

MIL-H-3992D  
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SUPERSEDING  
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## MILITARY SPECIFICATION

### HOSE AND HOSE ASSEMBLY, RUBBER: AIR AND VACUUM BRAKE, AUTOMOTIVE

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

#### 1. SCOPE

1.1 Scope. This specification covers construction, performance, and quality requirements of air and vacuum hose and hose assemblies intended for use as flexible connections on automotive air and vacuum brake systems (see 6.1).

#### 1.2 Classification.

1.2.1 Types. Brake hoses shall be of the following types (see 6.2):

Type I	- Air brake hose.
Type II	- Vacuum brake hose.

1.2.2 Classes. Type I hose shall be furnished in the following classes (see 6.2):

Class 1	- Mandrel built, reinforced with cotton or synthetic fiber yarn.
Class 2	- Non-mandrel built, reinforced with cotton or synthetic fiber yarn.
Class 3	- Mandrel built, reinforced with one braid of high tensile steel wire.

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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: DRSTA-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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- Class 4 - Mandrel built, reinforced with two cotton or synthetic fiber yarn braids separated by a high tensile steel wire braid.

1.2.3 Styles. Type II hose shall be furnished in the following styles (see 6.2):

- Style A - Heavy duty.  
Style B - Light duty.

1.2.4 Ambient temperature usage. Hoses and hose assemblies covered by this specification are to be used for automotive applications operating in a temperature range not exceeding 200°F and not below -60°F.

## 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 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, Castle, Knurled, Welding and Single Ball Seat.  
QQ-P-416 - Plating, Cadmium (Electrodeposited).  
QQ-Z-325 - Zinc Coating, Electrodeposited, Requirements for.  
TT-S-735 - Standard Test Fluids; Hydrocarbon.

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- MIL-F-13927 - Fungus Resistance Test; Automotive Components.  
MIL-C-81562 - Coating, Cadmium, Tin cadmium and Zinc (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.

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- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-190 - Identification Marking of Rubber Products.
- MIL-STD-1923 - Age Control of Age-Sensitive Elastomeric Materials.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting 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 D380-81 - Rubber Hose, Method of Testing.
- ASTM D413-76 - Rubber Property - Adhesion for Flexible Substrate, Test Method for.
- ASTM D622-81 - Rubber Hose for Automotive Air and Vacuum Brake System, Method of Testing.

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

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

## 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 (QPL) (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).

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3.3 Construction. Hose shall be constructed with an inner tube, a 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-7-325; 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 tube shall consist of a synthetic rubber compound capable of meeting the requirements of this specification including exposure to hydrocarbon test fluid (see 3.6.12). The inner tube shall have a smooth bore, shall be free of pitting, cracks and other recognizable defects. The bore shall be free of dirt and other foreign material and shall not contain residual mandrel lubricant to the extent that the requirements of this specification cannot be met.

3.3.2 Reinforcement. The hose shall have a reinforcement of cotton or synthetic fiber yarn or fabric, steel wire, or a combination thereof (see 1.2.2).

3.3.3 Outer cover. The outer cover shall consist of a synthetic rubber compound capable of meeting the test requirements of this specification including ozone resistance and exposure to hydrocarbon test fluid. The outer cover shall be of uniform thickness and be free of cuts, breaks, blisters and other recognizable defects.

#### 3.3.4 Fittings.

3.3.4.1 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.

3.3.4.2 Interchangeability. Fittings shall conform to the performance requirements specified herein when installed on any hose conforming to the requirements specified herein and when attached to any standard mating part for the specified fitting type and size (see 4.3.2.1).

3.3.4.2.1 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.

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3.3.4.3 Swivel fittings. Swivel fitting shall swivel freely with hand torque.

3.4 Diameters. Diameters and tolerance of hose shall be as shown in table I.

3.5 Lengths. Hose shall be furnished in lengths as shown on applicable drawings (see 6.2).

3.6 Performance.

3.6.1 Burst pressure. The hose shall not burst or show signs of failure, and the hose assemblies shall not leak at any hydrostatic pressure up to and including that shown in table II (see 4.6.1).

