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REV. A

Submitted for recognition as an American National Standard

HOSE ASSEMBLIES, METAL, MEDIUM PRESSURE, HIGH TEMPERATURE

1. SCOPE:

This specification covers medium-pressure, high-temperature, flexible, metal-hose assemblies suitable for continuous operation in pneumatic systems up to 850°F with short duration excursion to 1200°F and primarily for use on jet aircraft power plants.

1.1 Types: Hose assemblies furnished under this specification may be of two types:

Type 1: Convoluted annular or helical inner tube, welded, seamless, or butt-welded and redrawn, of moderate or light weight, and of moderate or high flexibility.

Type 2: Convoluted annular inner tube, seamless or butt-welded and redrawn, of light weight, and of high flexibility.

2. APPLICABLE DOCUMENTS:

The following specifications and standards, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 Specifications:

2.1.1 Federal:

QQ-P-35 Passivation Treatments for Corrosion-Resisting Steel
QQ-S-763 Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resisting

REAFFIRMED April 1994

2.1.2 Military:

MIL-C-5501	Caps and Plugs, Protective, Duct & Moisture
MIL-H-6875	Heat Treatment of Steels (Aerospace Practice) Process for
MIL-W-8611	Welding, Metal Arc and Gas, Steels, and Corrosion and Heat Resistant Alloys, Process for
MIL-T-8808	Tubing, Steel, Corrosion-Resistant (18-8 Stabilized) Aircraft Hydraulic Quality
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for

2.1.3 Industry:

AMS 5689C	Wire -18Cr-9.5 Ni -0.40Ti Solution Heat Treated (Apr 83)
ARP908B	Hose and Tube Fitting-Installation and Qualification Test Torque Requirements (Sep 15 85)
ASTM A 262	Detecting Suseptibility to Intergranular Attack in Stainless Steels
ASTM A 580	Stainless & Heat-Resisting Steel Wire

2.2 Standards:

2.2.1 Military:

MS21921	Nut-Sleeve Coupling, Flareless
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal
DOD-STD-100	Engineering Drawing Practices
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-810	Environmental Test Methods

2.2.2 Industry:

NAS 1760 Fitting End, Flareless Acorn, Standard Dimensions for

AS136	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, STRAIGHT TO STRAIGHT
AS137	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, STRAIGHT TO 45°
AS138	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, STRAIGHT TO 90°
AS139	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, 45° TO 45°
AS140	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, 45° TO 90°
AS141	HOSE ASSEMBLY, METAL-MEDIUM PRESSURE, FLARELESS, WELDED, 90° TO 90°
AWS A5.9	COROSION RESISTANT WELDING ELECTRODES AND WELDING WIRE

3. REQUIREMENTS:

3.1 Qualification: Any hose assembly furnished under this specification shall be a product identical in hose construction and end fitting attachment method to specimens which have been tested and passed the qualification tests specified herein.

3.2 Materials: The hose assembly materials shall be uniform in quality, free from defects, suitable for use in continuous ambient and/or fluid temperatures up to 850°F with short fluid temperature excursions up to 1200°F, consistent with good manufacturing practices, and in conformance with the applicable specifications and the requirements specified herein. Materials used in these hose assemblies shall be selected from those listed in Table I.

TABLE I – Hose Assembly Materials

Component	Material Description	Specification	Finish
Flexible metal hose inner tube	321 Corrosion resistant steel	MIL-T-8808 or QQ-S-763	Passivate per QQ-P-35
Hose reinforcement wire	321 Corrosion resistant steel	ASTM A 580 AMS 5689	Passivate per QQ-P-35
All fitting components except coupling nuts	321 Corrosion resistant steel	MIL-T-8808 or QQ-S-763	Passivate per QQ-P-35
Coupling nuts	321 or 347 Corrosion resistant steel	QQ-S-763	Passivate per QQ-P-35
Nut retaining wire	321 or 347 Corrosion resistant steel	ASTM A 580 QQ-S-763	Passivate per QQ-P-35
Identification bands	300 Series corrosion resistant steel	QQ-S-763	Passivate per QQ-P-35

