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INTERNATIONAL
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AEROSPACE STANDARD

SAE AS5356

Issued 1999-01

Submitted for recognition as an American National Standard

Coupling, Fuel Line, Flexible, 125 psi
General Specification for

1. SCOPE:

1.1 Scope:

This specification covers flexible couplings for joining tubing with MS33660 Type A beaded ends for use in aircraft fuel and vent systems (see 6.1).

1.2 Classification:

Couplings shall be of the following size, material and type as specified (see 6.2b).

1.2.1 Size: The size of couplings shall be as specified in Table 1.

TABLE 1 - Coupling Material

Materials Type	Materials Specification	Finish Specification
Aluminum alloy 2024-T6, 6061-T6	QQ-A-225/6 QQ-A-225/8	Anodized per MIL-A-8625 Type II Class 2
Corrosion-resistant steel (Cres)	AMS 5643, AMS 5659 or equivalent	Passivated per QQ-P-35
Titanium 6AL-4V	AMS 4921 AMS 4965 MIL-T-9046	None None Condition AB-1

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1.2.2 Material: The basic material of the coupling is designated by the following code letters:

D - Aluminum (class A)
C - Corrosion-resistant steel (class B)
T - Titanium (class C)

1.2.3 Type: The coupling shall consist of the following types:

1 - Standard coupling with no electrical bonding
2 - Coupling with electrical bonding

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 the text of 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 4921	Titanium, Bars, Forgings and Rings, Annealed, 70,000 PSI (485 MPA) Yield Strength
AMS 4965	Titanium Alloy, Bars, Forgings and Rings, 6.0Al - 4.0V Solution and Precipitation Heat Treated
AMS 5643	Steel Bars, Forgings, Tubing, and Rings, Corrosion Resistant 16Cr - 4.0Ni - 0.30 (Cb+Ta) - 4.0Cu Solution Heat Treated
AMS 5659	Bar, Forgings and Rings, and Extrusions Corrosion Resistant 15Cr - 45Ni - 0.30 (Cb+Ta) - 3.5Cu Consumable Electrode Melted Solution Heat Treated, Precipitation Hardenable
AS1710	Coupling, Fuel, Flexible, Variable Cavity Threaded Type with Ferrules
AS1720	Ferrule End, Coupling, Flexible, Variable, Cavity Threaded, Ferrule Type, Design Standard

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

ASTM D 1974	Fiberboard Shipping Containers, Methods of Closing, Sealing and Reinforcing, Standard Practice for
ASTM D 3951	Commercial Packaging

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

QQ-A-225/6	Aluminum Alloy Bar, Rod, and Wire, Rolled, Drawn, or Cold Finished, 2024
QQ-A-225/8	Aluminum Alloy 6061, Bar, Rod, Wire and Special Shapes: Rolled, Drawn or Cold Finished
QQ-P-35	Passivation Treatments for Corrosion-Resistant Steel
TT-S-735	Standard Test Fluids, Hydrocarbon
PPP-B-566	Boxes, Folding, Paperboard
PPP-B-576	Boxes, Wood-Cleated Panelboard
PPP-B-585	Boxes, Wood, Wirebound
PPP-B-591	Boxes, Shipping, Fiberboard, Wood-Cleated
PPP-B-601	Boxes, Wood, Cleated-Plywood
PPP-B-621	Box, Wood, Nailed and Lock-Corner
PPP-B-640	Boxes, Fiberboard, Corrugated, Triple-Wall
PPP-B-676	Boxes, Setup
PPP-C-795	Cushioning Material, Packaging (Flexible Closed Cell Plastic Film for Long Shipping Cycle Applications)
PPP-C-1752	Cushioning Material, Packaging, Polyethylene Foam
PPP-C-1797	Cushioning Material, Resilient, Low Density Unicellular, Polypropylene, Foam
PPP-C-1842	Cushioning Material, Flexible, Open Cell Plastic Film for Packaging Applications
MIL-P-116	Preservation, Methods of
MIL-H-775	Hose, Hose Assemblies; Rubber, Plastic Fabric, or Metal (Including Tubing) and Associated Hardware: Packaging of
MIL-B-5087	Bonding Electrical and Lighting Protection for Aerospace Systems
MIL-P-5315	Packing, Preformed, Hydrocarbon Fuel Resistant
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification for
MIL-T-8506	Tubing, Steel, Corrosion Resistant, (304), Annealed, Seamless and Welded
MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-T-9046	Titanium, Titanium Alloy, Sheet, Strip and Plate
MIL-C-22263	Coupling Fuel Line, Flexible, 125 psi, General Specification for
MIL-STD-100	Engineering Drawing Practice
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-470	Maintainability Program for Systems and Equipment
MIL-STD-471	Maintainability Demonstration
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-889	Dissimilar Metals
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking, and Waterproofing: With Appropriate Test Methods