3.6.2 Length change (type I). Type I, classes 1, 2, 3 and 4, hoses or hose assemblies, shall not contract in length more than 3 percent, nor elongate more than 5 percent when tested in accordance with procedures defined in ASTM D622 (see 4.6.2).

3.6.3 Air leakage. Hose assemblies, shall show no leaks while being subjected to 200 pounds per square inch (psi) internal air pressure and immersion in water (see 4.6.3).

3.6.4 Resistance to aging. Hose or hose assemblies, shall show no cracks, breaks, or other visual disintegration, internally or externally, after being bent against a form as defined in table II and figure 1, fixed in position, placed in an air oven heated for 70 hours at a temperature of  $212^{\circ}\text{F} \pm 2^{\circ}\text{F}$ , and straightened (see 4.6.4).

3.6.5 Low temperature flexibility. Hoses shall show no breaks or cracks after being conditioned for 72 hours in a straight position at minus  $65^{\circ} \pm 2^{\circ}\text{F}$ , and then being bent 180 degrees over a mandrel ten times the hose diameter (see 4.6.5).

3.6.6 Ozone resistance. Hose outer cover specimens cut from untested hose shall exhibit no cracking when examined under 9 power magnification after having been conditioned for 45 minutes in air at room temperature and then being exposed for a period of 168 hours at a temperature of  $100^{\circ} \pm 5^{\circ}\text{F}$  to an attack of ozone concentration maintained at  $50 \pm 5$  parts of ozone per hundred million parts of air by volume (see 4.6.6).

TABLE I. Diameters of hose.

Outside diameter tolerance (inches)										
Nominal size I.D. (inches)	Type I				Type II		Type I			Type II
	Class 1		Class 2		Style A	Style B	Class 1 and 2 + 1/32	Class 3 O.D. 2/ over wire	Class 4 + 1/32 Min. Max. A + 1/32 + 1/32	Style R
	1	2	3	4						
3/16 1/32	+1/64 (*)	+3/128 (*)	0.005 (*)	(*)	+0.028, -0.032 (*)	17/32 (*)	.500 .539	(*)	7/16	
1/4	+1/64	+3/128	+1/64	-0.008 +0.008, -0.020 +0.023	(*)	5/8	7/16 + 3/128	5/8	.562 .602 9/16 (*)	
5/16	+1/64	+3/128	-0.008 (*)	(*)	(*)	11/16	.656 .699	(*)	(*)	
11/32	(*)	(*)	(*)	(*)	+0.028, -0.032 (*)	(*)	3/4	19/32 + 3/128	25/32 13/16 (*)	
3/8	+1/64	+3/128	+1/64	+0.008, -0.020 +0.023	(*)	(*)	.742 .789	(*)	(*)	
13/32	+1/64	+1/32	0.008	(*)	(*)	13/16	(*)	(*)	(*)	
7/16	(*)	(*)		(*)	(*)	(*)	(*)	(*)	(*)	
15/32	(*)	(*)		(*)	(*)	(*)	(*)	(*)	(*)	
1/2	+1/64	+1/32	+3/128	-0.008 +0.008, -0.020 +0.023	(*)	7/8	23/32 +1/32	29/32 .898 .945	15/16 (*)	
5/8	+1/64	+1/32	-0.008 +0.008, -0.020 +0.023	(*)	(*)	1-1/16	1.054 1.101	1-1/16 (*)	(*)	
3/8 Spectral	+1/64	+1/32		(*)	(*)	1-3/8	(*)	(*)	(*)	
3/4	(*)	(*)		+0.008, -0.020 (*)	(*)	(*)	(*)	(*)	1- 3/16 (*)	
1	(*)	(*)		+0.010, -0.022 (*)	(*)	(*)	(*)	(*)	1-15/32 (*)	

\* Not applicable.

1/ 3/16 inch size class 1 and 2 may be single ply reinforcement.

2/ Outside diameter over wire reinforcement.

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3.6.7 Collapse under vacuum (type II). The outside diameter of a specimen of type II hose shall not collapse in excess of 1/16 inch after being subjected to an internal vacuum of 26 inches of mercury for 5 minutes (see 4.6.7).

