feet and not more than an additional 10 percent may be furnished in random lengths between 3 and 10 feet. When hose length is specified, tolerance shall be plus 1/4 inch and minus 1/8 inch for lengths less than 3 feet, and plus or minus 1 percent for lengths of 3 feet or more.

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TABLE I. Hose dimensions.

Nominal hose size (inches)	Wire braid outside diameter				Overall outside diameter			
	Inside diameter Classes A and B (inches)	Type I Classes A and B (inches)	Types II & III Classes A and B (inches)	Type I Class A (inches)	Type I Class B (inches)	Types II & III Class A (inches)	Types II & III Class B (inches)	
3/16	0.138 +.023-.008	0.375 +.023	0.438 +.023	0.500 +.031	0.465 +.023	0.625 +.031	0.535 +.027	
1/4	0.250 +.023-.008	0.438 +.023	0.500 +.023	0.625 +.031	0.527 +.023	0.687 +.031	0.593 +.027	
5/16	0.313 +.023-.008	0.500 +.023	0.563 +.023	0.688 +.031	0.590 +.023	0.750 +.031	0.660 +.027	
3/8	0.375 +.023-.008	0.594 +.023	0.656 +.023	0.781 +.031	0.684 +.023	0.843 +.031	0.754 +.027	
1/2	0.500 +.031-.015	0.719 +.031	0.781 +.031	0.906 +.031	0.805 +.031	0.968 +.031	0.874 +.031	
5/8	0.625 +.031-.015	0.844 +.031	0.906 +.031	1.031 +.031	0.930 +.031	1.093 +.031	1.000 +.031	
3/4	0.750 +.031-.015	1.000 +.031	1.063 +.031	1.187 +.031	1.086 +.031	1.250 +.031	1.156 +.031	
7/8	0.875 +.031-.015	1.125 +.031	1.188 +.031	1.313 +.046	1.211 +.031	1.375 +.031	1.281 +.031	
1	1.000 +.040-.015	1.313 +.031	1.375 +.047	1.500 +.062	1.430 +.031	1.562 +.046	1.500 +.031	
1 1/4	1.250 +.047-.015	1.594 +.047	1.750 +.047	1.812 +.062	1.741 +.047	2.000 +.062	1.857 +.047	
1 1/2	1.500 +.047-.015	1.844 +.047	2.000 +.047	2.062 +.062	1.968 +.047	2.250 +.062	2.148 +.047	
2	2.000 +.047-.015	2.375 +.047	2.500 +.047	2.625 +.062	2.500 +.047	2.750 +.062	2.648 +.047	

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**3.4.2 Fittings.**

**3.4.2.1 Threaded parts.** Screw threads of the form, number per inch, and class specified on the applicable drawing or military standard shall be in accordance with FED-STD-H28/2.

**3.4.2.1.1** When hose assemblies are specified, the fittings shall be the permanently attached type.

**3.4.2.2 Wrench flats.** Nominal distance across wrench flats (hexagon or other) shall be in multiples of 1/16 inch. Tolerance shall not exceed the tolerance across flats for the semifinished hexagon nut, nearest the fitting wrench flat size, as specified in FF-N-836.

**3.4.3 Swivel fittings.** Swivel fittings shall swivel freely with hand torque.

**3.5 Performance.**

**3.5.1 Resistance to impulse pressures.** Hose and hose assemblies shall withstand specified impulse pressures and cycling (see Table II and Figure 1) without hose leakage, leakage between fitting and hose, leakage at the threaded connection, cracking, rupture, or detachment from a fitting.

**3.5.2 Length change.** After being subjected to the applicable working pressure of Table II, hose length change shall not exceed the limit specified in Table III.

**3.5.3 Burst pressure.** Hose or hose assemblies shall withstand, without evidence of leakage, rupture, or detachment of any applicable fittings, the applicable burst pressures specified in Table II.

