SAE The Engineering Resource For Advancing Mobility
400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE STANDARD

AS 1710

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COUPLING, FUEL, FLEXIBLE, VARIABLE CAVITY, THREADED TYPE WITH FERRULES

1. SCOPE

This specification defines the requirements for a threaded flexible coupling assembly, which utilizes ferrules or machined tube end fittings to join tubing and components in aircraft fuel, vent or other systems. This coupling assembly is designed for use from -65 to 200 degrees F and at 125 psi peak working pressure.

2. APPLICABLE DOCUMENTS

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

2.1 SPECIFICATIONS

2.1.1 Federal

PPP-T-60	Tape, Packaging, Waterproof
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-576	Box, Wood, Cleated, Veneer, Paper Overlaid
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-591	Boxes, Shipping Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-636	Boxes, Shipping Fireboard
PPP-B-665	Boxes, Paperboard, Metal-Edged and Components
PPP-B-676	Boxes, Set-Up
VV-P-236	Petrolatum, Technical
WW-T-700/6	Tube, Aluminum Alloy, Drawn, Seamless, 6061
TT-S-735	Standard Test Fluids; Hydrocarbon

2.1.2 Military

MIL-P-116	Preservation - Packaging, Methods of
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series: General Specification for
MIL-L-10547	Liners, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
MIL-R-25988/1	Rubber, Fluorosilicone Elastomer, Oil and Fuel-Resistant, Sheets, Strips, Molded Parts, and Extruded Shapes

2.2 STANDARDS

2.2.1 Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-810	Environmental Test Methods
MIL-STD-831	Test Reports, Preparation of
MIL-STD-889	Dissimilar Metals

Copies of these documents may be obtained from the procuring activity or as directed by the Contracting Officer.

2.2.2 Industry - Society of Automotive Engineers

AS 567	General Practices for Use of Lock Wire, Key Washers, and Cotter Pins
AS 568	Aerospace Size Standard for O-rings
AS 1055	Fire Testing of Flexible Hose, Tube Assemblies, Coils, Fittings and Similar System Components
AS1711	Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends, Envelope Dimensions
AS1712	Coupling Sub-Assembly, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1713	Half Coupling Sub-Assembly, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1714	Nut Assembly, Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends

AS1715	Washer, Coupling, Flexibe, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1716	Ferrule, Coupling, Flexible, Variable Cavity, Threaded, Ferrule Tube Ends
AS1717	Retainer, Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1718	Coupling Body, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1719	Fitting End, Half-Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type, Design Standard
AS1720	Ferrule End, Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type, Design Standard

Copies may be obtained from The Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096

3. REQUIREMENTS

3.1 QUALIFICATION

Full coupling assemblies furnished under this specification shall be products which are qualified by meeting all of the requirements covered by this document. Manufacturers choosing to produce only a part or parts of the coupling assembly shall qualify the part or parts by complying with the requirements and performing all tests of this specification. The test specimens for qualification of a part or parts shall be completed with a qualified part or parts made by other manufacturers. Half coupling parts shall be qualified parts of the full coupling. Axial loading of the half coupling O-ring should be avoided and controlled by tubing installation.

3.2 MATERIALS AND FINISHES

Materials and finishes for the components shall be those designated on standards and drawings. Alternate materials and substitutions shall be approved by the purchaser. All materials and finishes shall be uniform in quality, free from defects, suitable for the purpose intended and consistent with good manufacturing practices.

3.2.1 Dissimilar Materials

Materials shall possess adequate corrosion-resistance characteristics or shall be suitably protected by the use of finishes to resist corrosion which may result from such conditions as dissimilar metal combinations, moisture, salt spray, and high-temperature deterioration. Dissimilar materials are defined by MIL-STD-889.

3.3 DESIGN AND CONSTRUCTION

The coupling shall be a lightweight, flexible connection with an O-ring seal. It shall be designed for engine feed and pressure fueling at 125 psig static working pressure in sizes up through 64, and for 25 psi for dump and vent lines in sizes from 72 up to and including size 88. The coupling shall operate at temperature extremes of -65 to 200 deg. F at static pressures, and -40 to 135 deg. F for pressure surging and dynamic operation during fueling and flight. The coupling shall function at a maximum misalignment of four degrees or with a maximum gap of .250 inch, or in combination, a minimum gap of 1/16 inch at a three degrees misalignment.