3.6.8 Hot vacuum collapse and degradation (type II).

3.6.8.1 Hot vacuum collapses. The outside diameter of a specimen of type II hose shall not collapse in excess of 15% of the original O.D. for style B hose, and 10% of the original O.D. for style A hose, while under an internal vacuum of 88 kPa (26 inches of mercury), after being subjected to a temperature of 125°C (257°F) for 96 hours (see 4.6.8.1).

3.6.8.2 Hot degradation. The above specimen, after cooling for four hours and being bent around a mandrel of a diameter 8 times the diameter of the hose, shall show no embrittlement or other evidence of degradation. The same hose sample shall show no leaks after being subjected to a proof pressure of 1.21 MPa (175 psig) for 1 minute (see 4.6.8.2).

3.6.9 Bend collapse (type II). The outside diameter of a specimen of type II hose shall not collapse in excess of the values shown in table II after being bent, with the bending force applied at the ends of the hose, until the ends meet (see 4.6.9).

3.6.10 Adhesion. Hose specimens of each type shall show no separation of the plies, the tube from the plies, or the cover from the plies upon application of a load of not less than 10 pounds per inch of hose width, using a tension test machine with ring type specimens (see 4.6.10).

3.6.11 Breaking strength of assemblies (type I). Type I hose assemblies shall withstand a minimum pull of 325 pounds without separation from the fittings or rupture of the hose structure (see 4.6.11).

3.6.12 Resistance to swell.

3.6.12.1 Type I. The tube shall show a volume increase of not more than 35 percent, and the cover shall show a volume increase of not more than 50 percent, when the type I specimen is soaked for 46 hours at room temperature using test fluid conforming to type I of TT-S-735 (see 4.6.12.1).

3.6.12.2 Type II. A 12 inch piece of style A hose, after being filled with test fluid conforming to TT-S-735 and held at room temperature for 48 hours, shall show a volume change limited to the extent that a steel ball of a diameter specified in table II shall pass through the hose freely immediately upon removal of the solvent from the

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TABLE II. Hose test data.

Hose size I.D.	Form dimensions (see figure 1)										Burst pressure	Swell type II only	
	Aging					Bend type II only						Ball diameter	Ball diameter
	Speci- men length inches	A inches	B inches	R inches	C (min.) inches	Speci- men length inches	Maxi- mum collapse of O.D. inches	Type I class psi	Type I class psi	Type II style A psi			
3/16	9	4-1/2	3	1-1/2	1/2	7	11/64	900	10,000	350	(*)	1/16	(*)
7/32	8	4-1/2	3	1-1/2	1/2	8	3/32	900	10,000	1,200	3/16	(*)	(*)
1/4	9	4-1/2	3	1-1/2	1/2	(*)	(*)	900	9,000	(*)	(*)	(*)	(*)
5/16	10	4-3/4	3-1/2	1-3/4	3/4	11	13/64	(*)	8,000	150	(*)	3/32	(*)
11/32	9	4-3/4	3-1/2	1-3/4	3/4	12	5/32	900	8,000	1,200	5/16	(*)	(*)
3/8 & 13/32	10	4-3/4	3-1/2	1-3/4	3/4	(*)	(*)	900	(*)	(*)	(*)	3/32	(*)
7/16	11	5	4	2	3/4	14	17/64	(*)	7,000	350	13/32	(*)	(*)
15/32	11	5	4	2	3/4	16	7/32	900	6,000	1,000	17/32	(*)	(*)
1/2	11	5	4	2	3/4	22	7/32	900	6,000	1,000	(*)	(*)	(*)
5/8	12	5-1/2	4-1/2	2-1/4	1	(*)	(*)	900	(*)	800	5/8	(*)	(*)
5/8 Special	14	6	5	2-1/2	1	28	7/32	(*)	(*)	800	7/8	(*)	(*)
3/4	14	6	5	2-1/2	1	36	9/32	(*)	(*)	800	(*)	(*)	(*)
1	16	7	6-1/2	3-1/4	1-3/8								

\* Not applicable.



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hose. The specimen shall show no separation of the inner tube from the plies, or the cover from the plies following a vacuum test after the steel ball has been passed through the specimen (see 4.6.12.2).

3.6.13 Fungus resistance. Hose and hose assemblies shall be fungus resistant. After being exposed to fungus, specimens shall meet the requirements of 3.6.1 (see 4.6.13 and 4.6.1).

