SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

AS1710	REV. C

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Superseding AS1710B

Coupling, Fuel, Flexible, Variable Cavity, Threaded Type With Ferrules

RATIONALE

Revision 'C' adds QPL/QML requirements and provides a general document update.

1. SCOPE

This SAE Aerospace Standard (AS) 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 and fuel vent or other systems. This coupling assembly is designed for use from -65 to +200 °F and at 125 psig peak working pressure, and the coupling assembly may be used in other fluid systems when requirements are within the limits.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS-R-25988	Rubber, Fluorosilicone Elastomer, Oil-and-Fuel-Resistant, Sheet, Strips, Molded Parts, and Extruded Shapes
AMS-WW-T-700/6	Tube, Aluminum Alloy, Drawn, Seamless, 6061
AS567	General Practices for Use of Lock Wire, Key Washers, and Cotter Pins
AS568	Aerospace Size Standard for O-rings
AS1055	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 Subassembly, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1713	Half Coupling Subassembly, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends
AS1714	Nut Assembly, Coupling, Flexible, Variable Cavity, Threaded, Ferrule Type Tube Ends

AS1715	Washer, Coupling, Flexible, 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
AS4060	Tube Fitting Swaged Joint, Roller Expander, Manual Process, Requirements for
AS7003	National Aerospace and Defense Contractors Accreditation Program (NADCAP)
AS7112	National Aerospace and Defense Contractors Accreditation Program Requirements for Fluid System Components

2.2 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, http://assist.daps.dla.mil/quicksearch/.

FED-STD-H28/2	Screw-Thread Standards for Federal Services Section 2: Unified Inch Screw Threads - UN and UNR Thread Forms
MIL-HDBK-831	Military Handbook, Preparation of Test Reports
MIL-L-10547	Liners, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible
MIL-PRF-680	Performance Specification, Degreasing Solvent (Stoddard Solvent)
MIL-PRF-7024	Performance Specification, Calibrating Fluids, Aircraft Fuel System Components
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-889	Dissimilar Metals
MIL-STD-2073-1	Department of Defense, Standard Practice for Military Packaging
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-676	Boxes, Set-up
VV-P-236	Petrolatum, Technical

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D 473 Standard Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method

ASTM D 5118/D5118M Standard Practice for Fabrication of Fiberboard Shipping Boxes

ASTM D 5486/D5486M Standard Specification for Pressure Sensitive Tape for Packaging, Box Closure, and Sealing

ASTM D 6251/D6251M Standard Specification for Wood Cleated Panelboard Shipping Boxes

2.4 PRI Publications

Available from Performance Review Institue, 161 Thornhill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2001 Qualified Product Management Council Procedures for Qualified Products Group

PD2101 Aerospace Quality Assurance, Product Standard, Qualification Procedures, Fluid Systems

2.5 ASME Publications

Available from ASME, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

2.6 ANSI Publications

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI/ASQC Z.1.4 Sampling Procedures and Tables for Inspection by Attributes.

3. TECHNICAL REQUIREMENTS

3.1 Qualification

Full coupling assemblies furnished under this document shall be products that 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 document. 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.

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).

3.1.2 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 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 O-ring seals. It shall be designed for engine feed and pressure fueling at 125 psig static working pressure in sizes up through -64 and for 30 psig 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 °F at static pressures, and -40 to +135 °F for pressure surging and dynamic operation during fueling and flight. The coupling shall function at a maximum misalignment of 4° or with a maximum gap of .250 in, or in combination, a minimum gap of .062 in at a 3° misalignment.

3.3.1 Coupling Components

The coupling assembly shall consist of the components shown as follows in Tables 1 and 2:

TABLE 1 - FULL COUPLING ASSEMBLY

Qty	Description	Standard No.
One	Nut Assembly	AS1714
Two	Washers	AS1715
Two	Ferrules	AS1716 /1/
Two	Retainer Halves	AS1717 /2/
One	Body	AS1718
Two	O-rings /3/	

/1/ Ferrules are attached to tubing by roller swaging or bulge forming in accordance with user specifications. Roller swaging shall conform to AS4060.
/2/ One retainer required for sizes -80 and -88.
/3/ Not part of assembly and supplied by user.