2.1.3 (Continued):

MS20995	Wire, Safety or Lock
MS29512	Packing, Preformed; Hydrocarbon Fuel Resistant, Tube Fitting, O-Ring
MS29513	Packing, Preformed, Hydrocarbon Fuel Resistant O-Ring
MS33540	Safety Wiring and Cotter Pinning General Specification for
MS33660	Tubing End, Hose Connection, Standard Dimensions for

3. REQUIREMENTS:

3.1 First Article:

When specified (see 6.2d), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.2 Materials:

Materials shall conform to applicable specifications and shall be as specified in Table 1. Materials which are not covered by applicable specifications, or which are not specifically described herein, shall be of the lightest practicable weight and compatible with aircraft fuel. All materials shall be resistant to fluids conforming to TT-S-735 and MIL-T-5624 to assure satisfactory operation.

3.2.1 Metals: Metals shall be of a corrosion-resisting material or treated in a manner to render them adequately resistant to corrosion when exposed to climatic and environmental conditions encountered during the service life of the equipment. The use of any protective coating that will crack, chip, or scale with age or extremes of climatic and environmental conditions shall be avoided.

3.2.1.1 Aluminum Alloy Parts: All aluminum alloy parts shall be in accordance with Table 1 and shall be anodized in accordance with MIL-A-8625, Type II, class 2.

3.2.1.2 Steel Parts: All steel parts shall be of corrosion-resistant steel in accordance with Table 1.

3.2.1.3 Titanium: Titanium shall be in accordance with Table 1.

3.2.1.4 Magnesium and Copper: Magnesium and copper shall not be used.

3.2.2 Fungus-Proof Materials: Materials which are not nutrients for fungi shall be used to the greatest extent practicable. In cases where materials that are nutrients for fungi must be used, such materials shall be treated with fungicidal agent as approved by the contracting activity.

3.2.3 Dissimilar Metals: Combinations of tubing and all contacting coupling parts shall be compatible in accordance with MIL-STD-889.

3.3 Design and Construction:

The coupling shall be designed for connection of MS33660 tubing type A beaded ends and shall meet the requirements of Figure 1 and Table 2.

3.3.1 Threads: Screw threads shall conform to MIL-S-7742. All threaded parts shall be securely locked in such a manner as to prevent loosening under test conditions specified herein and under normal service usage. Safety wire per MS20995 shall be installed in accordance with MS33540. Wrenching features shall conform to Figure 1. Pipe threads shall not be used.

3.3.2 Angular Misalignment: The coupling shall be capable of being installed with a maximum tubing installation misalignment of 3° in any direction.

3.3.3 Flexure: The coupling shall provide for 1° flexure in any direction from any installed position. The coupling shall provide for a variation in space between tubing ends of 0.062 to 0.188 in.

3.3.4 Permanent Deformation: Installation of the coupling on tubing ends under conditions specified herein shall not produce a permanent deformation of the coupling.

3.3.5 Tubing: The coupling shall be capable of connecting tubing having an outside diameter and wall thickness as specified in Table 3.

3.4 Seal:

The seal, which is used for testing purposes only and is not furnished as part of the flexible coupling, shall be in accordance with MIL-P-5315, and MS29513 of the applicable size specified in Table 2.

3.5 Configuration, Dimensions, and Weight:

The configuration, dimensions and weight shall be in accordance with Figure 1 and Table 2.

3.6 Performance:

The coupling, when installed in any position (attitude), shall meet all the performance requirements when tested as specified in Section 4 of this specification.

3.6.1 Visual Examination:

3.6.1.1 Coupling: When visually examined as specified in 4.6.1.1, the coupling shall conform to the requirements of this specification.