3.3 Design and Construction: The hose assembly shall consist of a seamless, welded, or welded and redrawn convoluted, stabilized, corrosion-resistant steel, pressure-carrying tube, uniform in size and wall thickness; reinforced with stabilized, corrosion-resistant steel, braided wire and having stabilized, corrosion-resistant steel end fittings and nuts. End fittings shall be attached to the hose by welding. The end fitting outlet design shall mate with MS33514 or MS33656 as applicable.

3.3.1 End Fitting: All standard end fittings shall be a single piece construction from the mating surface to the attachment of the convoluted tube. For special complex and/or nonstandard end fittings, if welding is required in construction, welded butt joints shall be used. Fittings shall conform to applicable requirements in Tables I and II. Flareless end fitting terminations shall conform to NAS 1760.

3.3.1.1 Coupling Nuts: When required, MS21921 coupling nuts or functional equivalents shall be used. Wire retained coupling nuts shall be used to the minimum extent possible, and when used, shall have the retaining wire inserted in a clockwise direction when viewed from the open end of the nut.

3.3.1.2 Screw Threads: All fitting threads shall be Class 3 in accordance with MIL-S-8879. A thread tolerance increase of 10% during assembly or testing shall not be a cause for rejection.

3.3.2 Hose:

3.3.2.1 Inner Tube Construction: In the case of Type 1 hoses, the inner tube shall be an annular or helical, convoluted flexible tube, made from welded, seamless, or butt-welded and redrawn, stabilized austenitic stainless steel tubing.

In the case of Type 2 hoses, the inner tube shall be an annular, convoluted flexible tube, made from seamless or butt-welded and redrawn, stabilized austenitic stainless steel tubing.

Tubing shall be uniform in size and quality and free from pitting, excessive die marks, and other defects. There shall be no inner tube splices on hose assemblies 3 ft in length or less. One splice is allowed for each additional 3 ft increment of hose assembly length. Splices are undesirable but if required, shall be low profile welds in accordance with 3.3.3 and Fig. 1. After welding, the convolutes shall be closed as shown in Fig. 1.

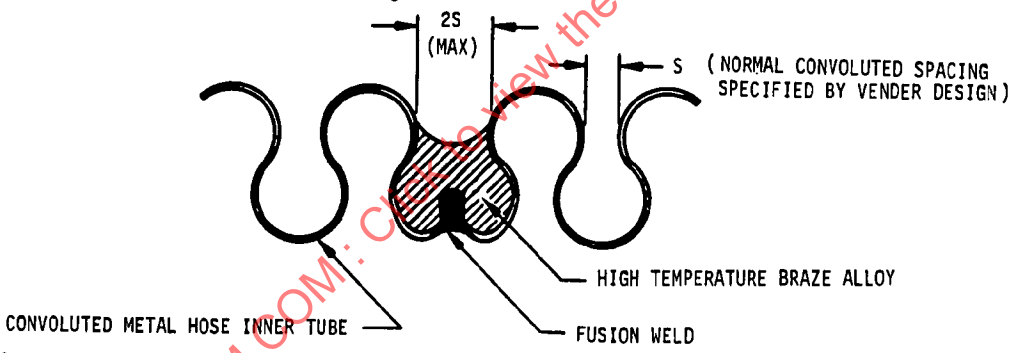


FIGURE 1 - Inner Tube Splice Configuration

3.3.2.2 Braid: Braid shall be of corrosion-resistant steel wire braided in such a manner as to meet the requirements of this specification. There shall be no splices allowed in the braid wire.

3.3.3 Welding: All welds shall be fusion welds per MIL-W-8611. Filler wire, if required, shall be AISI Type 347 per MIL-R-5031, Class 7A. Equivalent vendor or other comparable welding specifications may be substituted on prior approval by the purchaser.