**TABLE II. Pressure requirements.**

Nominal hose size (ID)	Burst pressure		Proof pressure		Recommended maximum working pressure	
	Type I	Type II & III	Type I	Type II & III	Type I	Type II & III
inches	psi	psi	psi	psi	psi	psi
3/16	12,000	20,000	6,000	10,000	3,000	5,000
1/4	11,000	20,000	5,500	10,000	2,750	5,000
5/16	10,000	17,000	5,000	8,500	2,500	4,250
3/8	9,000	16,000	4,500	8,000	2,250	4,000
1/2	8,000	14,000	4,000	7,000	2,000	3,500
5/8	6,000	11,000	3,000	5,500	1,500	2,750
3/4	5,000	9,000	2,500	4,500	1,250	2,250
7/8	4,000	8,000	2,250	4,000	1,125	2,000
1	4,500	8,000	2,250	4,000	1,125	2,000
1 1/4	2,500	6,500	1,250	3,250	625	1,625
1 1/2	2,000	5,000	1,000	2,500	500	1,250
2	1,500	4,500	750	2,000	375	1,000

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3.5.4 Low temperature flexibility. Hose or hose assemblies, the latter with a free length between fittings as specified in Table III, shall exhibit no cracks in the cover when bent over the applicable mandrel specified in Table III after having been conditioned for not less than 70 hours at minus 67°F  $\pm$  3.6°F ambient air temperature. The specimens shall subsequently meet the requirements of 3.5.5.

TABLE III. Physical requirements.

Nominal hose size	Allowable length change	Maximum bend radius (mandrel radius) Types I, II and III	Hose length impulse test	Hose length for heat resistance and low temperature flexibility
inches	percent	inches	inches	inches
3/16	+0 to -6	4	18	18
1/4	+0 to -6	4	18	18
5/16	+2 to -4	4 1/2	18	18
3/8	+2 to -4	5	18	18
1/2	+2 to -4	7	23	23
5/8	+2 to -4	8 1/2	28	28
3/4	+2 to -4	9 1/2	31	31
7/8	+2 to -4	10 1/2	18	33
1	+2 to -4	11	18	36
1 1/4	+2 to -4	16	18	42
1 1/2	+2 to -4	20	18	42
2	+2 to -4	22	18	42

3.5.5 Proof pressure. Hose and hose assemblies shall withstand the applicable proof pressure specified in Table II without leakage, rupture or detachment from a fitting. Fittings shall withstand the applicable proof pressure specified in Table II without rupture, crack, leakage between fittings and hose, or leakage at a threaded connection.

3.5.6 Oil resistance. Hose inner tube and outer cover specimens shall withstand immersion in oil conforming to MIL-H-6083 at a temperature of 158°F  $\pm$  3.6°F for 168  $\pm$  1/2 hours, with their average volume increasing not more than 30 percent and 100 percent respectively.

3.5.7 Ozone resistance. The hose outer cover elongated 12.5 percent, shall exhibit no cracking when examined under 7 power magnification after having been exposed for a period of 168 hours at a temperature of 100°F  $\pm$  2°F to an ozone concentration maintained at 50  $\pm$  5 parts of ozone per hundred million parts of air. (see 4.5.7)

3.5.8 Fungus resistance. Hose and hose assemblies shall exhibit no evidence of fungus growth after exposure to fungus. (see paragraph 4.6.8)

### 3.6 Marking.

3.6.1 Hose cover material. Hose cover material allowing the following information, repeated at intervals of not more than 12 inches, shall be either embossed or marked in white on the lay line of the hose:

Specification number.

Type.

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Class.  
Nominal size.  
Date of manufacture (quarter and year).  
Capital letters "OZ".  
Manufacturer's code symbol.

Permanence and legibility of marking shall be in accordance with MIL-STD-190.

3.6.2 Hose assemblies. A removable tag shall be attached to each hose assembly and shall contain the following information:

Military part number (when applicable).  
Date of assembly (quarter and year).  
Specification number.

3.7 Age. The age of bulk hose and hose assemblies covered by this specification and furnished for use by Government shall not exceed the limits established in MIL-STD-1523.

3.8 Workmanship. Workmanship shall be in accordance with the best current manufacturing practice and of such quality as to produce hose or hose assemblies free of defects that will affect their strength, assembly, serviceability, or durability.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements 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 prescribed requirements.

4.1.1 Materials, reinforcement and age. The contractor's inspection records shall be examined to determine conformance to 3.2, 3.3.2, and 3.7.

4.2 Classification of inspections. Inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3).
- b. Quality conformance inspection (see 4.5).