3.7 Marking. Marking shall be in accordance with MIL-STD-130 and MIL-STD-190.

3.7.1 Hose cover. The hose cover material shall have the following information legibly marked on the lay line of the hose at intervals of not more than 15 inches:

Specification number.

Type.

Class (type I only).

Style (type II only).

Nominal size.

Date of manufacture (quarter and year).

Manufacturer's identification.

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

Military part number.

Date of assembly (quarter and year).

Manufacturer's identification.

Cure date (quarter and year) for bulk hose used in assembly.

3.7.2.1 Age control. Storage and usage of hose assemblies supplied to this specification shall conform to requirements of 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, 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

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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. To determine conformance to 3.2, the contractor's inspection records shall be examined by the Government.

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. A qualification sample as indicated in table III shall be divided as necessary to provide the specimen size required for each test specified in table IV. The sample shall be representative of the units proposed to be furnished to the Government. 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 table IV.

TABLE III. Extension of qualification and samples required.

Samples required for test										
Hose qualified, hose tested		For assemblies			For bulk hose			Qualification extended to		
		Free hose		Quantity	Bulk hose, total		Hose only, total	Type	Class	Style
		length (inches)	length (feet)		length (inches)	length (feet)				
Type	Class	Style	Size ID (inch)	Quantity	Free hose length (inches)	Bulk hose, total length (feet)	Hose only, total length (feet)			Size ID (inch)
I	(any class)		3/8	7 2	36 18	25	55	I	The same as tested	3/16, 1/4, 5/16, 3/8
I	(any class)		5/8	7 2	36 18	25	55	I	The same as tested	7/16, 1/2, 5/8
I	(any class)		5/8 special	7 2	36 18	25	55	I	The same as tested	5/8 special
II	A		1/2	7 3 2	36 18 10	25	55	II	A	1/4, 3/8, 1/2
II	A		1	7 3 2	36 18 10	25	55	II	A	5/8, 3/4, 1
II	B		15/32	7 3 2	36 18 10	25	55	II	B	7/32, 11/32, 15/32

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4.3.1 Bulk hose qualification samples. One sample, for qualification inspection of one type and nominal size of hose, shall consist of not less than 55 feet of bulk hose (see table III).

4.3.2 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 III for the applicable size and type, plus 25 feet of bulk hose.

4.3.2.1 Fittings interchangeability. To insure interchangeability of fittings, additional hose assemblies will be required for qualification testing as specified in tables III and IV, whenever new or optional design fittings, new or optional design mating parts, or new acquisition sources are utilized (see 3.3.4.2).

4.3.3 Retention of qualification. Certification shall be requested every two years from each manufacturer listed on the 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.

TABLE IV. Qualification testing.

Specimen no.	Type	Applicable hose type	Test paragraph no.	Test name
1	Assembly	I	4.6.1	Burst pressure
2	Assembly	I	4.6.2	Length change
3	Assembly	I	4.6.3	Air leakage
4	Bulk	I	4.6.4	Resistance to aging
5, 6 and 7	Bulk	I	4.6.5	Low temperature flexibility
8	Bulk	I	4.6.6	Ozone resistance
9	Bulk	I	4.6.9	Adhesion
10	Assembly	I	4.6.11	Breaking strength of assemblies
11	Bulk	I	4.6.12.1	Resistance to swell
12, 13 and 14	Assembly	I	4.6.13	Fungus resistance
1 and 2	Assembly	II	4.6.1	Burst pressure
3	Assembly	II	4.6.3	Air leakage
4	Bulk	II	4.6.4	Resistance to aging

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TABLE IV. Qualification testing. - Continued

Specimen no.	Type	Applicable hose type	Test paragraph no.	Test name
5, 6 and 7	Bulk	II	4.6.5	Low temperature flexibility
8	Bulk	II	4.6.6	Ozone resistance
9	Assembly	II	4.6.8	Hot vacuum collapse and degradation
10	Bulk	II	4.6.9	Bend collapse
11	Bulk	II	4.6.10	Adhesion
12	Assembly	II	4.6.11	Breaking strength of assemblies
13	Bulk	II	4.6.12.2	Resistance to swell
14, 15 and 16	Assembly	II	4.6.13	Fungus resistance

4.4 Test conditions. Unless otherwise specified herein, tests shall be conducted in an ambient air temperature of  $77^{\circ} \pm 15^{\circ}\text{F}$ . Temperature of the test specimens shall be stabilized at this temperature prior to testing. When a mandrel is required for testing purposes, the diameter of the mandrel shall be as specified in the applicable test paragraph.