3.3.4 Heat Treatment: If stress relieving is required to meet corrosion and Strauss test requirements, the weld joints shall be stress relieved at 1650°F ± 25 for 2 h ±15 min per MIL-H-6875.

3.4 Dimensions and Weights:

3.4.1 Hose Diameter:

The inside diameter of the convoluted hose and the outside diameter of the braid covering shall be as specified in Table II.

TABLE II - Hose Assembly Data, Dimensional and Performance

Size No.	Hose			Fitting Bore Min[1]	Minimum Center-Line Bend Radius		Operating Pressure PSI Max		Proof Pressure PSI Min	Burst Pressure PSI Min	
	I.D. Nom	I.D. Min	O.D. Max		Static	Flexing	70°F	850°F	70°F	70°F	850°F
04	1/4	0.23	0.56	.141	2.00	4.00	2000	1320	3000	8000	5280
06	3/8	0.34	0.70	.250	3.00	6.00	1600	1060	2400	6400	4220
08	1/2	0.45	0.86	.360	4.00	8.00	1400	920	2100	5600	3690
10	5/8	0.57	1.00	.455	4.50	9.00	1200	790	1800	4800	3170
12	3/4	0.70	1.15	.568	5.00	10.00	1050	690	1575	4200	2770
16	1	0.95	1.45	.760	6.00	12.00	800	530	1200	3200	2120
20	1-1/4	1.20	1.75	.920	7.00	14.00	550	360	825	2200	1450

NOTE: For pressure data at other elevated temperatures, multiply data in Table II by percentage correction factor from Fig. 2 (expressed in decimal equivalent) for desired temperature level.

[1]Minimum I.D. through the elbow bend area, may be 10% less than the value shown, due to ovality.