3.3.1 Coupling Components

The coupling assembly shall consist of the following components.

FULL COUPLING ASSEMBLY		HALF COUPLING ASSEMBLY	
(2)	Nut Assembly - AS1714	(1)	Nut Assembly - AS1714
(2)	Washers - AS1715	(2)	Washers - AS1715
(2)	Ferrules - AS1716 <1>	(1)	Ferrule - AS1716 <1>
(1)	Retainer - AS1717	(1)	Fitting End - AS1719 <3>
(1)	Body - AS1718	(1)	O-ring Seal <2>
(2)	O-ring Seals <2>		

<1> Ferrules are attached to tubing by roller swaging or bulge forming in accordance with user specifications.

<2> Not part of assembly and supplied by user.

<3> Recommended design standard and supplied by user.

Full coupling sub-assembly (AS1712) and half coupling sub-assembly (AS1713) are provided to simplify drawing call outs and to aid in tubing fabrication and installation. Sub-assemblies consist of components listed above except for ferrules. Ferrules are usually installed during the fabrication of tubing. The other coupling components are not needed until final assembly. Tubing ends in accordance with design standard AS1720 may be used with coupling assemblies instead of the ferrule type tube end.

3.3.2 Threads

Threads shall be in accordance with Federal Standard H28 and shall conform to MIL-S-7742, Class 2.

3.3.3 Seals

O-rings are not considered a part of this specification except for coupling qualification test requirements. O-ring sizes for the couplings ar given in Table I.

TABLE I – FUEL SYSTEM PRESSURE AND TEMPERATURE REQUIREMENT

BASIC SYSTEM CRITERIA (Temperature Range - 65° to 200°F							TEST REQUIREMENTS								
							STATIC (TESTS) 3					DYNAMIC (TESTS) 3			
SYSTEM	DASH SIZE	TUBE SIZE INCH REF.	AS 568 O-RING DASH SIZE REF.	OPERATING PRESSURE 1		PEAK WORKING PRESSURE 2	PROOF		TEST BURST TEMPERATURE °F			FLEXURE	SURGE	TEST TEMPERATURE °F 4	
				NEGATIVE INCH HG	POSITIVE PSIG	PSIG	NEGATIVE INCH HG	POSITIVE PSIG	PSIG	MIN	MAX	PSIG	PSIG	MIN	MAX
Engine Feed	08	.500	114	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	10	.625	116	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	12	.750	212	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	16	1.000	216	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	20	1.250	220	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	24	1.500	326	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	28	1.750	328	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
	32	2.000	330	24	60	125	28	250	375	-65	200	60	0 to 125	-40	135
Pressure Fueling & Dump	36	2.250	332	10	60	125	12	250	375	-65	200	60	0 to 125	-40	135
	40	2.500	334	10	60	125	12	250	375	-65	200	60	0 to 125	-40	135
	48	3.000	338	10	60	125	12	250	375	-65	200	60	0 to 125	-40	135
	56	3.500	342	10	60	125	12	250	375	-65	200	60	0 to 125	-40	135
	64	4.000	346	10	60	125	12	250	375	-65	200	60	0 to 125	-40	135
Fuel Tank Vent	72	4.5	426	10	15	30	12	250	375	-65	200	15	0 to 30	-40	135
	80	5.0	430	10	15	30	12	250	375	-65	200	15	0 to 30	-40	135
	88	5.5	434	10	15	30	12	250	375	-65	200	15	0 to 30	-40	135

NOTES: 1 The operating pressure shown here is the pressure range between the normal, continuous pump pressure and the maximum negative pressure (suction) that can occur.

2 The peak working pressure represents maximum surge conditions, pressure spikes.

3 The static test simulates ground operations, the dynamic test simulates flight operations.

4 Surge tests are conducted at room temperature and at 135°F (4.6.7).

3.4 DIMENSIONS

The coupling assembly envelope dimensions shall be as specified in AS1711. Part dimensions shall be as specified in applicable part standards.

3.4.1 Coupling Weight

The coupling assembly and components shall not exceed the maximum weights listed on the applicable standard or drawing.

3.5 PERFORMANCE

The coupling assembly shall meet the following performance requirements.

3.5.1 Proof Pressure

The coupling assembly shall meet the negative and positive proof pressures listed in Table I. A decrease in negative pressure exceeding 1/2 inch Hg within five minutes, or leakage sufficient to form a drop when pressurized or evidence of any other malfunction shall be cause for rejection. The test method is specified in Paragraph 4.6.2.