TABLE 2 - HALF COUPLING ASSEMBLY

Qty	Description	Standard No.
One	Nut Assembly	AS1714
Two	Washers	AS1715
One	Ferrule	AS1716 /1/
One	Fitting End	AS1719 /2/
One	O-rings /3/	

/1/ Ferrules are attached to tubing by roller swaging or bulge forming in accordance with user specifications. Roller swaging shall conform to AS4060.
/2/ Recommended design standard and supplied by user.
/3/ Not part of assembly and supplied by user.

Full coupling subassembly (AS1712) and half coupling subassembly (AS1713) are provided to simplify drawing call outs and to aid in tubing fabrication and installation. Subassemblies consist of components listed except for ferrules. Ferrules are usually installed during the fabrication of tubing. The other coupling components are not needed until final assembly. Fitting 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 H28/2 or ASME B1.1.

3.3.3 Seals

O-rings are not considered a part of this document except for coupling qualification test requirements. O-ring sizes for the couplings are given in Table 3.

TABLE 3 - FUEL SYSTEM PRESSURE AND TEMPERATURE REQUIREMENT

	Basic System Criteria Temperature Range -65 to 200 °F						Test Requirements								
							Static (Tests) /3/					Dynamic (Tests) /3/			
	Dash Size	Tube Size in	AS568 O-ring Dash Size	Operating Pressure /1/		Peak Working Pressure /2/	Proof		Burst	Test Temperature °F		Flexure	Surge	Test Temperature °F /4/	
System		Ref	Ref	Negative in Hg	Positive psig	psig	Negative in Hg	Positive psig	psig	Min	Max	psig	psig	Min	Max
Engine Speed	08	.500	114	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	10	.625	116	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	12	.750	212	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	16	1.000	216	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	20	1.250	220	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	24	1.500	326	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	28	1.750	328	24	60	125	28	250	375	-65	200	60	0-125	-40	135
	32	2.000	330	24	60	125	28	250	375	-65	200	60	0-125	-40	135
Pressure Fueling and Dump	36	2.250	332	10	60	125	12	250	375	-65	200	60	0-125	-40	135
	40	2.500	334	10	60	125	12	250	375	-65	200	60	0-125	-40	135
	44	2.750	336	10	60	125	12	250	375	-65	200	60	0-125	-40	135
	48	3.000	338	10	60	125	12	250	375	-65	200	60	0-125	-40	135
	56	3.500	342	10	60	125	12	250	375	-65	200	60	0-125	-40	135
	64	4.000	346	10	60	125	12	250	375	-65	200	60	0-125	-40	135
Fuel Tank Vent	72	4.5	426	10	15	30	12	250	375	-65	200	15	0-30	-40	135
	80	5.0	430	10	15	30	12	250	375	-65	200	15	0-30	-40	135
	88	5.5	434	10	15	30	12	250	375	-65	200	15	0-30	-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 Leakage

3.5.1.1 Liquid Leakage

The test assembly shall be subjected to the positive proof pressures listed in Table 3. Any leakage sufficient to form a drop while pressurized or evidence of other malfunctions shall be cause for rejection. The test method is specified in 4.6.2.2.

3.5.1.2 Vacuum Leakage

The test assembly shall be subjected to the negative proof pressures listed in Table 3. A decrease in the negative pressure exceeding .5 in Hg within 5 min shall be cause for rejection. The test method is specified in 4.6.2.1.

3.5.1.3 Pneumatic Leakage

The test assembly shall be subjected to a pneumatic pressure equal to the proof pressure listed in Table 3 for a period of 3 min at room temperture. Any evidence of pneumatic leakage after 1 min at pressure or other malfunctions that would affect the performance of the assembly will be cause for rejection when tested as specified in 4.6.2.3.

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 at +200 °F, low temperature fuel aging at -65 °F, and air dry out at +200 °F. The test procedure and duration of aging is specified in 4.6.3.

3.5.3 Vibration

The coupling assembly shall show no evidence of malfunction or structural failure and shall not leak (sufficient to form a drop) when subjected to the proof pressure requirements of 3.5.1 after exposure to vibration levels in accordance with 4.6.4.

3.5.4 Salt Fog

The coupling assembly shall not leak (sufficient to form one drop) when proof tested to the requirements of 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 4.6.5.

