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INTERNATIONAL
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AEROSPACE STANDARD

SAE AS1424

REV. C

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Superseding AS1424B

Hose Assemblies, Metal, Medium Pressure, High Temperature

1. SCOPE:

This SAE Aerospace Standard (AS) 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 document may be of two types:

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

1.2 Classes:

Hose assemblies furnished under this document may be of the following classes. If no class is defined the class “S” shall be utilized.

a. Class “N”: Convoluted innertube shall be fabricated from nickel alloy type 625 material.
b. Class “S”: Convoluted innertube shall be fabricated from corrosion resistant steel type 321 material.

TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790 SAE WEB ADDRESS: http://www.sae.org

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 5556	Steel, Corrosion and heat Resistatn, Seamless or Welded Tubing, 18Cr 11Ni 0.70(Cb+Ta) (SAE 30347), Hydraulic, Solution Heat Treated
AMS 5557	Steel Tubing, Seamless and Welded, Corrosino and Heat Resistant, 18.5Cr 10.5Ni 0.40Ti (SAE 30321), Hydraulic, Solution Heat Treated
AMS 5581	Nickel Alloy, Corrosion and Heat Resistant, Seamless or Welded Tubing, 62Ni 21.5Cr 9.0Mo 3.7Cb, Annealed (SAE 06625)
AMS 5645	Steel Bars, Forging, Tubing, and Rings, Corrosion Resistant, 18Cr-10Ni-0.40Ti, Solution Heat Treated (SAE 30321)
AMS 5646	Steel Bars, Forging, Tubing, and Rings, 18Cr-11Ni-0.60 (Cb+Ta), Solution Heat Treated (SAE 30347)
AMS 5680	Steel, Corrosion and Heat Resistant, Welding Wire, 18.5Cr-11Ni-0.40Cb (SAE 30347)
AMS 5689	Steel, Corrosion and Heat Resistant, Wire, 18Cr-10.5Ni-0.40Ti, Solution Heat Treated (SAE 30321)
AMS 5837	Nickel Alloy, Corrosion and Heat Resistant, Welding Wire, 62Ni-21.5Cr-9.0Mo-3.7Cb (SAE 06625)
AMS-QQ-S-763	Steel Bars, Wire Shapes and Forgings, Corrosion Resisting
AMS-STD-2219	Fusion Welding for Aerospace Applications
AMS-H-6875	Heat Treatment of Steels (Aerospace Practice)
AS4395	Fitting End - Flared Tube Connection, Design Standard
ARP908	Hose Fitting - Installation and Qualification Test Torque Requirements
ARP1835	Preparation for Delivery, General Requirements for Hose Assemblies
AS1708	Fitting End, Internal Flared, Design Standard
AS7003	National Aerospace and Defense Contrctors Accreditation Program (NADCAP)
AS7112	National Aerospace and Defense Contrctors Accreditation Program Requirements for Fluid System Components
AS8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter
AS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal

2.1.2 ASTM Publications: Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 262	Detecting Susceptibility to Intergranular Attack on Stainless Steel
ASTM A 580	Stainless and Heat-Resistant Steel Wire - Type 321 or 347, Condition A
ASTM B 444	Nickel-Chromium-Molybdenum-Columbium Alloys, Pipe and Tube (UNS 06625)

2.1.3 NAS Publications: Available from Aerospace Industries Association, 1250 Eye Street NW, Washington, DC 20005.

NAS 847	Caps and Plugs, Protective, Dust and Moisture Seal
NAS 1760	Fitting End, Flareless Acorn, Standard Dimensions for

2.1.4 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-HDBK-810	Environmental Test Methods
MIL-HDBK-831	Preparation of Test Reports
MIL-STD-100	Engineering Drawings
MS21921	Nut-Sleeve Coupling, Flareless

2.1.5 PRI Publications: Available from Performance Review Institute, 161 Thornhill Road, Warrendale, PA 15086-7527 (www.pri.sae.org).

PD2001	Qualified Product Management Council Procedures for Qualified Products Group
PD2101	Aerospace Quality Assurance, Product Standrd, Qualification Procedures, Fluid Systems

2.2 Hose Assembly Procurement Documents:

Refer to AS1424SUP1 for a listing of applicable hose assembly procurement standards applicable to this document.

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

Hose assemblies supplied in accordance with this document shall be representative of products which have been subjected to and which have successfully passed the qualification tests specified in this standard.