3.5.2 Fuel Resistance

The coupling assembly shall not leak (sufficient to form a drop) nor show evidence of malfunction when subjected to fuel resistance testing at high temperature fuel aging 200 deg. F, low temperature fuel aging -65 deg. F, and air dry out 200 deg. F. The test procedure and duration of aging is specified in Paragraph 4.6.3.

3.5.3 Vibriation

The coupling assembly shall show no evidence of malfunction or structural failure and shall withstand without leakage – sufficient to form a drop – the proof pressure requirements of Paragraph 3.5.1 after exposure to vibration levels in accordance with Paragraph 4.6.4.

3.5.4 Salt Fog

The coupling assembly shall not leak when proof tested to the requirements of Paragraph 3.5.1 and shall show no evidence of excessive corrosion, peeling, chipping or blistering of the finish or exposure of base metal under plated surfaces after being subjected to the salt fog test. The test method is specified in Paragraph 4.6.5.

3.5.5 Flexure

The coupling assembly shall withstand the Table I negative and positive proof pressures after being subjected to a total of 50,000 flexure cycles. At room temperature, a decrease in negative pressure exceeding 1/2 inch Hg within five minutes, leakage sufficient to form a drop when pressurized for a minimum of five minutes, or evidence of any other malfunction shall be a cause for rejection. Leakage at -40 deg. F, if observed, shall be recorded; it is not cause for rejection. Flexure shall be ± 1/2 degree from an initial misaligned position of three degrees. Testing is specified in Paragraph 4.6.6.

3.5.6 Pressure Surge

The coupling assembly shall withstand 50,000 pressure surges as defined in Figure 5 and in table I without evidence of malfunction or leakage – sufficient to form a drop. Testing is specified in Paragraph 4.6.7.

3.5.7 Burst Pressure

3.5.7.1 Burst Pressure Test at Temperature Extremes

The coupling assembly shall not rupture nor show evidence of leakage – sufficient to form a drop – at any pressure up to the Table I burst pressures and at the two temperature extremes. The test procedure is specified in Paragraph 4.6.8.1.

3.5.7.2 Burst at Room Temperature

The assembly shall be pressurized to rupture at room temperature. There shall be no evidence of leakage – sufficient to form a drop – at any pressure up to the burst test pressures listed in table 1. The pressure at which rupture occurs shall be above the values listed in table 1. The test procedure is specified in Paragraph 4.6.8.2.

3.6 IDENTIFICATION OF PRODUCT

Coupling assemblies and parts shall be marked for identification in accordance with the applicable standard or drawing and MIL-STD-130 as applicable.

3.7 WORKMANSHIP

Coupling components shall be manufactured and finished in accordance with commercially accepted practices and processes.

3.8 CLEANING

The coupling assemblies as supplied shall be free of oil, grease, dirt or any other foreign material both internally and externally.

4. QUALITY ASSURANCE PROVISIONS

4.1 RESPONSIBILITY FOR INSPECTION

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection and test requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the purchaser for the performance of the inspection and test requirements. The purchaser reserves the right to perform any of the inspections and tests set forth in the specification, where such inspections and tests are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 CLASSIFICATION OF INSPECTIONS

The examining and testing of assemblies shall be classified as:

a. Qualification inspections (see Paragraph 4.3)

b. Quality conformance inspections (see Paragraph 4.4)

4.3 QUALIFICATION INSPECTIONS

4.3.1 Qualification Test Specimens

Test specimens shall be in accordance with Figure 1 and Table II. The number of specimens are specified in Paragraph 4.3.2. Tubing for fabrication of test specimens shall be 6061-T4 in accordance with WW-T-700/6 with wall thickness as shown in Table III. O-Rings per MIL-R-25988/1 shall be used for qualification testing of all specimens.

TABLE II – TEST SPECIMEN LENGTHS AND END FITTING CONFIGURATIONS

DASH SIZE	TUBE SIZE (REF)	SPECIMENS 1, 2, 5 AND 6 INCHES				SPECIMENS 3 AND 4 INCHES				SPECIMENS 7 AND 8 INCHES	
		E1	L1	L2	E2	E1	L1	L2	E2	L1	L2
08	.500		12	20			8	12		6	6
16	1.000		12	20			11	12		6	6
32	2.000	[1]	12	20	[1]	[1]	16	12	[1]	6	6
48	3.000		12	20			18	12		6	6
64	4.000		12	20			23	12		6	6
80	5.000		12	20			26	12		6	6

[1] End configuration is to be compatible with test requirements and is to be determined by test laboratory or coupling manufacturer.