3.5.5 Flexure

The coupling assembly shall withstand the Table 3 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 .5 in Hg within 5 min, leakage sufficient to form a drop when pressurized for a minimum of 5 min, or evidence of any other malfunction shall be a cause for rejection. Flexure shall be ±.5° from an initial misaligned position of 3°. Testing is specified in 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 3 without evidence of malfunction or leakage (sufficient to form a drop). Testing is specified in 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 3 burst pressures and at the two temperature extremes. The test procedure is specified in 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 3. The pressure at which rupture occurs shall be above the values listed in Table 3. The test procedure is specified in 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 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 4.3)

b. Quality conformance inspections (see 4.4)

4.3 Qualification Inspections

4.3.1 Qualification Test Specimens

Test specimens shall be in accordance with Figure 1 and Table 4. The number of specimens are specified in 4.3.2. Tubing for fabrication of test specimens shall be 6061-T4 in accordance with AMS-WW-T-700/6 with the standard wall thickness as shown in Table 5. O-rings per AMS-R-25988/1 shall be used for qualification testing of all specimens.

TABLE 4 - TEST SPECIMEN LENGTHS AND END FITTING CONFIGURATIONS

Dash Size	Tube Size (Ref)	Specimens 1, 2, 5 and 6 in				Specimens 3 and 4 in				Specimens 7 and 8 in	
		E1	L1	L2	E2	E1	L1	L2	E2	L1	L2
08	.500	/1/	12	20	/1/	/1/	8	12	/1/	6	6
16	1.000	/1/	12	20	/1/	/1/	11	12	/1/	6	6
32	2.000	/1/	12	20	/1/	/1/	16	12	/1/	6	6
48	3.000	/1/	12	20	/1/	/1/	18	12	/1/	6	6
64	4.000	/1/	12	20	/1/	/1/	23	12	/1/	6	6
80	5.000	/1/	12	20	/1/	/1/	26	12	/1/	6	6

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

TABLE 5 - TUBE SIZE AND WALL THICKNESS

Dash Size	Tube Diameter in /1/	Tube Wall Thickness in /2/
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
44	2.750	.042
48	3.000	.042
56	3.500	.049
64	4.000	.049
80	5.000	.065
88	5.500	.065

/1/ All sizes listed are not required for qualification testing but are included in the event that the purchaser specifies additional testing.
/2/ Aluminum tubing, 6061-T4 in accordance with AMS-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 6.

TABLE 6 - TEST SCHEDULE AND SEQUENCE

Specimen Numbers	1	2	3	4	5	6	7	8
Paragraphs	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1	4.6.1
	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2	4.6.2
	4.6.3	4.6.3	4.6.6	4.6.6	4.6.5	4.6.5	--	--
	4.6.4	4.6.4	4.6.2	4.6.2	4.6.7	4.6.7	--	--
	4.6.2	4.6.2	--	--	4.6.2	4.6.2	4.6.8	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 copies of a test report in accordance with MIL-HDBK-831, which shall include a report of all tests and a description of 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 the contract or order.

c. Drawings: Three sets of assembly and subassembly drawings. The assembly drawings shall have a cutaway 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 ANSI/ASQC Z1.4, Single Sampling Plan, Inspection Level II with an acceptance number zero, and 4.4.1 and 4.4.2. Each coupling part shall be subjected to the examination of product as specified in 4.6.1.

4.4.1 Sample Size and Distribution

The sample size shall be as specified in accordance with ANSI/ASQC Z1.4, Table II-A for AQL 1.0 and Table II-C for AQL 4.0 and AQL 6.5. The defect characteristics are further defined in Tables 7 and 8.

TABLE 7 - 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 8 - CLASSIFICATION OF DEFECTS

Part	Class	Characteristic /1/
AS1714 Nut Assembly	Major 1.0% AQL	T Thread, D Dia
	Minor A 4.0% AQL	E Min, F Dim, G Dim
	Minor B 6.5% AQL	4.6.1
AS1715 Washer	Major 1.0% AQL	.020 Max Gap at C Gage
	Minor A 4.0% AQL	B Thickness
	Minor B 6.5% AQL	4.6.1
AS1716 Ferrule	Major 1.0% AQL	D Dia, K Depth
	Minor A 4.0% AQL	B Dia
	Minor B 6.5% AQL	4.6.1
AS1717 Retainer	Major 1.0% AQL	A Rad, B Rad
	Minor A 4.0% AQL	G Dim, H Dim, N Dim
	Minor B 6.5% AQL	4.6.1
AS1718 Body	Major 1.0% AQL	T Thread, D Dia
	Minor A 4.0% AQL	None
	Minor B 6.5% AQL	4.6.1

/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-rings 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 MIL-PRF-680 or MIL-PRF-7024. Optional test fluids such as MIL-H-5606 may be used if approved by PRI.