3.1.1 Manufacturer Qualification: A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of PD2101, AS7003 and AS7112, and shall be listed in a Performance Review Institute (PRI) Qualified Manufacturers List (QML).

3.1.1 Product Qualification: All products shall conform to the requirements of this procurement specification and shall be approved in accordance with the requirements of PD2001, and PD2101, for listing in a Performance Review Institute (PRI) Qualified Parts List (QPL).

3.2 Material:

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 1.

TABLE 1 - Hose Assembly Materials

Component	Material Description	Specification
Flexible metal hose inner tube	Class "N" - nickel alloy type 625	AMS 5581 or ASTM B 444
	Class "S" - 321 corrosion resistant steel	AMS 5556, AMS 5557, or AMS-QQ-S-763
Hose reinforcement wire	321 corrosion resistant steel	ASTM A 580 or AMS 5689
All fitting components except coupling nuts	321 corrosion resistant steel	AMS 5645, AMS 5556, AMS 5557, or AMS-QQ-S-763
Coupling nuts	321 or 347 corrosion resistant steel	AMS 5645, AMS 5646, or AMS-QQ-S-763
Nut retaining wire	321 or 347 corrosion resistant steel	ASTM A 580 or AMS-QQ-S-763
Identification bands	300 series corrosion resistant steel	AMS-QQ-S-763

3.3 Design and Construction:

The hose assembly shall consist of a seamless, welded, or welded and redrawn convoluted, stabilized, corrosion-resistant, pressure-carrying tube, uniform in size and wall thickness; reinforced with stabilized, corrosion-resistant steel, braided wire and having stabilized, corrosion-resistant end fittings and nuts. End fittings shall be attached to the hose by welding. The end fitting outlet design shall mate with AS33514, AS4375, or AS4395 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 1 and 2. Flareless end fitting terminations shall conform to NAS 1760. Flared end fittings shall conform to AS1708.

3.3.1.1 Coupling Nuts: When required, MS21921 type 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 AS8879 (ISO 3161). 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: For Type 1 hoses, the inner tube shall be an annular or helical, convoluted flexible tube, made from welded, seamless, or butt-welded and redrawn tubing. Material shall be class "N" or "S" as applicable.

For Type 2 hoses, the inner tube shall be an annular, convoluted flexible tube, made from seamless or butt-welded and redrawn tubing. Material shall be class "N" or "S" as applicable.

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 Figure 1. After welding, the convolutes shall be closed as shown in Figure 1.

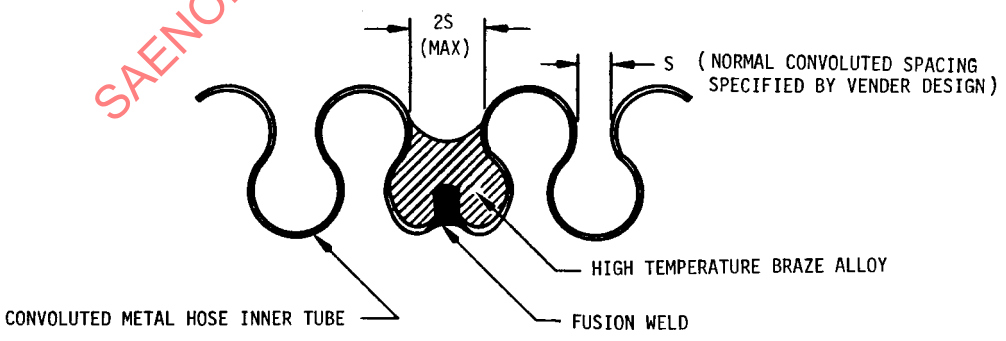

FIGURE 1 - Inner Tube Splice Configuration

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 document. There shall be no splices allowed in the braid wire.

3.3.3 Welding: All pressure welds shall be fusion welds per AMS-STD-2219 Class B and braid attachment weld shall be per Class C. Equivalent or other comparable welding specifications may be substituted on prior approval by the purchaser. Filler wire, if required, shall be per AMS 5680 (Type 347) or AMS 5837 (nickel alloy) as applicable.