TABLE III – TUBE SIZE AND WALL THICKNESS

DASH SIZE	TUBE DIA. INCH [2]	TUBE WALL THICKNESS INCH [3]
08	.500	.035
10	.625	.035
12	.750	.035
16	1.000	.035
20	1.250	.035
24	1.500	.035
28	1.750	.035
32	2.000	.035
36	2.250	.042
40	2.500	.042
48	3.000	.042
56	3.500	.049
64	4.000	.049
80	5.000	.065
88	5.500	.065

[2] All sizes listed are not required for qualification testing but are included in the event that the purchaser specifies additional testing.

[3] Aluminum tubing, 6061-T4 in accordance with WW-T-700/6.

4.3.2 Test Schedule and Sequence

Eight test specimens for each of the coupling sizes 08, 16, 32, 48, 64 and 80 shall be subjected to qualification tests in the order indicated in Table IV.

TABLE IV – TEST SCHEDULE AND SEQUENCE

SPECIMEN NUMBERS	1	2	3	4	5	6	7	8
PARAGRAPHS	4.6.1 4.6.2 4.6.3 4.6.4 4.6.2	4.6.1 4.6.2 4.6.3 4.6.4 4.6.2	4.6.1 4.6.2 4.6.6 4.6.2	4.6.1 4.6.2 4.6.6 4.6.2	4.6.1 4.6.2 4.6.5 4.6.7 4.6.2	4.6.1 4.6.2 4.6.5 4.6.7 4.6.2	4.6.1 4.6.2 4.6.8	4.6.1 4.6.2 4.6.8

4.3.3 Test Report, Test Samples and Data for the Purchaser

Unless the tests are conducted by the purchaser the following shall be furnished by the supplier:

a. Test Report

Three (3) copies of a test report in accordance with MIL-STD-831, which shall include a report of all tests and describe the tests and conditions. (See note below)

b. Test Samples

Test samples when requested by the purchaser. Samples subjected to qualification testing shall not be shipped as part of contract or order.

c. Drawings

Three (3) sets of assembly and subassembly drawings. The assembly drawings shall have a cut-away of section showing all details in their normal assembly position and shall carry part numbers of all details and subassemblies.

Note: Log sheets and recorded test data shall remain on file at the source test facility and are not sent to the purchaser unless specifically requested.

4.3.4 Qualification Inspection Methods

Qualification inspection methods shall consist of all the examinations and tests specified under 4.6.

4.4 Quality Conformance Inspections

Quality conformance inspections shall be in accordance with MIL-STD-105 and Paragraphs 4.4.1 and 4.4.2. Each coupling part shall be subjected to examination of product as specified in 4.6.1. Any coupling failing to pass the examination shall be rejected.

4.4.1 Sample Size and Distribution

The sample size shall be as specified in accordance with MIL-STD-105. The classes, AQLs and defect characteristics referred to in MIL-STD-105 are further defined in Tables V and VI.

TABLE V – DEFECT CHARACTERISTICS

CLASS	AQL	CHARACTERISTICS
MAJOR	1.0%	LIKELY TO CAUSE MALFUNCTION, OR REDUCING USABILITY OF THE PART
MINOR A	4.0%	MAY HAVE A SLIGHT EFFECT ON USABILITY
MINOR B	6.5%	ESSENTIALLY NO EFFECT ON USABILITY

4.4.2 Classification of Defects

TABLE VI – CLASSIFICATION OF DEFECTS

PART	CLASS	CHARACTERISTIC [1]
AS1714 NUT ASSEMBLY	MAJOR 1.0% AQL	T,D
	MINOR A 4.0% AQL	E,F,G
	MINOR B 6.5% AQL	C
AS1715 WASHER	MAJOR 1.0% AQL	C
	MINOR A 4.0% AQL	B
	MINOR B 6.5% AQL	A
AS1716 FERRULE	MAJOR 1.0% AQL	D,K
	MINOR A 4.0% AQL	B
	MINOR B 6.5% AQL	REMAINDER
AS1717 RETAINER	MAJOR 1.0% AQL	A,B
	MINOR A 4.0% AQL	G,H,N
	MINOR B 6.5% AQL	REMAINDER
AS1718 BODY	MAJOR 1.0% AQL	T,D
	MINOR A 4.0% AQL	NONE
	MINOR B 6.5% AQL	REMAINDER

[1] See applicable standard page for dimension

4.4.3 Rejection and Retest

Where one or more items selected from a lot fails to meet the specification, all items in the lot shall be inspected.