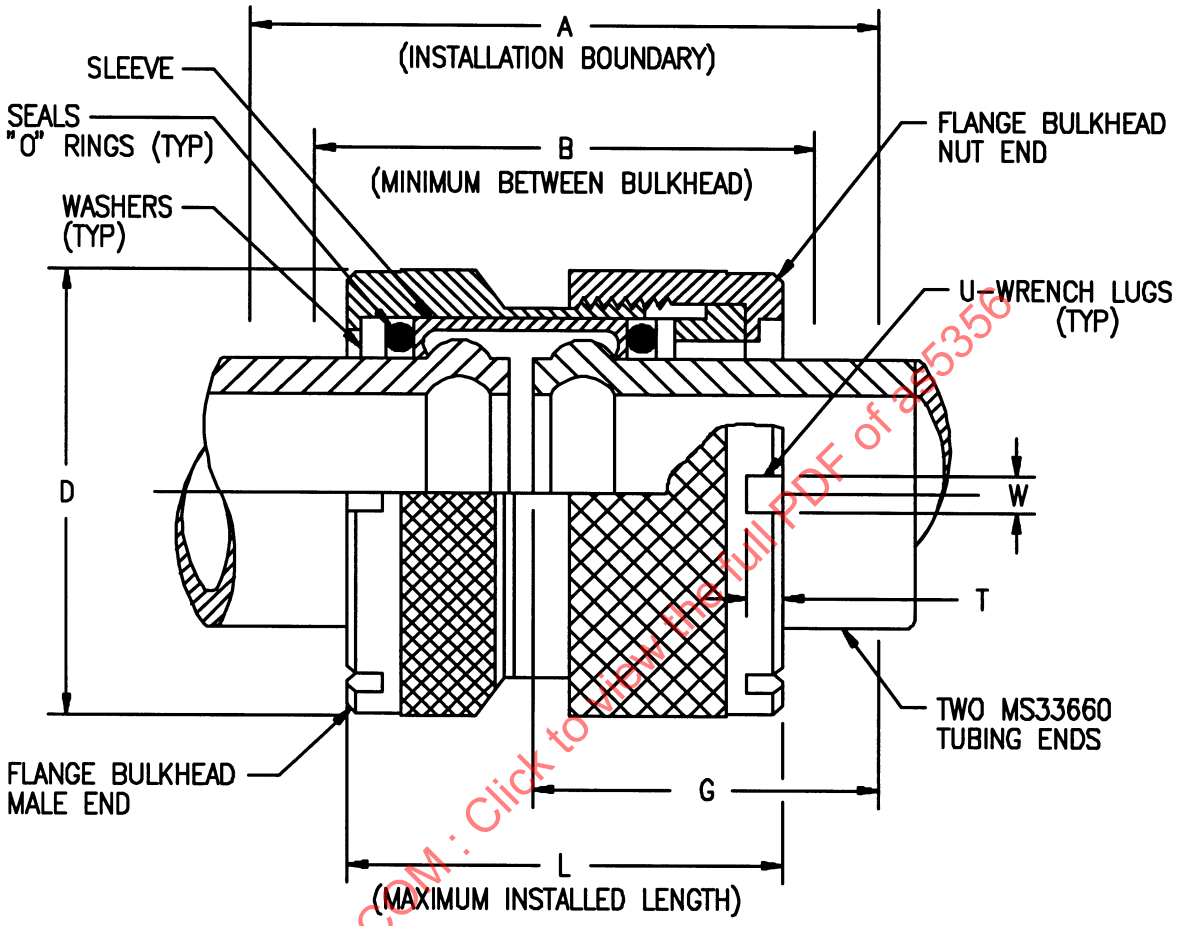

FIGURE 1 - Wrenching Features Typical Installation of Type 1 Fuel Coupling
(Two AS5131 Tubing Ends)

TABLE 2 - Dimension and Weight Requirements for Type 1 and Type 2 Couplings

Dash No.	OD Tube (inch) Ref	A ±0.010	B (Min)	D (Max)	G (Min)	L (Max)	U (No)	MS29513 Seal Ref[1]
-04	0.250	3.390	1.810	0.890	1.220	1.762	--	-010
-06	0.375	3.610	2.62	1.100	1.289	1.954	4	-110
-08	0.500	3.610	2.62	1.230	1.291	1.954	4	-112
-10	0.625	3.610	2.62	1.360	1.291	1.954	4	-114
-12	0.750	3.840	2.62	1.480	1.300	2.230	4	-210
-16	1.000	4.010	2.840	1.730	1.430	2.350	8	-214
-20	1.250	4.010	2.840	1.980	1.430	2.350	8	-218
-24	1.500	4.500	3.130	2.470	1.580	2.600	8	-325
-28	1.750	4.500	3.130	2.720	1.580	2.600	8	-327
-32	2.000	4.500	3.130	2.970	1.580	2.600	8	-329
-40	2.500	4.500	3.130	3.470	1.580	2.600	12	-333
-48	3.000	4.500	3.130	3.970	1.580	2.600	12	-337
-56	3.500	4.610	3.190	4.600	1.580	2.650	16	-341
-64	4.000	4.610	3.190	5.100	1.580	2.650	16	-345
-72	4.500	4.740	3.190	5.660	1.710	2.650	16	-349
-80	5.000	5.270	3.470	6.231	1.800	2.930	16	-429
-88	5.500	5.270	3.470	6.680	1.800	2.930	16	-433
-96	6.000	5.980	3.700	7.230	1.920	3.160	16	-437

[1] See the detail dimensions on MS29513 for the corresponding sizes.