#### 4.5 Quality conformance inspection.

##### 4.5.1 Sampling.

4.5.1.1 Lot formation. Unless otherwise specified (see 6.2), a lot shall consist of all hose or hose assemblies of one type and part number, from an identifiable production period, from one manufacturer, submitted at one time for acceptance.

4.5.1.2 Sampling for examination. Samples for quality conformance examination shall be selected in accordance with MIL-STD-105.

4.5.1.3 Sampling for acceptance testing. Samples for acceptance testing shall be selected in accordance with level S3 of MIL-STD-105.

##### 4.5.2 Quality conformance examination.

4.5.2.1 Acceptable quality level. Each hose or hose assembly selected in accordance with 4.5.1.2, shall be examined for conformance

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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

4.5.2.2 Classification of defects. For examination purposes defects shall be classified as specified in table V. FED-STD-162 shall be used as a guide for visual inspection. Any units in the sample containing one or more defects shall be rejected, and if the number of defective units in any one sample exceeds the quality conformance number for that sample, the lot represented by the sample shall be rejected.

TABLE V. Classification of defects.

<u>Category</u>	<u>Hose only</u>	<u>Hose assy.</u>	<u>Defect</u>	<u>Method of inspection</u>
<u>Major:</u>				
101	X	X	Dimensions affecting interchangeability not within tolerance (see 3.3, 3.4 and 3.5).	SIE 1/
102	X	X	Exposed reinforcement (see 3.3).	Visual
103	X		Loose cover (see 3.3.3).	Visual
104	X		Blisters (see 3.3.3).	Visual
105	X	X	Break in cover (see 3.3.3).	Visual
106		X	Improper size, length or form of thread (see 3.3.4.1).	SIE
107		X	Improperly attached fittings (see 3.3.4.2).	Visual
108		X	Damaged or defective seating end fittings (see 3.3.4.2).	Visual
<u>Minor:</u>				
201	X	X	Dimensions not within specified tolerances (see 3.3 and 3.5).	SIE
202	X	X	Excessive mandrel lubricant or other foreign material (see 3.3.1).	Visual
203	X		Knife cuts (see 3.3.3).	Visual
204		X	Improper angle or depth of seat (see 3.3.4.2).	SIE
205		X	Failure of swivel-type fitting to move properly (see 3.4.3).	Visual
206	X	X	Improper, illegible or missing marking (see 3.7).	Visual
207	X	X	Workmanship (see 3.8).	
1/ SIE = Standard inspection equipment.				

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

- a. Acceptance tests (see 4.5.4).
- b. Control tests (see 4.5.5).

4.5.4 Acceptance tests. Samples selected in accordance with 4.5.1.3 shall be examined for the defects specified in table V and subjected to acceptance tests specified in table VI, using an AQL of .65 on the basis of percent defective.

4.5.4.1 Acceptance test failure. Failure of an acceptance test sample(s) to pass any examination or test shall be cause for Government refusal to accept hose and hose assemblies until corrective action by the contractor has been approved by the Government and successful retest has been accomplished.

4.5.5 Control tests.

4.5.5.1 Sampling for bulk hose. Samples shall be selected and tested at the time of manufacture at the rate of one sample for each 2000 feet of nominal size and type produced, 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.

4.5.5.2 Sampling for hose assemblies. Samples shall be selected and tested at the time of assembly of hoses and fittings at the rate of four of each 500 assemblies produced, except that not less than four nor more than eight assemblies shall be selected in any 30-day period. Each sample shall consist of 25 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 examined for the defects specified in table V and subjected to the tests specified in table VI.

4.5.5.4 Control test failure. Failure of a control test sample to pass any examination or test 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.

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TABLE VI. Classification of tests.