4.4.3.1 Resubmitted Lots

Once a lot (or part of a lot) has been rejected by a purchaser (Government or industry), full particulars concerning the cause of the rejection and the action taken to correct the defect(s) in the lot shall be submitted, in writing, to the purchaser before it can be resubmitted for tests.

4.5 TEST CONDITIONS

4.5.1 Assembly of Test Specimens

O-ring shall be lubricated with VV-P-236 Petrolatum. Lock wiring of coupling assemblies shall be in accordance with AS567, if applied, - optional for testing.

4.5.2 Test Fluids

Test fluids shall be in accordance with TT-S-735, Type I for -65 deg. F tests and Type III for room temperature and 200 deg. F tests, or as specified. Optional test fluids may be approved by the purchaser.

4.5.3 Pressure Measurements

Unless otherwise specified, positive pressure measurements shall have a tolerance of ±10 psi. Negative pressures shall be equal to or greater than the specified value.

4.5.4 Temperature Measurements

Unless otherwise specified, the test specimens and fluid shall be maintained within ±5 deg. F. Ambient temperature measurements shall be taken within six inches of the specimen.

4.5.5 Test Setup

Preferred test setups are shown by Figure 2 through Figure 4. Deviations from these setups shall be approved by the purchaser.

4.6 INSPECTION METHODS

4.6.1 Examination of Product

Each assembly or part shall be visually and dimensionally inspected to determine compliance with the applicable standard or drawing with respect to material, size, workmanship and AQL level specified in table VI. Inspection reports shall be provided if requested by the purchaser.

4.6.2 Proof Pressure Test

Test specimens shall be subjected to the positive and negative proof pressure as specified in Table I or as specified in conjunction with other tests.

4.6.2.1 Negative Proof Pressure Test

Test specimens shall be dry and free of fuel or test fluid vapors. The connection between the test specimen and vacuum pump shall be 1/2 inch nominal hose or tube size maximum and shall not exceed a length of 10 feet. Pressure shall be measured within six inches of the test specimen. A stop valve shall be installed adjacent to the pressure gage in the line to the pump. A negative proof pressure equal to or greater than the Table I specified pressure shall be maintained for a minimum of 15 minutes. The stop valve shall then be closed and the pressure shall be monitored for five minutes for evidence of leakage. The test specimen shall meet the requirements of Paragraph 3.5.1.

4.6.2.2 Positive Proof Pressure Test

The test specimen shall be proof pressure tested to the Table I positive value for not less than 30 seconds and not more than five minutes. The test fluid shall be as specified in other tests or may be water. The test specimen shall be monitored for leakage and shall meet the requirements of Paragraph 3.5.1.

4.6.3 Fuel Resistance Test

Test specimens 1 and 2, as specified in Figure 1, shall be mounted on a test fixture as shown in Figure 2 with a 3 degree misalignment between tube center lines for each size coupling to be qualified. Tube end (L2) shall be rigidly clamped and tube end (L1) shall be clamped with clearance to allow axial movement of the tube until it is restrained by the coupling. Clamp blocks adjacent to the coupling shall be spaced 20 inches apart. The coupling shall be centered between clamp blocks.

4.6.3.1 High Temperature Aging

Coupling assemblies shall be proof pressure tested in accordance with Paragraph 4.6.2.2 to the Table I positive proof pressure using TT-S-735, Type I test fluid. If no evidence of leakage or other malfunction occurs, the pressure shall be reduced to 125 psi. Ambient and fluid temperatures shall then be increased to 200 deg. F. After temperature stabilization, the test shall be continued for a minimum of 72 hours maintaining a fluid and ambient temperature of 200 deg. F. Upon completion and while at 200 deg. F, the couplings shall be subjected to a positive proof pressure test in accordance with Paragraph 4.6.2.2. The ambient and fluid temperatures shall then be reduced to room temperature.