4.3 Qualification inspection. Qualification inspection shall be conducted under Government surveillance by the contractor, or by an authorized testing facility at a place approved by the Government, and shall consist of examination for the defects specified in Table V and testing as specified in 4.6.1 through 4.6.8 (see table VI).

4.3.1 Samples for qualification. Samples for qualification shall be representative of the products proposed to be furnished to the Government.

4.3.1.1 Bulk hose qualification samples. One sample, for qualification inspection of one type and nominal size of hose, shall consist of not less than 50 feet of bulk hose (see Table IV).



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4.3.1.2 Hose assembly qualification samples. One sample, for qualification inspection of hose assemblies consisting of one type and nominal size of hose with one or both types of fittings of corresponding size, shall consist of assemblies of lengths and quantities as specified in Table IV for the applicable size and type, plus 6 feet of bulk hose.

TABLE IV. Establishment of qualification and samples required.

Test samples required						Qualification established for	
Type	Size ID (inches)	Assembly Qualification		Bulk hose qualification		Type	Size ID (inches) (of same class as tested)
		Assemblies	Bulk hose	total length (feet)	Total length (feet)		
I	1/4	15 8	18 26	6	50	I	3/16, 1/4, 5/16, 3/8, 1/2
II & III	1/4	15 8	18 26	6	50	III	3/16, 1/4, 5/16, 3/8, 1/2
I & II	1	10 8 6	18 26 37	6	50	I	5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 13/16, 2
III	1	10 8 6	18 26 37	6	50	III	5/8, 3/4, 7/8, 1, 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 13/16, 2

4.3.2 Retention of qualification. Certification shall be requested every two years from each manufacturer listed on the Qualified Products List (QPL), to retain listing on the QPL. This certification shall be forwarded to the preparing activity and shall be signed by a responsible official of management, attesting that the listed product still meets the requirements of the current issue of the specification, is available from the listed plant, and can be produced under the same conditions as originally qualified; i.e., same process, materials, construction, design, and manufacturer's part number or designation. Failure to provide certification will be cause for removal from the QPL (see 6.3).

4.4 Test specimen conditioning. Test specimens to be conditioned shall consist of four untested hose assemblies. Test specimen lengths shall be as required for subsequent tests (see 4.6.1 and 4.6.4). Each test specimen shall be filled with hydraulic fluid conforming to MIL-H-6083 and plugged at one end. The specimens shall be hung in an ambient air temperature of  $250 \pm 5^\circ\text{F}$  for  $24 \pm 1/2$  hours. Following this heating, the specimens shall be allowed to cool to room temperature and the oil shall be drained.



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4.5 Quality conformance inspection.4.5.1 Examination inspection for hose and hose assemblies.

4.5.1.1 Acceptable quality level. "Samples for examination shall be selected in accordance with MIL-STD-105. Each sample selected shall be examined to the following acceptable quality levels (AQL's) on the basis of percent defective."

<u>Classification</u>	<u>AQL</u>
Major	1.0
Minor	2.5

4.5.1.2 Classification of defects. For the purpose of examination inspection, defects shall be classified in accordance with Table V. Description of defects listed shall be as specified in FED-STD-162.

TABLE V. Classification of defects.

<u>Category</u>	<u>Defect</u>	<u>Method of inspection</u>
Major:		
101	Dimensions affecting interchangeability not within tolerance (see 3.3 and 3.4.1 or 3.4.2).	SIE <u>1/</u>
102	Ridge on tube - severe (see 3.3.1).	SIE
103	Bunching of tube - severe (see 3.3.1).	SIE
104	Loose tube (see 3.3.1).	SIE
105	Off center - under gage cover (see 3.3.1).	SIE
106	Hole in tube (see 3.3.1).	SIE
107	Nad lap or delamination of tube (see 3.3.1).	SIE
108	Wire through tube (see 3.3.1).	Visual
109	Wire through cover (see 3.3.3).	Visual
110	Poorly patched cover (see 3.3.3).	Visual
111	Blistered or loose patch on cover (see 3.3.3).	Visual
112	Under gage cover area (see 3.3.3).	Visual
113	Poor coverlap, opening or lack of adhesion (see 3.3.3).	Visual
114	Cover missing (see 3.3.3).	Visual
115	Loose cover (wrinkles when bent) (see 3.3.3).	Visual
116	Exposed wire braid (see 3.3.3).	Visual
117	Depressed area, groove or hole in cover (exceeding specified tolerance) (see 3.3.3).	Visual
118	Split, slit or break in cover (see 3.3.3).	Visual
119	Blister under cover (see 3.3.3).	SIE <u>2/</u>
120	Hose inside diameter at fitting junction out of tolerance (see 3.4.1.1).	Visual <u>2/</u>
121	Swivel fitting will not turn by hand (see 3.4.3).	Visual
122	Misbranding (see 3.6.1 and 3.6.2).	Visual