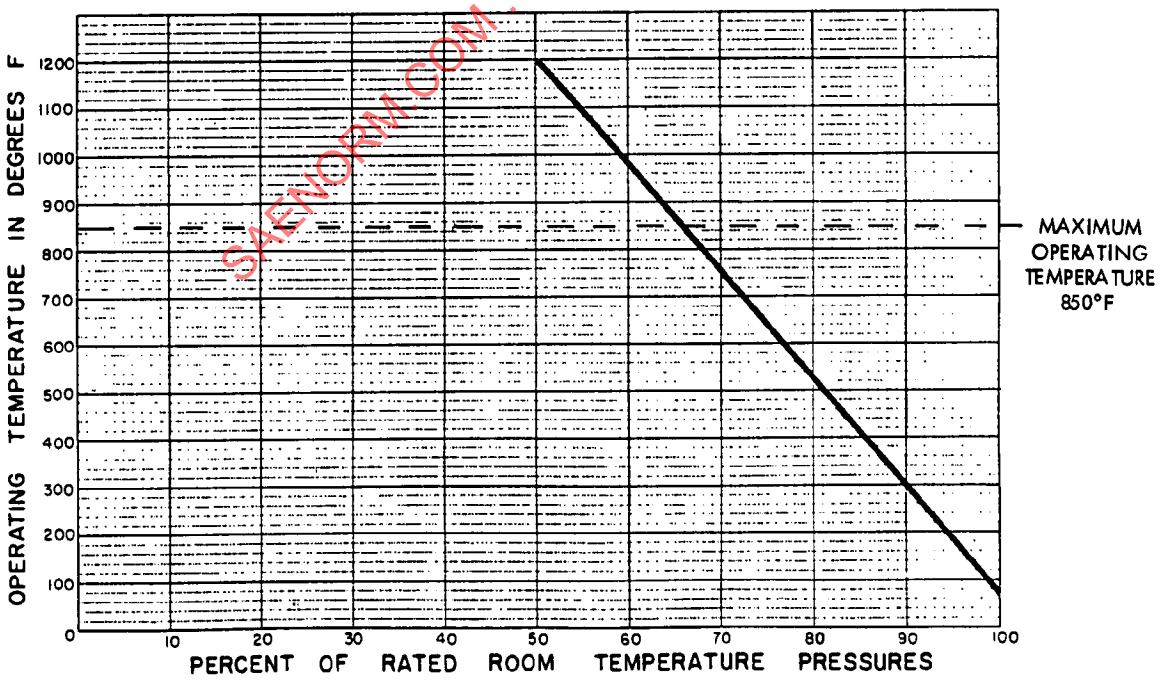


FIGURE 2 - Pressure Correction at Elevated Temperatures

3.4.2 Assembly Length: Hose assembly lengths shall be as specified on the applicable standard or drawing. Flareless hose assemblies with NAS 1760 end terminations shall be measured from gage point to gage point.

Available length increments and tolerances shall be in accordance with Table III. Length standardization is highly desirable to reduce spares requirements.

Table III - Length Increments and Tolerances

Hose Assembly Length (in)	Available Length Increments (in)	Length Tolerance (in)
Under 10	(Not less than) 1/8	±1/16
10 to 36	(Not less than) 1/8	±1/8
36 to 50	(Not less than) 1/4	±1/4
Over 50	(Not less than) 1/2	±1

3.4.3 Weights: Maximum weights of standard components of these hose assemblies shall be in accordance with Table IV. Maximum weights of hose assemblies with nonstandard end fittings shall be listed on the supplier's drawing when submitted to the purchase for approval.

TABLE IV - Weights

Hose Size (REF)	Tube Size (O.D. REF)	Maximum Weights Standard End Fittings (LBS) Hose LBS/IN	Straight	45 deg Elbow	90 deg Elbow	Hose Length Deductions[1] Straight	45 deg Elbow	90 deg Elbow
-04	1/4	0.0160	0.05	0.05	0.05	0.93	1.02	0.63
06	3/8	0.0200	0.07	0.08	0.08	1.04	1.17	0.74
08	1/2	0.0284	0.12	0.13	0.14	1.22	1.43	0.92
10	5/8	0.0380	0.18	0.20	0.22	1.36	1.87	1.28
12	3/4	0.0422	0.36	0.39	0.41	1.41	2.01	1.36
16	1	0.0580	0.48	0.57	0.64	1.52	2.18	1.63
20	1-1/4	0.0720	0.79	0.91	0.99	1.58	2.99	2.35

[1]Deduct appropriate lengths from hose assembly length for each end-fitting when determining hose weight for hose assemblies with standard end-fittings.

3.5 Performance: The hose assembly minimum bend radius and operating proof and burst pressure ratings, as shown in Table II, shall be verified by demonstration of meeting or exceeding the following performance requirements through qualification testing as specified herein. Compliance with performance requirements shall be maintained by adherence to the quality assurance provisions as specified herein.

3.5.1 Examination of Product: Each assembly must conform dimensionally and materially to the applicable standard or drawing and to all requirements of this specification, when examined in accordance with 4.6.1.

3.5.2 Proof Pressure: The hose assembly shall withstand the applicable room temperature (70°F) proof pressure specified in Table II, without leakage or evidence of permanent deformation or malfunction that would affect hose assembly installation or removal, when assembled with torque values per ARP908 and tested in accordance with 4.6.2.

3.5.3 Corrosion Test: The hose assembly shall be capable of withstanding the proof pressure requirements of 3.5.2 after 50 immersion cycles in a 3.5% NaCl solution in accordance with 4.6.3.

3.5.4 Vibration: The hose assembly shall have no broken braid wire and shall be capable of withstanding, without leakage, the proof pressure requirements of 3.5.2 after vibration testing in accordance with 4.6.4.