4.6.3.2 Low Temperature Aging

Coupling assemblies shall be proof pressure tested in accordance with Paragraph 4.6.2.2 to the Table I positive proof pressure using TT-S-735, Type I test fluid. If no evidence of leakage or other malfunction occurs, the

pressure shall be reduced to 125 psi. Ambient and fluid temperatures shall be lowered and stabilized at -65 deg. F. The test shall be continued for a minimum of 72 hours maintaining a fluid and ambient temperature of -65 deg. F. Upon completion and while at -65 deg. F, the couplings shall be subjected to a positive proof pressure test. The ambient and fluid temperatures shall then be increased to room temperature conditions. The test fluid shall then be drained and the couplings air dried for further testing without disassembly or removal from the test fixture.

4.6.3.3 High Temperature Drying

The coupling assemblies, while vented to the atmosphere, shall be maintained for 168 hours at 200 deg. F. Following this drying cycle the low temperature test per Paragraph 4.6.3.2 shall be repeated one additional time except upon completion the test fluid will not be drained. Without disassembly of the couplings or removal from the text fixture, the couplings shall be subjected to vibration testing in accordance with Paragraph 4.6.4.

4.6.4 Vibration test

At the completion of the Fuel Resistance Test in accordance with Paragraph 4.6.3, test specimens 1 and 2 per Figure 1 shall be mounted on a test fixture as shown in Figure 2 with a three degree misalignment between tube center lines. Tube end L2 shall be rigidly clampled. Tube end L1 shall be clamped with a clearance to allow axial tube movement until it is restrained by coupling. Clamp blocks adjacent to the coupling shall be spaced 20 inches apart and the coupling located midway between the clamp blocks. The vibration time shall be divided equally between the specimen pressurized to 125 psi with TT-S-735, Type I test fluid and the specimen at the Table I negative operating pressure while empty. Testing shall be conducted at room temperature. The test data shall include:

a. Input - Plots of the actual vibration input spectra for each axis and test level shall be included.

b. Response - Frequency response plots of transmissibility (response/input) versus frequency for the equipment response points. Frequencies associated with minimum performance or other frequencies selected for resonance dwell points shall be identified on response points.

c. Chronological Log - The log shall contain a clear description of the test being performed and shall include all pertinent information concerning conduct of test, equipment performance, identification and a description of any failures. Any failures and/or performance degradations during the vibration testing shall be fully discussed as well as remedial action taken.

4.6.4.1 Resonance Survey

A sinusoidal resonance survey shall be made in one orthogonal axis. The frequency sweep shall be made slowly from 5 to 2000 Hz at .024 inch double amplitude, or ±2g, whichever is less. Resonance points shall be noted and resonance recorded and the modes of each resonance described. Resonant points used for resonance vibration shall be determined by a synchronized strobe light.

4.6.4.2 Sinusoidal Vibration Test

Each test specimen shall be vibrated along the same orthogonal axis, with up to four resonance dwells in the 5 to 2000 Hz range, for test times specified in Table VII at the worst resonant conditions.

TABLE VII – VIBRATION TEST TIMES

NUMBER OF RESONANCE	0	1	2
TOTAL DWELL TIME AT RESONANCE POINTS (MINUTES)	0	30	60
TOTAL CYCLING TIME (MINUTES)	90	60	30

If more than two resonant frequencies are noted, only the most severe shall be used for resonance dwell. The double amplitude and acceleration levels shall be:

5 - 18 Hz	0.10 inch double amplitude
18 - 24 Hz	±1.5g
24 - 50 Hz	0.036 inch double amplitude

The Resonance Survey and Sinusoidal Vibration Test shall be performed on specimens 1 and 2 (see table IV) in each orthoganal axis. The test specimens shall be monitored for leakage and shall meet the requirements of Paragraph 3.5.3.

4.6.5 Salt Fog Test

Test specimens 5 and 6 as specified in Figure 1 shall be mounted in a suitable chamber and exposed to salt fog for 168 hours in accordance with MIL-STD-810, Method 509.1. After the 168 hours of exposure, the test specimen shall be examined for evidence of corrosion or other damage of the finish. Proof pressure test in accordance with Paragraph 4.6.2 shall be performed. The test specimen shall be monitored for leakage during the proof pressure test and shall meet the requirements of Paragraph 3.5.4.