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TABLE V. Classification of defects. cont'd

Category	Defect	Method of inspection
Minor:		
201	Dimensions not affecting interchangeability out of tolerance (see 3.3 and 3.4.1 or 3.4.2).	SIE
202	Ridge on tube (see 3.3.1).	SIE
203	Bunching of tube (see 3.3.1).	SIE
204	Excessive mandrel lubricant or other foreign material (see 3.3.1).	SIE
205	Off center - but minimum gage in cover met (see 3.3.1).	SIE
206	Under gage cover area (less than one quarter circumference in largest dimension) (see 3.3.3).	Visual
207	Surface lines, ridges or irregularity (see 3.3.3).	Visual
208	Depressed area (within tolerance) (see 3.3.3).	SIE
209	Rough surface (within tolerance) (see 3.3.3).	SIE
210	Wrinkles in cover (see 3.3.3).	Visual
211	Branding not in specified place (see 3.6.1 and 3.6.2).	Visual
212	Improper workmanship (see 3.8).	Visual

1/ SIE = Standard Inspection Equipment.

2/ Hose assemblies only.

4.5.2 Classification of tests. Classification of tests shall be as follows:

- a. Acceptance tests (see 4.5.3).
- b. Control tests (see 4.5.4).

4.5.3 Acceptance tests - 100 percent. All bulk hose and hose assemblies furnished under this specification shall be subjected to acceptance test specified in Table VI.

4.5.3.1 Acceptance test failure. Failure of bulk hose or hose assemblies to pass any examination or test shall be cause to reject failed item.

4.5.4 Control tests.

4.5.4.1 Sampling for bulk hose. Samples shall be selected and tested at the time of manufacture at the rate of one sample for each approximately 10,000 feet of nominal size and type produced for the Government except that not more than two samples shall be selected in any 30 day period. Each sample shall consist of sufficient hose to conduct the specified tests.

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4.5.5.2 Sampling for hose assemblies. Samples shall be selected and tested at the time of assembly of hoses and fittings. One sample shall be selected for each approximately 10,000 feet of hose used in fabrication of each type and size (nominal inside diameter) hose assembly produced for the Government except that not more than two samples shall be selected in any 30 day period. Each sample shall consist of 6 feet of bulk hose and the quantity of hose assemblies of lengths as specified in the applicable tests.

4.5.5.3 Applicable tests. Hose and hose assembly samples selected for control tests shall be subjected to the tests specified in Table VI.

4.5.5.4 Control test failure. Failure of control test sample to pass control inspection shall be cause for Government refusal to accept hose and hose assemblies until corrective action taken by the contractor has been approved by the Government.

TABLE VI. Classification of tests.

Name of test	Requirement	Qualification	Acceptance	Control
Impulse	3.5.1	4.6.1		
Length change	3.5.2	4.6.2		
Burst	3.5.3	4.6.3		4.6.3
Low temperature flexibility	3.5.4	4.6.4		4.6.4
Proof pressure	3.5.5	4.6.5	4.6.5	4.6.5
Oil resistance	3.5.6	4.6.6		
Ozone resistance	3.5.7	4.6.7		
Fungus resistance	3.5.8	4.6.8		

4.6 Conformance verification.4.6.1 Resistance to impulse pressure.

4.6.1.1 Test specimens. Test specimens shall consist of two hose assemblies, each with a free length between fittings as specified in Table III, which have been conditioned in accordance with 4.4.