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 °F. Ambient temperature measurements shall be taken within 6 in 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 8. 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 3 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 .5 in nominal hose or tube size maximum and shall not exceed a length of 10 ft. Pressure shall be measured within 6 in 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 3 specified pressure shall be maintained for a minimum of 15 min. The stop valve shall then be closed and the pressure shall be monitored for 5 min for evidence of leakage. The test specimen shall meet the requirements of 3.5.1.2.

4.6.2.2 Positive Proof Pressure Test

The test specimen shall be proof pressure tested to the Table 3 positive value for not less than 30 s and not more than 5 min. 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 3.5.1.1.

4.6.2.3 Proof Pressure Pneumatic

The test assemblies (see Figure 1) shall be placed in a protective enclosure and pressure tested at room temperature at a value equal to the proof pressure value of Table 4 for a minimum period of 3 min. The test fluid shall be dry compressed air or nitrogen. The test assemblies shall be prepared without use of oil except O-ring lubricant, during assembly or prior to testing. Any oil or grease used for tubing attachment shall be completely removed before test. The test specimen shall be monitored for leakage and shall meet the requirements of 3.5.1.3.

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° misalignment between tube centerlines 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 in 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 4.6.2.2 to the Table 3 positive proof pressure using MIL-PRF-680 or MIL-PRF-7024 test fluid. If no evidence of leakage or other malfunction occurs, the pressure shall be reduced to 125 psig. Ambient and fluid temperatures shall then be increased to +200 °F. After temperature stabilization, the test shall be continued for a minimum of 72 h maintaining a fluid and ambient temperature of +200 °F. Upon completion and while at +200 °F, the couplings shall be subjected to a positive proof pressure test in accordance with 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 4.6.2.2 to the Table 3 positive proof pressure using MIL-PRF-680 or MIL-PRF-7024, Type I test fluid. If no evidence of leakage or other malfunction occurs, the pressure shall be reduced to 125 psig. Ambient and fluid temperatures shall be lowered and stabilized at -65 °F. The test shall be continued for a minimum of 72 h maintaining a fluid and ambient temperature of -65 °F. Upon completion and while at -65 °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 h at +200 °F. Following this drying cycle the low temperature test per 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 4.6.4.

4.6.4 Vibration Test - Overall Guidelines

Upon completion of the fuel resistance test in accordance with 4.6.3, test specimens 1 and 2 per Figure 1 shall be mounted on a test fixture as shown in Figure 2 (Reference Figure 6) with a minimum initial 3º misalignment between tube assembly centerlines.

Tube end L1 shall be clamped with a clearance to allow axial tube movement until it is restrained by the coupling. Tube end L2 shall be rigidly clamped. The clamp blocks adjacent to the coupling shall be spaced 20 in apart with the coupling located midway between these clamp blocks. The vibration test shall be conducted along three mutually perpendicular axes as shown in Figure 6. The vibration time shall be divided equally between the specimen pressurized to 125 psig with MIL-PRF-680 or MIL-PRF-7024, Type I test fluid and the specimen pressurized at the Table 3 negative operating pressure while empty. Testing shall be conducted at room temperature. The test amplitude shall correspond to Curve II of Figure 7.

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 Resonant Survey

A sinusoidal resonant survey shall be made in one orthogonal axis. The frequency sweep shall be made slowly from 5 to 2000 Hz with each resonant point measured, noted, and the modes of each resonant described. A resonant is defined as a magnification of output to input levels by a factor of two or more. Resonant points used for resonant vibration may be verified by a synchronized strobe light.

4.6.4.2 Sinusoidal Vibration Test

The test specimen shall be installed as in 4.6.4 and subjected to a vibration sweep (5 to 2000 Hz). The sweep shall be held at the resonant frequency (or frequencies) noted in 4.6.4.1, while oscillating for 10 min. If more than four resonant frequencies are found, dwell shall occur at the four most severe resonant frequencies, for 10 min at each resonant.