3.5.5 Flexure and Pressure Cycling Endurance: The hose assembly shall have no broken braid wire and shall be capable of withstanding the proof pressure requirements of 3.5.2, after 50 000 combination flexure and pressure cycles in accordance with 4.6.5

3.5.6 Repeated Torque: The hose assembly end fitting shall be capable of sealing and withstanding the proof pressure requirements of 3.5.2, after 15 installations on a mating fitting when assembled with torque values per ARP908 and tested in accordance with 4.6.6. The fitting nut shall be free enough to permit turning on the elbow or insert by hand.

3.5.7 Burst Pressure: The hose assembly shall not rupture and shall show no evidence of leakage at any pressure up to the burst pressure specified in Table II, when tested in accordance with 4.6.7.

3.5.8 Strauss Test: There shall be no evidence of fissures or intergranular or transgranular corrosion of the weld specimen when tested in accordance with 4.6.8.

3.6 Part Numbering of Interchangeable Parts: All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirements of DOD-STD-100 shall govern the manufacturer's part number and changes thereto.

3.7 Identification of Product: The hose assemblies shall be marked for identification in accordance with the following:

3.7.1 Fittings: The manufacturer's name or trademark shall be permanently marked on all end-fittings.

3.7.2 Assemblies: The hose assemblies shall have all identification marking electroetched or impression stamped on one end fitting or on a permanently attached corrosion-resistant steel band 0.012 to 0.020 in thick and not more than 1.00 in wide. The marking shall include, but is not limited to, the following:

a. Manufacturer's name, trademark, or code number
b. Complete manufacturer's part number
c. Complete "AS" standard number or specification control number
d. "PSI OPR at 850°F"
e. "PSI OPR at 70°F"
f. Pressure test symbol "PT"
g. Date of hose assembly manufacture expressed in terms of month and year

3.8 Workmanship: The hose assembly, including all parts, shall be constructed and finished in a thoroughly workmanlike manner. All surfaces shall be free from burrs.

3.8.1 Dimensions and Tolerances: All pertinent dimensions and tolerances, where interchangeability, operation or performance of the hose assembly may be affected, shall be specified on the applicable "AS" standard or drawing.

3.8.2 Cleaning: The hose assemblies shall be cleaned according to the general commercial practice of the manufacturer to remove oil, grease, dirt or any other foreign material, both internally or externally to the hose unless otherwise specified on standard or drawing.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Supplier's Responsibility: The supplier is responsible for the performance of all quality assurance provisions at specified herein. Accurate records of the testing shall be kept by the supplier and shall be available to the purchaser for inspection, on request. The supplier's test data, subject to the approval of the purchaser, shall be considered adequate for product qualification.

4.1.1 Rejection and Retest: Rejected hose or hose assemblies shall not be submitted for reinspection without furnishing full particulars concerning previous rejection and measures taken to overcome the defects.

4.1.1.1 Defects on Items Already Accepted: If the investigation of the rejection indicates that the defect or defects causing the rejection may exist in hose assemblies previously supplied to the purchaser, the contractor shall advise the purchaser of this condition, the method for identifying these parts and the corrective action or disposition of the defective parts.

4.2 User's Responsibility: The user shall establish adequate inspection procedures to ensure that all requirements of this specification are met. Emphasis shall be placed on the following aspects:

a. Configuration and end fitting conformance
b. Length
c. Marking
d. Pressure test

4.3 Classification of Inspections: The examining and testing of these hose assemblies shall be classified as:

a. Qualification inspections
b. Quality conformance inspections

4.4 Qualification Inspections: The qualification inspections outlined herein are intended to qualify a manufacturer's hose construction and end-fitting attachment method only. The configuration of the outlet parts shall be as described on the standard or drawing. A number shall be assigned for each attachment method and hose construction used for qualificaiton. The attachment method and hose shall be fully described in the test report by design standard drawings. All other end connections shall also be considered qualified, provided the hose and hose attachment method have not been altered. The purchasing agent shall receive notification at least 14 days prior to start of testing, and shall reply within 7 days prior to start of testing of intent to witness the testing.