4.6.1.2 Procedure. To determine conformance to 3.5.1, each test specimen of 3/4 inch inside diameter or less shall be mounted on the impulse test machine in a "U" shape with a bend radius as specified in Table III. Each hose assembly of 7/8 inch inside diameter or larger shall be straight when mounted on the impulse test machine. One end of each test specimen shall be connected to a rigid support and the other end to a nonrigid support to allow for specimen contraction in length. Hydraulic fluid conforming to MIL-H-6083, maintained at a temperature of  $120^{\circ} \pm 10^{\circ}\text{F}$  shall be used as the impulse medium and shall circulate through the hose during the test. Each impulse cycle shall consist of a pressure rise from 0 pounds per square inch (psi) (tolerance plus 150 psi, minus 0 psi) to  $125 \pm 5$  percent of the working pressure specified in Table II (except that the maximum impulse pressure shall not exceed 3,750 psi), followed by a pressure drop to 0 psi (tolerance plus 150 psi, minus 0 psi). The shape of the pressure-time curve shall fall within the shaded area shown in Figure 1. Cycles shall occur at the rate of  $35 \pm 5$  cycles per minute. The test pressure shall be 125 percent of the working pressure specified in Table II for Type III and the one inch

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and smaller ID Type I hoses and 100 percent of the working pressure specified in Table II for the larger than one inch ID Type I hoses except the test pressure shall not exceed 5,000 psi. The number of impulse cycles shall be 150,000 for Type I hoses and 200,000 for Type II and III hoses. Nonconformance to 3.5.1 shall constitute failure of this test."

**4.6.2 Length change.** To determine conformance to 3.5.2, the length change test shall be conducted as specified in ASTM D380, except as modified herein. Test specimens shall consist of three hose assemblies, each not less than 12 inches between fittings. Final pressure shall be the working pressure specified in Table II for the type and size hose tested. Rate of increase from initial (10 psi) pressure to final pressure shall be approximately 1,000 psi per minute. Measurement can be taken 2 minutes after required working pressure has been reached. Average change in length of the three specimens, expressed in percentage of original length, shall be calculated and used to determine conformance to 3.5.2.

**4.6.3 Burst pressure.** To determine conformance to 3.5.3, the three test specimens used in 4.6.2 shall be subjected to the burst pressure test specified in ASTM D380, except as specified herein. The rate of pressure application shall be from 5,000 to 10,000 psi per minute. Pressure shall be increased until each specimen fails. Failure of a hose specimen shall consist of leakage, rupture, or detachment from a fitting. Failure of a hose assembly specimen shall consist of leakage or rupture of the hose or fitting, leakage between hose and fitting or leakage between fitting and test fixture connector. Average burst pressure for the three specimens shall be calculated and used to determine conformance to 3.5.3.

**4.6.4 Low temperature flexibility.**

**4.6.4.1 Test specimens.** Test specimens shall consist of three hose assemblies, each with a free length between fittings as specified in Table III. Two specimens shall be selected from those previously conditioned in accordance with 4.4 and one specimen shall be unconditioned.

**4.6.4.2 Procedure.** To determine conformance to 3.5.4, test specimens and test fixture shall be temperature conditioned as specified in 3.5.4. The test shall then be conducted at the same temperature. Each test specimen shall be tested by bending it around a mandrel until the full length of the hose is in contact with the mandrel circumference, then straightening the hose and bending it in the reverse direction about the mandrel circumference. Each bend shall be accomplished at a substantially uniform rate in  $12 \pm 3$  seconds. The mandrel radius shall be as specified in Table III. Each specimen shall be examined during and after test to determine conformance to 3.5.4.

**4.6.5 Proof pressure.** To determine conformance to 3.5.5, the proof pressure test shall be conducted as specified in ASTM D380, except as modified herein. Control or qualification test specimens shall consist of three hose assemblies previously tested in accordance with 4.6.4.2. Acceptance tests shall be conducted on all bulk hose and hose assemblies submitted in lengths as received. Proof pressures shall be as specified in Table II for the type and size tested. Proof pressure shall be held for not less than 30 seconds, nor more than 60 seconds, during which time each specimen shall be examined for conformance to 3.5.5.