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

3.4 Dimensions and Weights:

3.4.1 Dimensions: Hose assembly dimensions, except for length, shall be as specified in Table 2.

TABLE 2 - Hose and Fitting Dimensions

Hose Size	Rigid Tube OD (Ref)	Hose ID Min	Hose OD Max	Straight Fitting Bore Min	Spherical Ball Size for Determining Minimum Hose Assembly ID[1] Straight Fitting	Spherical Ball Size for Determining Minimum Hose Assembly ID[1] Elbow Fitting
04	.250	.23	.56	.141	.127	.120
05	.312	.28	.63	.197	.177	.167
06	.375	.34	.70	.250	.225	.212
08	.500	.45	.86	.360	.324	.306
10	.625	.57	1.00	.455	.410	.387
12	.750	.70	1.15	.568	.511	.483
16	1.000	.95	1.45	.760	.684	.646
20	1.250	1.20	1.75	.920	.828	.782

1. **Minimum specified inside diameter through the hose assembly shall be verified by passing the applicable, or larger, spherical ball through the assembly.**

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

Assembly length tolerance shall be as follows:

a. ±.062 in for lengths under 10 in
b. ±.125 in for lengths from 10 to 36 in exclusive
c. ±.250 in for lengths from 36 to 50 in exclusive
d. ±1% for lengths of 50 in and over

3.4.3 Hose Weight: Hose consisting of inner tube and reinforcement shall not exceed the maximum weight noted in Table 3.

3.5 Performance:

The hose assembly minimum bend radius and operating, proof, and burst pressure ratings, as shown in Table 3, 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 document, when examined in accordance with 4.6.1.

TABLE 3 - Hose Weight, Bend Radius, and Pressures Requirement

Hose Size	Tube Size (Ref)	Hose Weight Max lb/in	Minimum Centerline Bend Radius Static	Minimum Centerline Bend Radius Flexing	Operating Pressure psig Max 70 °F	Operating Pressure psig Min 70 °F	Proof Pressure psig Min 70 °F	Burst Pressure psig Min 70 °F	Burst Pressure psig Min 850 °F
04	.250	.016	2.00	4.00	2000	1320	3000	8000	5280
05	.312	.018	2.50	5.00	1800	1190	2700	7200	4750
06	.375	.020	3.00	6.00	1600	1060	2400	6400	4220
08	.500	.028	4.00	8.00	1400	920	2100	5600	3690
10	.625	.038	4.50	9.00	1200	790	1800	4800	3170
12	.750	.042	5.00	10.00	1050	690	1575	4200	2770
16	1.000	.058	6.00	12.00	800	530	1200	3200	2120
20	1.250	.072	7.00	14.00	550	360	825	2200	1450

NOTE: For pressure rating at other elevated temperatures, multiply data in table by percentage factor from Figure 2 (expressed in decimal equivalent) for desired temperature level.