4.4.1 Test Specimens: Seven flexible metal hose assemblies of each size shall be used for qualifying performance of the manufacturer's product. They shall be standard "AS" series hose assemblies, as defined in Table V, fabricated according to the manufacturer's assembly drawing(s).

TABLE V – Test Specimen Configurations

Specimen No.	Hose Assembly Type	Hose Nominal Tube Size						
		1/4	3/8	1/2	5/8	3/4	1	1-1/4
1 2	AS136	-04-[1]	-06-[1]	-08-[1]	-10-[1]	-12-[1]	-16-[1]	-20-[1]
3 4	AS140	E120-000	G120-000	H120-000	J120-000	K120-000	M120-000	N120-000
5 6 7	AS136	-04-[2]	-06-[2]	-08-[2]	-10-[2]	-12-[2]	-16-[2]	-20-[2]

[1]Actual gage point to gage point hose assembly length equal to dimension "L_1" of Table VII.
[2]Actual gage point to gage point hose assembly length equal to dimension "L_2" of Table VII.

4.4.2 Test Schedule and Sequence: The test specimens shall be subjected to qualification tests in the order indicated in Table VI (from left to right):

TABLE VI - Test Schedule and Sequence for Qualification Testing

Specimen No.	Examination of Product 4.6.1	Proof Pressure 4.6.2	Corrosion Test 4.6.3	Proof Pressure 4.6.2	Vibration 4.6.4	Proof Pressure 4.6.2	Flexure Pressure Cycling Endurance 4.6.5	Repeated Torque 4.6.6	Proof Pressure 4.6.2	Burst Pressure 4.6.7	Strauss Test 4.6.8
1	x	x			x	x		x	x	x[1]	
2	x	x			x	x				x[1]	
3	x	x						x	x	x	x
4	x	x						x	x	x	x
5	x	x	x	x	x	x	x[1]		x[1]	x[1]	
6	x	x	x	x			x		x	x[1]	
7	x	x					x		x	x[1]	

[1]The assemblies need not meet minimum requirements but all data should be accurately recorded and included in the report.

4.5 Quality Conformance Inspections: Quality conformance inspections shall consist of the following:

a. Individual tests (100% inspection)
b. Sampling tests
c. Periodic control tests

4.5.1 Individual Tests (Functional Tests): Each hose assembly shall be subjected to the following:

a. Examination of product
b. Proof pressure test

4.5.2 Sampling Tests: The following tests shall be performed on a hose assembly selected at random from a production run when the supplier has manufactured an accumulated total of between 5000 and 6000 hose assemblies made to this specification.

a. Proof pressure test per 4.6.2
b. Burst test per 4.6.7
c. Strauss test per 4.6.8

4.5.3 Periodic Control Tests: The flexure test in Table VI shall be performed according to 4.6.5 except the test shall be conducted at room temperature on two hose assemblies when a supplier has manufactured an accumulated total of between 8000 and 9000 hose assemblies made to this specification.

4.6 Test Methods:

4.6.1 Examination of Product: Hose assemblies shall be visually and dimensionally inspected to determine compliance with the applicable hose assembly standard and examined for compliance with requirements of 4.3.

4.6.2 Proof Pressure Test: Hose assemblies shall be proof pressure tested under water at room temperature to the applicable pressures of Table II using air or nitrogen as test medium. Pressure shall be held 5 min. All hose assemblies shall be thoroughly dried after testing. For individual tests (functional tests) only, the pressure shall be held 1 min.

