AEROSPACE RECOMMENDED PRACTICE

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Superseding ARP907

Missile and Rocket Applications: Hose Assemblies, Flexible Metal, High Pressure and High Temperature

RATIONALE

This technical report is being stabilized because it covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

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1. SCOPE:

This recommended practice covers the requirements and qualification tests for two types of flexible all-metal hose assemblies intended for hydraulic use on missile and rocket applications at rated pressures of 4000 psi.

Type I -65° to +650 °F service temperature range
Type II -65° to +1000 °F service temperature range

2. APPLICABLE DOCUMENTS:

The following specifications, standards, drawings, and publications of the issue in effect on date of invitation for bid, form part of this specification to the extent specified herein. When the requirements of the specifications listed below conflict with the requirements of this specification, the requirements of this specification shall govern.

2.1 Specifications:

MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment (General Specification for).
MIL-H-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance.
MIL-L-6082	Lubricating Oil, Aircraft Reciprocating (Piston) Engine.
MIL-W-8611	Welding, Metal Arc and Gas, Steels, and Corrosion and Heat Resistant Alloys; Process for.

2.2 Standards:

MIL-STD-130	Identification Marking of U.S. Military Property.

2.3 Publications:

AMS 2669* Brazing - Silver, Flexible Metal Hose - 800 F Max Operating Temperature.

ARP602* Hose Assemblies, Flexible Metal, Aeronautical, Medium Pressure.

3. REQUIREMENTS:

3.1 Qualifications:

Any hose assembly furnished under this specification shall be a product which consists of a metal pressure carrier and external wire reinforcement, with fittings suitable for use in missile and rocket systems at the applicable pressure and temperature per Table 1, and which has passed the basic qualification tests specified herein.

TABLE 1

HOSE SIZE NO.	HOSE NOMINAL ID (Inches)	HOSE BORE MINIMUM (Inches)	HOSE MAXIMUM OD (Inches)	FITTING BORE MINIMUM (Inches)	MINIMUM CENTERLINE BEND RADIUS FIXED POSITION (Inches)	WORKING PRESSURE MAXIMUM (psi)	BURST PRESSURE MINIMUM (psi)
-4	1/4	.230	.750	.146	3.50	4000	12,000
-6	3/8	.335	1.000	.271	5.50	4000	12,000
-8	1/2	.460	1.250	.365	6.50	4000	12,000
-10	5/8	.585	1.500	.455	8.00	4000	12,000
-12	3/4	.700	1.750	.568	9.75	4000	12,000
-16	1	.950	2.000	.778	13.00	4000	12,000

NOTE: Pressure data in Table 1 is based on operating temperatures of 650 °F and 1000 °F for Type I and Type II hose respectively.

3.2 Materials and Processes:

Materials and processes used in the construction of various types of hose assemblies enumerated in paragraph 1 shall be compatible with the operating conditions specified for the applicable type of hose assembly.

3.3 Design and Construction:

The hose assembly design and construction shall be such that the resulting assembly will perform in accordance with the requirements of this specification.

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3.3.1 Pressure Carrier: The pressure carrier shall be of flexible metal tubular construction of corrosion resistant material. It shall be uniform in size and quality, consistent with good manufacturing practice.

3.3.2 Wire Reinforcement: Wire reinforcement shall be of corrosion resistant material, applied uniformly and without splices and in such a manner as to meet the other requirements of this specification.

3.3.3 Fittings: Fittings shall be made of non-free machining stainless steel to perform in accordance with the classification type per paragraph 1. and other requirements of this specification. Fitting attachments by brazing, welding per MIL-W-8611, or mechanical methods shall be acceptable for classified types as follows:

TYPE OF HOSE	PERMITTED FITTING ATTACHMENT METHOD
I	Brazing per AMS 2669, welding or mechanical
II	Welding or mechanical

3.3.4 Assemblies: Hose assemblies to this specification are to be considered as factory assembled only, with no consideration given to field replacement of end fittings.

3.4 Dimensions:

The inside diameter of the hose and the outside diameter of the wire reinforcement shall be within limits specified in Table 1.

3.5 Performance:

The hose assemblies shall satisfy the performance requirements specified in Table 1 and paragraph 4. et seq. when subjected to the basic qualification tests headed as follows:

a. Hose assembly proof pressure.
b. Hose assembly burst pressure.
c. Vibration test.
d. Hydraulic impulse cycling test.
e. Corrosion test.

3.6 Identification:

Unless otherwise specified by the procuring agency, the hose assemblies shall be identified in accordance with MIL-STD-130.

3.7 Workmanship:

Workmanship shall be of the highest quality.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Classification of Tests:

The inspection and testing of hose assemblies shall be classified as follows:

a. Inspection Tests - Inspection tests are those tests accomplished on material manufactured and submitted for acceptance under contract.

b. Basic Qualification Tests - Qualification tests are those tests accomplished on samples submitted for qualification as a satisfactory product.

4.2 Inspection Tests:

4.2.1 General: The manufacturer shall be responsible for accomplishing the required tests. The manufacturer shall furnish test reports showing results for all tests required by this specification, and signed by the authorized representative of the manufacturer or laboratory as applicable. Acceptance or approval of material during course of manufacture shall in no case be construed as a guarantee of the acceptance of the finished product.

4.2.2 Examination of Product: Hose assemblies shall be carefully examined to determine conformance with this specification with respect to materials, processes, workmanship, dimensions, and fitting details as specified in the contract or order.