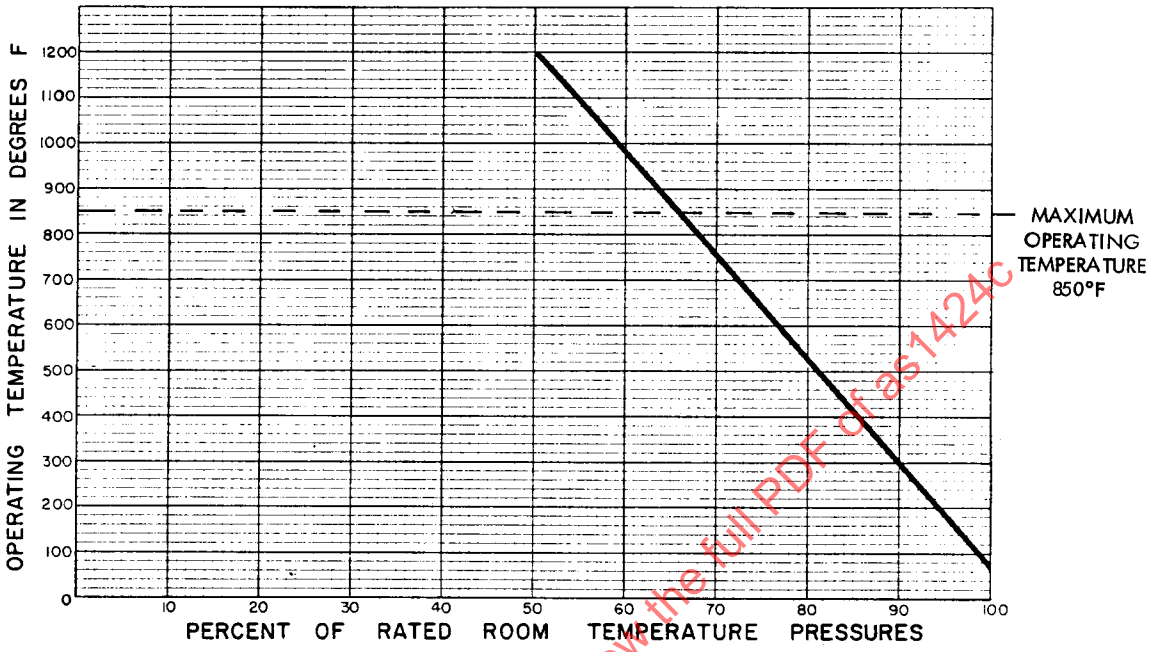

FIGURE 2 - Pressure Correction at Elevated Temperatures

3.5.2 Proof Pressure: The hose assembly shall withstand the applicable room temperature (70 °F) proof pressure specified in Table 3, 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 maintaining operating pressure after 50,000 combination flexure and pressure cycles in accordance with 4.6.5

3.5.6 Repetitive Assembly Torque: The fitting shall withstand repetitive assembly tightening torque values specified in ARP908 when tested in accordance with 4.6.6. There shall be no leakage, galling, or other malfunction of the fitting nut and sealing interface connection during the pressure test specified in 3.5.2.

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 3, 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 MIL-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 end-fittings.

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

a. Manufacturer's name or trademark and cage code
b. Complete hose assembly 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 as 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 document 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 qualification. 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 4, fabricated according to the manufacturer's assembly drawing(s).

TABLE 4 - Test Specimen Configurations

Specimen No.	Hose Assembly Type	Hose Nominal Tube Size .250	Hose Nominal Tube Size .312	Hose Nominal Tube Size .375	Hose Nominal Tube Size .500	Hose Nominal Tube Size .625	Hose Nominal Tube Size .750	Hose Nominal Tube Size 1.00	Hose Nominal Tube Size 1.25
1	AS136	-04-[1]	-05-[1]	-06-[1]	-08-[1]	-10-[1]	-12-[1]	-16-[1]	-20-[1]
2									
3	AS140	E120-000	F120-000	G120-000	H120-000	J120-000	K120-000	M120-000	N120-000
4									
5									
6	AS136	-04-[2]	-05-[2]	-06-[2]	-08-[2]	-10-[2]	-12-[2]	-16-[2]	-20-[2]
7									

1. **Actual gage point to gage point hose assembly length equal to dimension "L_1" of Table 6.**
2. **Actual gage point to gage point hose assembly length equal to dimension "L_2" of Table 6.**

4.4.2 Test Schedule and Sequence: The test specimens shall be subjected to qualification tests in the order indicated in Table 5 (from left to right):

TABLE 5 - 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	x1				
6	x	x	x	x			x				
7	x	x					x				

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

4.4.3 Test Report, Test Samples, and Data for the Procuring Activity: When the tests are conducted at a location other than the laboratory of the procuring activity, the following shall be furnished to that activity:

a. Test Report: The test report shall be in accordance with MIL-HDBK-831 which shall include a report of all tests and outline description of the tests and conditions.

b. Test Samples: Test samples when requested by the procuring activity. Samples subjected to qualification testing shall not be shipped as part of the contract.

c. Drawings: Three sets of assembly drawings. The assembly drawings shall have a cut-away section showing all details in their normal assembly position and shall define all details and subassemblies.

d. Sources: List of sources of hose, or hose components, including source's name and product identification for the inner tube, braid, and assembly.

NOTE: Log sheets and recorded test data shall remain on file at the source test facility and are not to be sent to the qualifying activity unless specifically requested.

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 document.

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 5 shall be performed according to 4.6.5 except the test may 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 document.

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 3 using air or nitrogen as test medium. Pressure shall be held 5 min minimum. All hose assemblies shall be thoroughly dried after testing. For individual tests (functional tests) only, the pressure shall be held 1 min minimum.

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

a. Pressurize the hose assembly to the 70 °F operating pressure listed in Table 3 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 5 sequence.

4.6.4 Vibration Test: Test specimens 1, 2, and 5, as shown in Table 5, shall be subjected to the vibration test. The test specimens shall be mounted as shown in Figures 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 °F. 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 6 - Specimen Lengths

Hose Size	Tube Size	"L_1"	"L_2"
04	.250	8.0	21.0
05	.312	9.3	24.5
06	.375	10.5	28.0
08	.500	13.0	35.5
10	.625	15.0	39.5
12	.750	16.5	43.5
16	1.000	19.5	51.5
20	1.250	23.0	59.5