4.6.6 Assembly Flexure Test

Test specimens 3 and 4, as specified in Figure 1 shall be mounted in the flexure test setup as illustrated by Figure 2. Tube end L2 shall be rigidly fixed and tube end L1 shall be initially misaligned three degrees between tube center lines. Axial movement of tube end L1 shall be constrained only by the coupling assembly. The test setup shall provide for rotary or planer flexure of tube end L1. Tube displacement during flexure shall be equivalent to plus or minus 1/2 degree movement in each direction from the initial three degree misalignment of the tubes. Flexure shall be conducted at 60 ± 5 cycles per minute. The test fluid shall be per 4.5.2. The coupling assemblies shall be subjected to the following test sequence.

a. Proof pressure test the specimens according to Paragraph 4.6.2.2 while misaligned and at room temperature.

b. Condition (soak) test specimens at 135 deg. F for a minimmum of one (1) hour while misaligned and full of test fluid but unpressurized.

c. Flexure test the specimens for 25,000 cycles while at 135 deg. F and pressurized to Table I positive operating pressure.

d. Condition (soak) test specimens at -40 deg. F for a minimum of one (1) hour while misaligned and full of test fluid but unpressurized.

e. Flexure test the specimens for 25,000 cycles while at -40 deg. F and pressurized to Table I positive operating pressure.

f. Proof pressure test the specimens according to Paragraphs 4.6.2.1 and 4.6.2.2. The test specimens shall be monitored for leakage and shall meet the requirements of Paragraph 3.5.5.

4.6.7 Pressure Surge Test

Test specimens 5 and 6 as specified in Figure 1 shall be installed in test fixture as illustrated in Figure 4. The specimen shall be proof pressure tested in accordance with Paragraph 4.6.2.2. Pressure surges as specified in table 1 shall be applied at the rate of 20 to 30 cycles per minute with pressure traces conforming to Figure 5. Test sequence shall be as follows:

a. 25,000 pressure surge cycles at room temperature, to 125 psi, except to 30 psi for vent lines (table I).

b. One hour soak at 135 deg. F to 125 psi.

c. 25,000 pressure surge cycles at 135 deg. F, to 125 psi, except to 30 psi for vent lines (table I).

d. Proof pressure test at room temperature according to Paragraph 4.6.2.2.

4.6.8 Burst Test

4.6.8.1 Burst Test at Temperature Extremes

Test specimens 7 and 8 shall be assembled per figure 1 and mounted per figure 2. They shall be pressurized to burst values specified in table I and held at that pressure for two minutes; first at -65 deg. F, then at 200 deg. F. Test fluid shall be per 4.5.2.

4.6.8.2 Burst Test at Room Temperature

Test specimens 7 and 8 shall be retested per 4.6.8.1 above, except that the test specimens shall be pressurized at room temperature and the pressure increased until failure occurs. The failure mode shall be recorded. Test fluid may be water.

5. PREPARATION FOR DELIVERY

5.1 PRESERVATION PACKING

Preservation shall be required by the purchase order as level A or C (Paragraph 6.2). Other satisfactory methods may be applied if no level is specified.

5.1.1 Level A

Fuel coupling components shall be preserved in accordance with Method III of MIL-P-116 and unit packaged in containers conforming to PPP-B-566, PPP-B-665 or PPP-B-676. The gross weight of the boxes shall not exceed the weight limitations of the applicable container specification.

5.1.2 Level C

Fuel coupling components shall be preserved and packaged as necessary to prevent damage or deterioration during shipment.

5.2 PACKING

Packing shall be required by the purchase order as level A, B, or C (Paragraph 6.2). Other satisfactory methods may be applied if no level is specified.

5.2.1 Level A

Fuel coupling components preserved and packaged to meet 5.1.1 shall be packed in exterior type shipping containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636 or PP-B-576. Insofar as practical, exterior containers shall be of uniform shape and size, of minimum cube and tare consistent with the protection required, and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the application or appendix thereto. Containers shall be provided with a case liner conforming to MIL-L-10547 and shall be sealed in accordance with the appendix thereto. The case liner shall not be required when the unit, intermediate, or exterior container conforms to PPP-B-636 and is sealed at all joints and seams, including manufacturer's joint, with tape conforming to PPP-T-60.