Name of test	Requirement	Acceptance	Control	
			Assy.	Bulk
Burst pressure	3.6.1	4.6.1		
Length change	3.6.2	4.6.2		
Air leakage	3.6.3		4.6.3	
Resistance to aging	3.6.4		4.6.4	4.6.4
Low temperature flexibility	3.6.5		4.6.5	4.6.5
Ozone resistance	3.6.6		4.6.6	4.6.6
Collapse under vacuum	3.6.7	4.6.7		
Hot vacuum collapse and degradation	3.6.8		4.6.8	
Bend collapse	3.6.9	4.6.9		
Adhesion	3.6.10	4.6.10		
Breaking strength	3.6.11		4.6.11	
Resistance to swell (type I)	3.6.12.1	4.6.12.1		
Resistance to swell (type II)	3.6.12.2	4.6.12.2		

#### 4.6 Conformance verification.

4.6.1 Burst pressure. To determine conformance to 3.6.1, a specimen 36 inches in length shall be tested in accordance with the applicable requirements of ASTM D380.

4.6.2 Length change (type I). To determine conformance to 3.6.2, a specimen 36 inches in length shall be tested in accordance with ASTM D622. Initial length measurements should be made at 10 psi prior to raising the pressure. The final pressure shall be 200 psi and the final measurement made within 1 minute after application of the final pressure.

4.6.3 Air leakage. To determine conformance to 3.6.3, test shall be conducted in accordance with ASTM D622.

4.6.4 Resistance to aging. To determine conformance to 3.6.4, a hose specimen shall be bent against a form, conforming in general to figure 1, and fixed in this position. Length of specimen and dimensions of form shall be as specified in table II and figure 1. The specimen while on the form shall be placed in an air oven and heated for 70 hours at a temperature of  $212^{\circ} \pm 2^{\circ}\text{F}$ . At the end of the 70-hour period, the hose and form shall be removed from the oven and allowed to cool to room temperature. The hose shall then be removed from the form and straightened on a flat surface (see figure 2). The specimen shall then be split and examined internally and externally for conformance to 3.6.4.



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4.6.5 Low temperature flexibility. To determine conformance to 3.6.5, a specimen of hose of full circumference and approximately 12 inches longer than the circumference of the required mandrel, shall be conditioned for 72 hours in a straight position at minus  $65^{\circ} \pm 2^{\circ}\text{F}$ . After conditioning, and while still at the specified temperature, the specimen shall be bent 180 degrees around a mandrel having a nominal diameter 10 times the outside diameter of the hose. Bending time shall not exceed 15 seconds. The hose shall be examined for conformance to 3.6.5.

4.6.6 Ozone resistance. To determine conformance to 3.6.6, the test shall be conducted as follows: 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 the mandrel shall be 7 times the nominal outside diameter of the hose being tested, and bound with tape or twine where the ends cross one another. If collapse of the hose occurs when bent around the mandrel, provision shall be made to support the hose internally. The specimen shall be conditioned for 45 minutes in air at room temperature and then, while on the mandrel, shall be placed in a chamber containing air mixed with ozone in the proportion of  $50 \pm 5$  parts of ozone per 100,000,000 parts of air by volume. The ambient air temperature in the chamber during the test shall be  $100^{\circ} \pm 5^{\circ}\text{F}$ . The specimen shall be exposed to the ozone and air mixture for 168 hours. After required exposure to ozone, the cover of the specimen shall be examined under 9 power magnification, ignoring areas immediately adjacent to or within the area covered by the tape or twine, to determine conformance to 3.6.6.

4.6.7 Collapse under vacuum (type II). To determine conformance to 3.6.7, a specimen of type II hose 18 inches in length shall be subjected to an internal vacuum of 26 inches of mercury for 5 minutes, and the diameter measured to determine that the collapse of the outside diameter does not exceed 1/16 inch.

#### 4.6.8 Hot vacuum collapse and degradation (type II).

4.6.8.1 Hot vacuum collapse. To determine conformance to 3.6.8, a 300 mm (12 inch) straight length of type II hose shall be heated to a temperature of  $125^{\circ}\text{C}$  ( $257^{\circ}\text{F}$ ) for 96 hours. The average outside diameter over the 12 inch length shall be determined using calipers prior to heating. After 96 hours of heating and within 5 minutes, the outside diameter at the point of greatest collapse shall be measured using calipers to determine if requirements of 3.6.8 have been met.