The test specimen shall be subjected to sinusoidal vibration and searched for resonant while at the operating pressure of Table 3 at room temperature. Cyclic vibration shall be conducted with the frequency varying between 5 and 2000 Hz. The rate of change shall be approximately logarithmic and shall be such that a complete cycle (5 to 2000 to 5 Hz) will consume approximately 15 min. The test amplitude shall be that given by Curve I in Figure 7. The test shall continue for a minimum of 60 min. Upon completion of the test, the specimen components shall be visually examined for any mechanical failures, excessive wear, or loosened parts. The specimen condition shall be noted.

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 h in accordance with MIL-STD-810, Method 509.3. After the 168 h of exposure, the test specimen shall be examined for evidence of corrosion or other damage of the finish. Proof pressure test in accordance with 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 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 a minimum of 3° between tube centerlines. 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 ±.5° movement from the initial 3° misalignment of the tubes. Flexure shall be conducted at 60 cpm ± 5. 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 4.6.2.2 while misaligned and at room temperature.

b. Condition (soak) test specimens at +135 °F for a minimum of 1 h while misaligned and full of test fluid but unpressurized.

c. Flexure test the specimens for 25 000 cycles while at +135 °F and pressurized to Table 3 positive operating pressure.

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

e. Flexure test the specimens for 25 000 cycles while at -40 °F and pressurized to Table 3 positive operating pressure.

f. Proof pressure test the specimens according to 4.6.2.1 and 4.6.2.2. The test specimens shall be monitored for leakage and shall meet the requirements of 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 4.6.2.2. Pressure surges as specified in Table 3 shall be applied at the rate of 20 to 30 cpm with pressure traces conforming to Figure 5. Test sequence shall be as follows::

a. 25,000 pressure surge cycles at room temperature, to 125 psig, except to 30 psig for vent lines (Table 3)

b. 1 h soak at +135 °F to 125 psig

c. 25,000 pressure surge cycles at +135 °F, to 125 psig, except to 30 psig for vent lines (Table 3)

d. Proof pressure test at room temperature according to 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 3 and held at that pressure for 2 min; first at -65 °F, then at +200 °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, 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 (see 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-STD-2073-1 and unit packaged in containers conforming to PPP-B-566 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 (see 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 ASTM D 6251/D6251M, ASTM D 5118/D5118M or PPP-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 lb. 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 an is sealed at all joints and seams, including manufacturer's joint, with tape conforming to ASTM D 5486/D5486M.

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, ASTM D 6251/D6251M, or ASTM D 5118/D5118M. 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 lb. 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 ASTM D 5118/D5118M.

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 document. Installation in which the limits specified herein are exceeded, or in which the application is not covered specifically by this document will be subject to the approval of the purchaser. Axial loading of the half coupling O-ring should be avoided and controlled by tubing installation.

6.1.1 Fire Resistance

When fireproofing or fire resistance is a requirement, the test shall be conducted to the procedures and requirements specified in AS1055.

6.2 Ordering Data

Procurement documents should specify:

a. Title, number, and date of this document

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)