4.2.3 Hose Assembly Proof Pressure: All assemblies supplied under this specification shall be subjected to a 10,000 psi hydrostatic pressure at room temperature for a minimum period of three minutes and a maximum of five minutes. One end shall be fastened to the pressure source and the other end shall be free and unrestrained. Any evidence of leakage or mechanical damage shall be cause for rejection.

4.2.4 Hose Assembly Leak Test: All assemblies supplied under this specification shall be subjected to a 4000 psi pneumatic pressure under water for a minimum period of three minutes and a maximum of five minutes. Prior to test, all assemblies shall be oven dried for one hour at 250 °F. Any evidence of leakage shall be cause for rejection.

4.2.5 Rejection and Retest: Rejected hose assemblies shall not be submitted for re-inspection without furnishing full particulars concerning previous rejection and measures taken to overcome the defects.

4.3 Qualification Tests:

4.3.1 Sampling Instructions: Five (5) flexible metal hose test specimen assemblies manufactured to the configuration shown in Figure 1 shall be used for each nominal ID size for determining performance of manufacturer's product. They shall be made up with flexible metal hose and fittings according to manufacturer's assembly drawings. These assemblies shall have one solid male and one swivel female fitting with nominal length of hose between the backs of the fittings as shown in Table 2. Two assemblies shall be burst tested and the other three assemblies shall be subjected to Proof Pressure, Vibration, and Hydraulic Impulse testing at room temperature.

TABLE 2 - High Pressure Hose Assembly Test Specimen Data

HOSE SIZE NO.	HOSE NOMINAL ID (Inches)	A DIMENSION 2R (Inches)	HOSE NOMINAL LENGTH (Inches)
4	1/4	7.0	13.000
6	3/8	10.0	18.750
8	1/2	13.0	24.500
10	5/8	16.0	30.250
12	3/4	19.5	36.750
16	1	26.0	49.000

NOTE: Test lengths allow 4 x Nominal ID straight section adjacent to each fitting, plus 180° bend at minimum allowable fixed position bend radius.

4.3.2 Tests: Qualification tests of hose assemblies shall consist of all tests of this specification. The test sequence is described in Table 3.

TABLE 3

SPECIMEN NO.	TEST SEQUENCE					
	INSPECTION 4.2	BURST 4.4.1.2	PROOF PRESSURE 4.4.1.1	VIBRATION 4.4.1.3	IMPULSE CYCLING 4.4.1.4	CORROSION 4.4.1.5
1 & 2	1	2	--	--	--	--
3, 4 & 5	1	--	2	3	4	5

4.4 Qualification Test Methods:

4.4.1 Test Specimens: Test specimens used in the following tests shall be fabricated according to paragraph 4.3.1 and shall be examined in accordance with paragraph 4.2.2.

4.4.1.1 Proof Pressure Test: Proof pressure tests shall be made on all flexible metal hose assemblies before and after the completion of all other qualification testing except for the burst test samples. The test specimens shall be tested at the proof pressure of 8000 psi at the maximum rated temperature of paragraph 1. for the “Type” hose, and the pressure shall be held for not less than three minutes nor more than five minutes without seepage, leakage, or other evidence of failure as indicated by a visual examination after removal from high temperature chamber.

4.4.1.2 Burst Pressure Test: Two test specimens of each size of hose shall be subjected to an internal pressure test at the applicable burst pressure of Table 1 at 70 °F for five minutes. The hose shall not burst, the end fittings shall not blow off or loosen, the braid shall not rupture, and there shall be no external leakage from the hose or end fittings below the burst pressure specified. During this test, the flexible metal 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. At the end of the five minute period, the specimens shall be further tested per paragraphs 4.4.1.2.1 and 4.4.1.2.2.

4.4.1.2.1 One specimen shall be subjected to gradual pressure increase until rupture occurs.

4.4.1.2.2 One specimen shall be subjected to the applicable rated temperature while maintaining the rated burst pressure for five minutes. Upon removal from heat, the specimen shall meet the requirements of paragraph 4.4.1.2.

4.4.1.3 Vibration Test: While pressurized hydraulically at 4000 psi, the hose shall be mounted on a test fixture (see Figure 1). The vibration test shall be performed at room temperature (70 °F ± 20 °F) in the following order: Resonance Sweep Test, Sinusoidal Sweep Test, and Resonance Dwell Test. Proof Test (paragraph 4.4.1.1) shall be performed after completion of the Vibration Tests.

4.4.1.3.1 Sweep for Resonance: The hose shall be surveyed for resonance in the frequency range from 5 to 2000 cps at a 2 g input vibration level to determine the major resonance frequencies along each of the three mutually perpendicular axes (planes V, X, Y - see Figure 1). The sweep for resonance shall be accomplished in 10 minutes.

4.4.1.3.2 Sinusoidal Sweep: The hose shall be subjected to a sinusoidal frequency sweep cycling from 5 to 2000 cycles along each of the three mutually perpendicular axes shown in Figure 1. Vibration input levels shall be as follows:

5 to 45 cps at .250 D/A
45 to 100 cps at a 10 g peak
100 to 500 cps at .020 D/A
500 to 2000 cps at a 20 g peak

The rate of change for frequency shall be logarithmic and such that ten minutes is required to proceed from 5 to 2000 cps and back to 5 cps. One ten minute sweep shall be performed for each of the three axes (V, X, Y).