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4.6.6 Oil resistance. To determine conformance to 3.5.6, the oil resistance test shall be conducted as specified in method 6211 of FED-STD-601, except as modified herein. Three specimens shall be taken from the outer cover of untested hose, and three specimens shall be taken from the inner tube of untested hose. Each specimen shall be approximately 2 square inches in area. Each specimen shall be immersed in the hydraulic fluid, at the temperature specified in 3.5.6. The change in volume reported for the outer cover shall be the average of the values obtained from the three outer cover specimens tested. The change in volume of the inner tube shall be the average of the values obtained from the three inner tube specimens tested. The change in volume of the outer cover and inner tube shall each be calculated to determine conformance to 3.5.6.

4.6.7 Ozone resistance. To determine conformance to 3.5.7, a specimen of hose, of full circumference and approximately 10 inches longer than the circumference of the required mandrel, shall be bent around the mandrel, the diameter of which shall be as specified in 4.4, and bound with tape or twine where the ends cross one another. If collapse of the hose occurs where bent around the mandrel, provision shall be made to support the hose internally. This procedure will result in a 12 1/2 percent elongation of the cover. The specimen shall be conditioned for 45 minutes in air at room temperature, and then while still on the mandrel, shall be placed in an exposure chamber. Length of time in the ozone chamber, temperature, and the ozone concentration therein shall be as specified in 3.5.7. The specimen shall be examined daily for cracking, with 7 power magnification and without magnification, except area covered by tape or twine. The first observable cracking shall be recorded. After required exposure to ozone, the specimen shall again be examined with 7 power magnification to determine conformance to 3.5.7.

4.6.7.1 Alternate method. When the size of the hose is large, requiring too large a mandrel, it is permissible to bend the hose specimen around an arc or segment of a mandrel of the proper size, resulting in an elongation of 12 1/2 percent. The ends of the hose shall be tied to the ends of the segment with tape or twine. Examination after exposure shall be restricted to the surface within the 12 1/2 percent elongation.

4.6.8 Fungus resistance. To determine conformance to 3.5.8, test specimens shall consist of six hose assemblies, each with hose length between fittings of not less than 24 inches. Specimens shall be tested in accordance with MIL-STD-810, method 508, procedure I. Two specimens shall be subjected to the proof pressure test (see 4.6.5) after each of the incubation periods (30, 60 and 90 days) to determine conformance to 3.5.8.

## 5. PACKAGING

5.1 Preservation, packaging, packing and marking. Preservation, packaging, packing and marking for the desired level of protection shall be in accordance with the applicable packaging standard or packaging data sheet specified by the procuring activity (see 6.2).

## 6. NOTES

6.1 Intended use. Hose and hose assemblies covered by this specification are intended for use in medium and high pressure hydraulic systems at temperatures

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between minus 65° and plus 200° F.

**6.2 Ordering data.** Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Hose type, class and nominal size (see 1.2.1, 1.2.2 and Table I).
- c. Title, number, and date of applicable drawings (see 3.3).
- d. Fitting description where applicable (see 3.3).
  - (1) Male or female.
  - (2) Fixed or swivel.
  - (3) Thread size.
  - (4) Hose to pipe or hose to tube.
  - (5) Flare type (S.A.E. or J.I.C.) or flareless (compression) type where applicable.
  - (6) Type of plating on fittings (see 3.3).
- e. Hose or hose assembly length where applicable (see 3.4.1.2).
- f. Required level of preservation and packaging, and packing (see 5.1)

**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 on the applicable Qualified Products List, whether or not such products have actually been so listed by that date. The attention of contractors is called to this requirement, and manufacturers are urged 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 parts covered by this specification. The activity responsible for the QPL is the Commanding General, US Army Tank-Automotive Command, ATTN: DRSTA-GSS, Warren, MI 48090, and information pertaining to qualification of products may be obtained from that activity.

**6.4 Special provisions for establishing qualification.** Qualification by test of types and classes of hose specified in 1.2, submitted by a manufacturer, will establish qualification for other nominal sizes of the same type hose for that manufacturer in accordance with Table IV. Qualification by test of hose assemblies consisting of hose of a given type (see 1.2) with assembled fittings of a given description (see 6.2), of 1/4 inch or 1 inch nominal size, submitted by a manufacturer, will establish qualification for other nominal sizes of hose assembly (with the same hose type and fitting design) for that manufacturer in accordance with Table IV.

**6.5 Recycled materials.** The use of recycled raw materials which meet the requirements of the applicable material specifications without jeopardizing the intended use of the item shall be encouraged (see 3.2).