6.3 Key Words

Coupling assembly, fuel coupling, flexible coupling

6.3 The change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document.

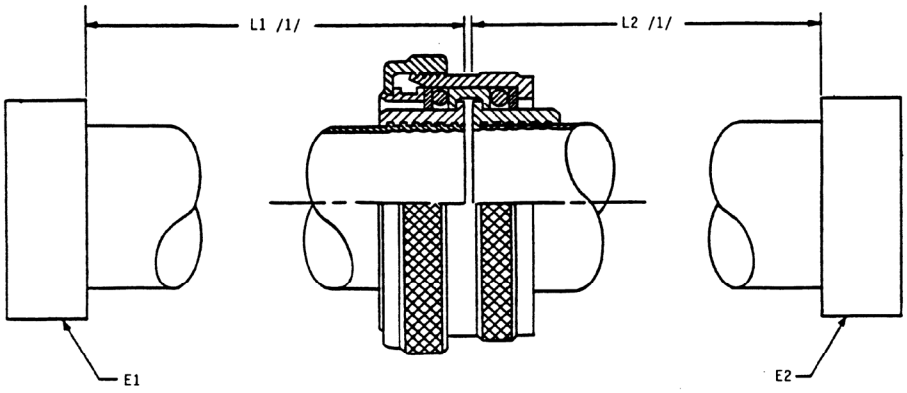
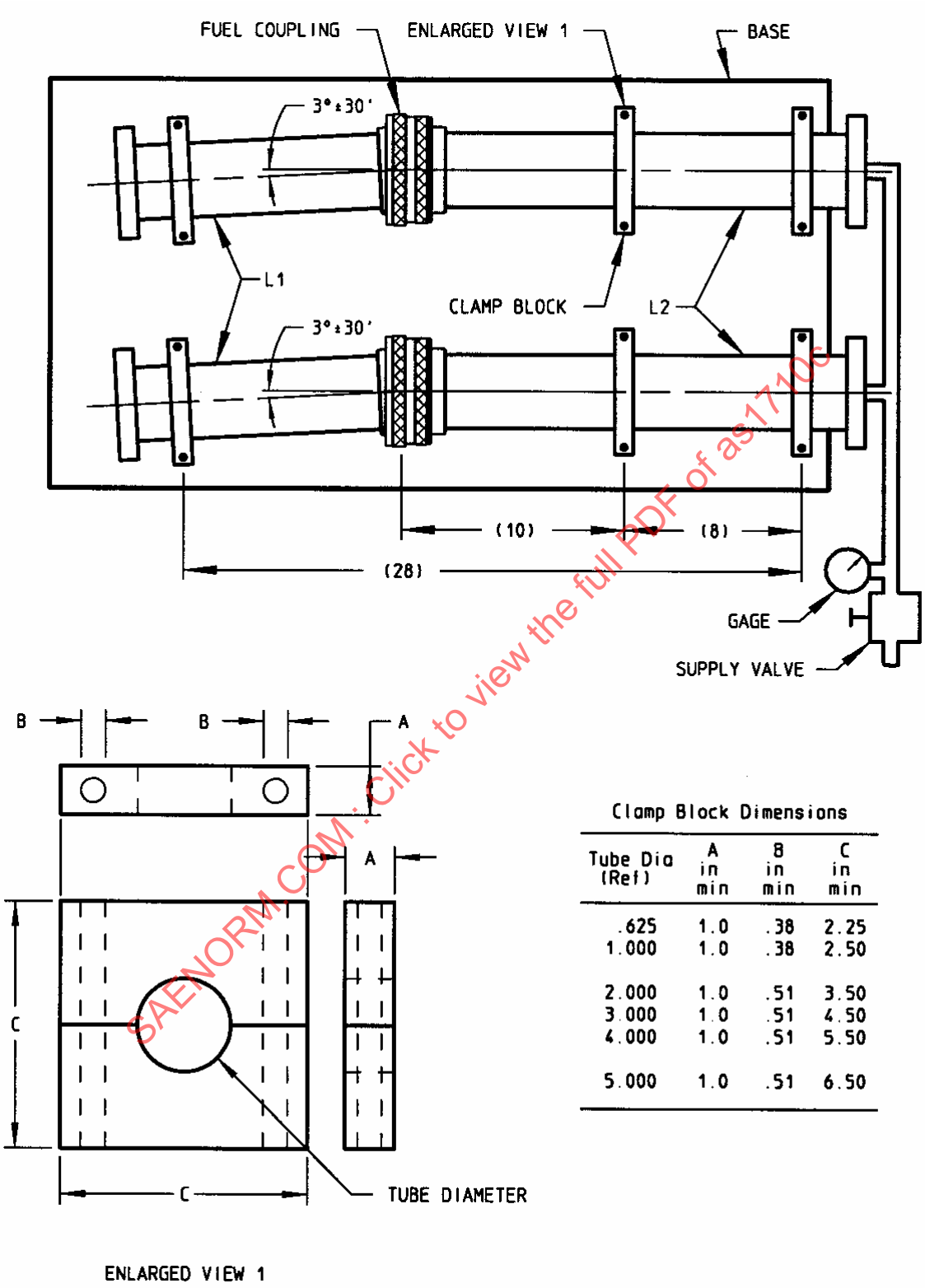


FIGURE 1 - TEST SPECIMEN CONFIGURATION



Clamp Block Dimensions

Tube Dia (Ref)	A in min	B in min	C in min
.625	1.0	.38	2.25
1.000	1.0	.38	2.50
2.000	1.0	.51	3.50
3.000	1.0	.51	4.50
4.000	1.0	.51	5.50
5.000	1.0	.51	6.50

FIGURE 2 - FUEL RESISTANCE, VIBRATION AND BURST PRESSURE TEST SETUP