4.6.8.2 Hot degradation. After allowing the above hose sample to cool for 4 hours, it shall be conditioned at normal room temperature ( $73.4 \pm 3.6^{\circ}\text{F}$ ) for 30 minutes. The hose should then be bent around a mandrel 8 times the nominal diameter of the hose and examined visually

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for evidence of embrittlement or other forms of surface degradation, both externally or internally. The hose sample shall then be subjected to a proof pressure of 1.21 MPa (175 psig) for one minute and checked for leakage.

4.6.10 Adhesion. To determine conformance to 3.6.9, specimens of each type of hose shall be tested in accordance with the applicable requirements of ASTM D413 using a tension test machine and a ring type specimen. The entire ring specimen should be separated to establish the average load required for separation of the plies. Sharp abrupt changes in load for a short duration of time should be discounted in establishing the average work load value for a given specimen.

4.6.11 Breaking strength of assemblies (type I). To determine conformance to 3.6.11, a type I hose assembly shall be installed in a testing machine provided with a recording device to indicate the total pull in pounds at the conclusion of the test. The rate of pull shall be approximately 1 inch per minute. The hose assembly approximately 18 inches long shall be held in the testing machine so that the hose fittings have a straight center line corresponding to the direction of machine pull. The hose assembly shall be subjected to an increasing tension load until failure occurs.

4.6.12 Resistance to swell.

4.6.12.1 Type I hose. To determine conformance to 3.6.12.1, a test shall be conducted in accordance with the applicable requirements of method 6211 of FED-STD-601, except that three specimens each of the inner tube and of the cover shall be tested and the results of each three averaged. The test shall be conducted at room temperature and the test fluid shall conform to type I of TT-S-735. Tests shall be conducted immediately upon removal from the fluid.

4.6.12.2 Type II hose. To determine conformance to 3.6.12.2, a specimen of style "A" hose, 12 inches long, shall be filled with a test fluid conforming to type I of TT-S-735 and held for 48 hours at room temperature. At the end of the 48 hour period the fluid shall be removed from the hose and, immediately, a steel ball of the diameter shown in table II shall be passed through the hose. For style "B" hose, prior to filling with the test fluid, the actual inside diameter shall be measured, and the ball used shall have a diameter equal to the actual inside diameter of the hose minus the ball-diameter factor shown in table II. After steel ball has been passed through the test specimen, a vacuum of 26 inches of mercury shall be applied for 10 minutes and then the specimen shall be examined for separation.

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4.6.13 Fungus resistance. To determine conformance to 3.6.13, a specimen 36 inches in length shall be subjected to the fungus resistance test of MIL-P-13927 except the test shall be continuous for 90 days. The hose shall then be subjected to the burst pressure test specified in 4.6.1.

### 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 as flexible connections in air or vacuum brake systems on automotive vehicles. They are to be used for applications operating in a temperature range not exceeding 200°F and not below -60°F. Type II hose is intended for, but not limited to, two different specific uses as follows:

- |         |  |
|---------|--|
| Style A | - Heavy-duty hose for service on truck-trailer combinations and similar applications.  |
| Style B | - Light-duty hose for service in conjunction with the power braking system on passenger cars and light trucks, where hose is used in a protected location. |

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 and 3.5).
- d. Fitting description where applicable (see 3.3 and 3.3.4):
  - (1) Male or female.
  - (2) Fixed or swivel.
  - (3) Thread size.
  - (4) Type of plating on fittings.
- e. Whether outside cover shall be other than as specified (see 3.3.3).
- f. If lot is to be formed other than as specified (see 4.5.1.1).
- g. Selection of method and applicable level of preservation and packaging and level of packing specified (see 5.1).

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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-CSS, 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 III. 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 3/8, 1/2, 15/32, 5/8 or 1 inch nominal size, submitted by a manufacturer, will establish qualification for other nominal sizes of hose assembly (with the same type hose, style and fitting design) for that manufacturer in accordance with table III.

6.5 Recycled materials. The use of recycled 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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