4.6.3 Corrosion Test: Test specimens 5 and 6, as shown in Table VI shall be subjected to a corrosion test as follows:

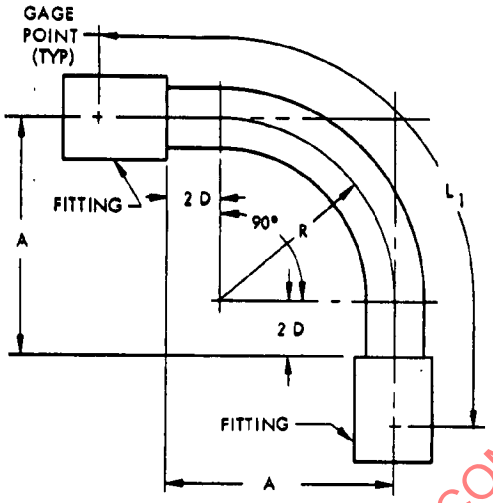
a. Pressurize the hose assembly to the 70°F operating pressure listed in Table II and maintain the pressure for steps b through d.
b. Immerse in 3.5% NaCl solution for 8 to 10 min.
c. Air dry for remainder of 1 h.
d. Repeat b and c for a total of 50 times.
e. Proof test assemblies according to 4.6.2.
f. Without removing salt or cleaning hose, continue testing according to Table VI sequence.

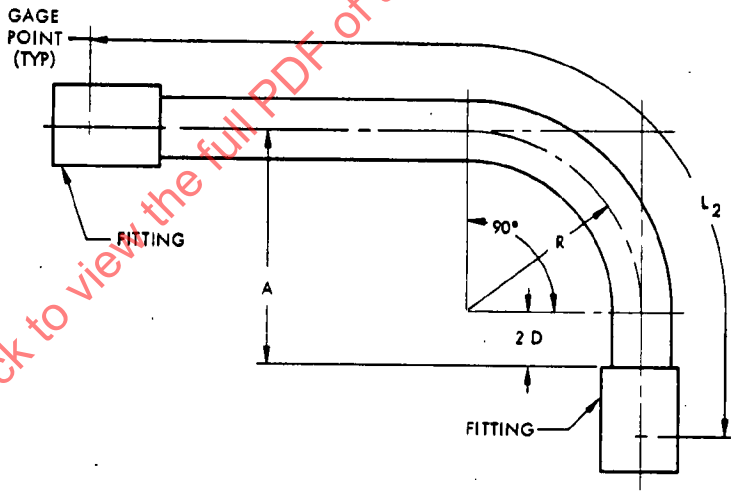
4.6.4 Vibration Test: Test specimens 1, 2 and 5, as shown in Table VI, shall be subjected to the vibration test. The test specimens shall be mounted as shown in Fig. 3 and 3A and pressurized with air or nitrogen to maximum operating pressure at a temperature of 850°F. Hose temperature must be stabilized at 850°F ± 25. One end of the specimen shall be fixed and the other end vibrated. Vibration shall be induced in three mutually perpendicular axes, one axis at a time, as follows:

a. One axis parallel to the plane of the specimen and the centerline of the free end fitting.
b. One axis parallel to the plane of the specimen and the centerline of the fixed end fitting.
c. One axis perpendicular to the plane of the specimen.

TABLE VII - Specimen Lengths

Hose Size	Tube Size	"L_1"	"L_2"
04	1/4	8.0	21.0
06	3/8	10.5	28.0
08	1/2	13.0	35.5
10	5/8	15.0	39.5
12	3/4	16.5	43.5
16	1	19.5	51.5
20	1-1/4	23.0	59.5





A = R + 2D
D = Hose OD Max
R = Static Bend Radius (Table II)

Refer to Table VII for Dimensions

FIGURE 3 - Vibration Test (4.6.4)

FIGURE 3A - Vibration Test (4.6.4)/ Flexure Test (4.6.5)

4.6.4 (Continued):

The vibration testing consists of three parts: (1) resonance search, (2) resonant dwell, and (3) sinusoidal cycling. This testing shall be conducted in the indicated order. The required vibration test envelope is:

5 -	30 Hz	±0.015 in
30 -	53 Hz	±1.5G
53 -	100 Hz	±0.005 in
100 -	350 Hz	±5.0G
350 -	490 Hz	±0.0004 in
490 -	1000 Hz	±10.0G