5.2.2 Level B

Coupling Components preserved and packaged to 5.1.1 shall be packed in domestic-type exterior containers conforming to PPP-B-585, PPP-B-591, PPP-B-601, PPP-B-636 or PPP-B-576. Exterior containers shall be of minimum cube and tare consistent with the protection required. Insofar as practicable, exterior containers shall be of uniform size and shape, and shall contain identical quantities. The gross weight of each pack shall be limited to approximately 200 pounds. Containers shall be closed and strapped in accordance with the applicable container specification or appendix thereto. When fiberboard containers are used, the fiberboard shall conform to the special requirements of Table PPP-B-636.

5.2.3 Level C

Packages which require over-packing for acceptance by the carrier, shall be packed in exterior-type shipping containers in a manner that will ensure safe transportation at the lowest rate to the point of delivery. Containers shall meet uniform freight classification rules or regulations of other common carriers, as applicable to the mode of transportation.

5.3 MARKING

Interior and exterior containers shall be marked in accordance with MIL-STD-129.

5.3.1 Packing Date

The date of packing shall be marked on all interior and exterior containers.

6. NOTES

6.1 INTENDED USE

These coupling assemblies are intended for joining tubing in aircraft fuel, vent or other systems where the designed operating pressures and temperatures are within the requirements of this specification. Installation in which the limits specified herein are exceeded, or in which the application is not covered specifically by this specification will be subject to the approval of the purchaser.

6.1.1 Fire Resistance

When fire proofing or fire resistance is a requirement, the test shall be conducted to the procedures and requirements specified in AS 1055.

6.2 ORDERING DATA

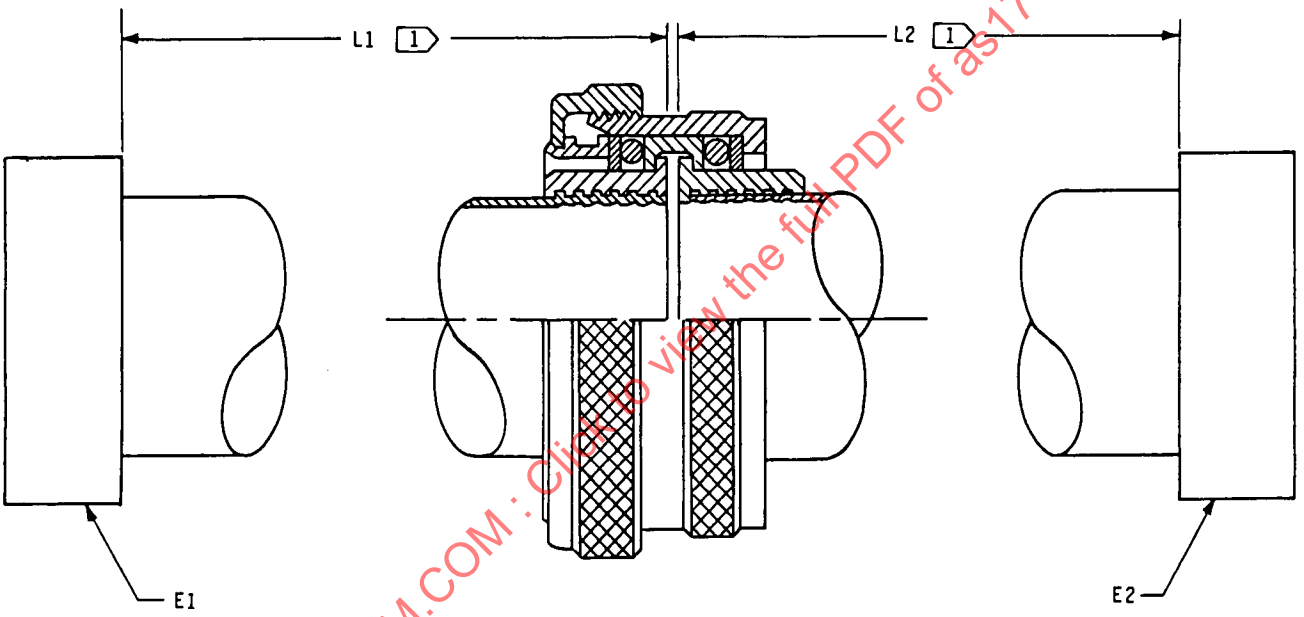
Procurement documents should specify:

a. Title, number and date of this specification

b. Applicable "AS" part number

c. Data requirements (see 4.3.3)

d. Applicable level of preservation, packaging and packing or special preparation for delivery (see 5.1 and 5.2).



1 SEE TABLE II FOR DIMENSIONS.

TEST SPECIMEN CONFIGURATION

Figure 1