**6.6 Cadmium effluents.** Electroplaters of cadmium plated fittings must meet all federal, state and local requirements for waste treatment of cadmium effluents (see 3.3).

**6.7 Changes from previous issue.** Asterisks are not used in this revision, to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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Navy - MC

Review activities:

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DLA - CS

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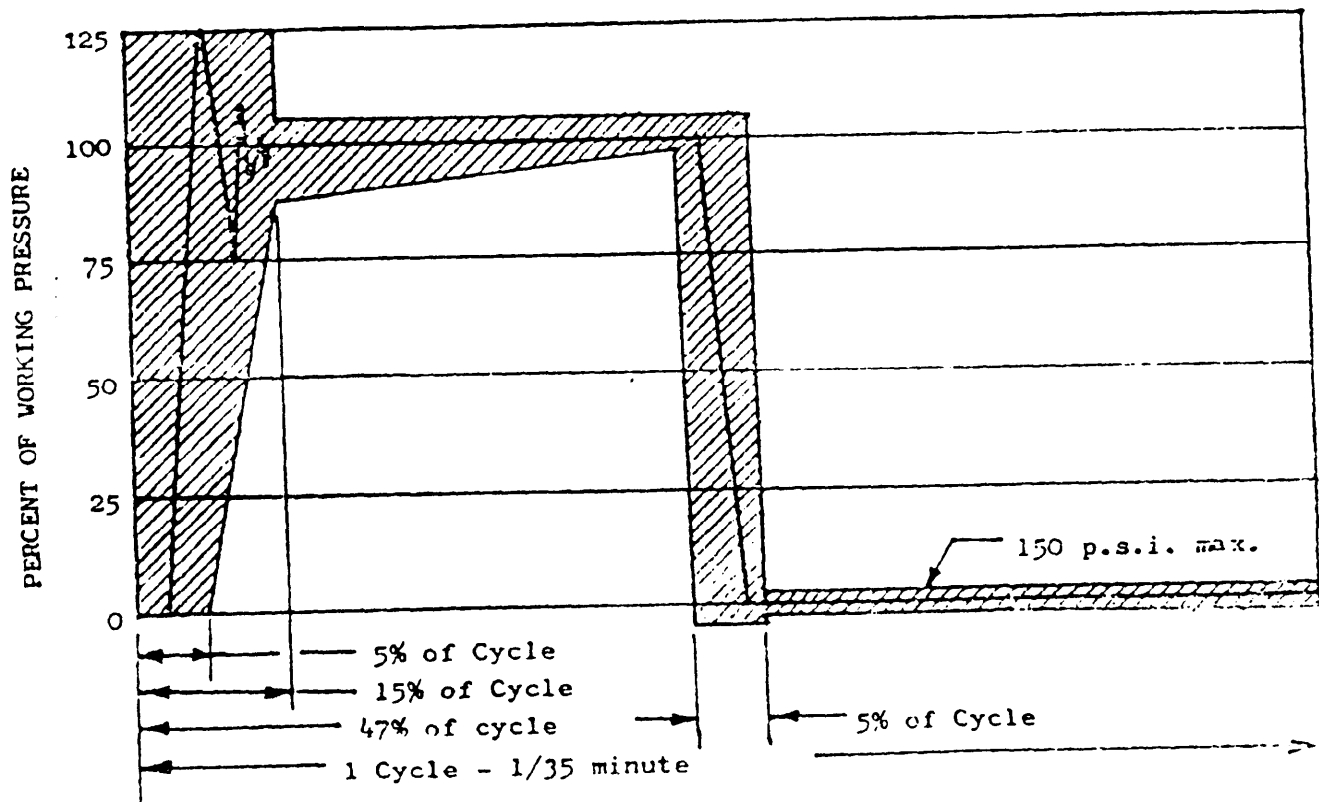


FIGURE 1. Impulse pressure cycle.

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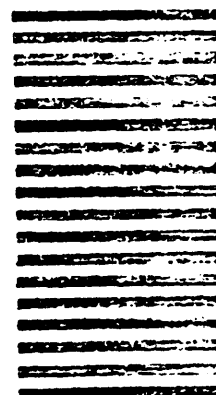
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