TABLE 2 (Continued)

Dash No.	W (Min)	T ±0.010	Lb (Max) Type 1 Al	Lb (Max) Type 1 CRES	Lb (Max) Type 1 Ti	Lb (Max) Type 2 AL	Lb (Max) Type 2 CRES	Lb (Max) Type 2 Ti
-04	--	--	0.030	0.106	0.056	0.035	0.122	0.064
-06	0.187	0.135	0.040	0.125	0.071	0.043	0.131	0.082
-08	0.187	0.135	0.046	0.138	0.086	0.053	0.159	0.099
-10	0.187	0.135	0.056	0.163	0.105	0.064	0.187	0.121
-12	0.187	0.135	0.078	0.210	0.146	0.090	0.215	0.168
-16	0.187	0.135	0.130	0.250	0.243	0.150	0.288	0.280
-20	0.187	0.135	0.142	0.310	0.265	0.163	0.360	0.305
-24	0.250	0.135	0.242	0.580	0.452	0.278	0.667	0.520
-28	0.250	0.135	0.255	0.720	0.476	0.293	0.830	0.550
-32	0.250	0.135	0.294	0.770	0.549	0.338	0.886	0.631
-40	0.250	0.145	0.350	1.051	0.653	0.403	1.209	0.751
-48	0.250	0.145	0.438	1.310	0.818	0.504	1.507	0.941
-56	0.250	0.160	0.563	1.780	1.051	0.647	2.047	1.209
-64	0.250	0.160	0.633	2.030	1.182	0.728	2.335	1.360
-72	0.250	0.160	0.812	2.280	1.516	0.934	2.622	1.743
-80	0.250	0.175	1.140	3.310	2.128	1.311	3.685	2.447
-88	0.250	0.175	1.200	3.300	2.240	1.380	3.800	2.580
-96	0.250	0.175	1.450	3.500	2.334	1.668	4.025	2.684

TABLE 3 - Tubing Size and Wall Thickness

Tube OD (inches)	Nominal Wall Thickness AL	Nominal Wall Thickness CRES	Nominal Wall Thickness Ti	Tube OD (inches)	Nominal Wall Thickness Minimum (inches) AL	Nominal Wall Thickness Minimum (inches) CRES	Nominal Wall Thickness Minimum (inches) Ti
0.250	0.028	0.020	1	2.000	0.035	0.035	1
0.375	0.028	0.020	1	2.500	0.042	0.035	1
0.500	0.035	0.020	1	3.000	0.042	0.035	1
0.675	0.035	0.020	1	3.500	0.049	0.049	1
0.750	0.035	0.020	1	4.000	0.049	--	1
1.000	0.035	0.020	1	4.500	0.065	--	1
1.250	0.035	0.025	1	5.000	0.065	--	1
1.500	0.035	0.020	1	5.500	0.065	--	1
1.750	0.035	0.035	1	6.000	0.065	--	1

[1] Wall thickness to be specified by the qualifying activity.

3.6.1.2 Inspection for Delivery: When visually examined as specified in 4.6.1.2, the shipping container shall conform to the requirements of this specification.

3.6.2 Proof Pressure: The coupling assembly shall be designed to withstand a proof pressure of 250 psi ± 5 psi. A decrease in pressure when pressurized to proof pressure or any leakage (see 6.7.4) shall be cause for rejection of the coupling.

3.6.3 Fuel Resistance: The coupling assembly shall not leak (sufficient to form a drop) nor show evidence of damage when subjected to high temperature aging, 200 °F, low temperature fuel aging, -65 °F and air dryout at 200 °F when tested as specified in 4.6.3

3.6.4 Vibration: The coupling assembly shall show no evidence of malfunction or structural failure and shall pass the proof pressure test (see 4.6.2) after exposure to vibration levels as specified in 4.6.4.

3.6.5 Repeated Assembly: There shall be no evidence of deformation, damage nor degradation in the connecting ability of the coupling after 25 repeated assembly and disassembly operations and shall pass without leakage the proof pressure test as specified in 4.6.2.

3.6.6 Salt Fog: The coupling assembly shall be capable of passing the salt fog test, specified in 4.6.6, without any malfunction nor degradation due to corrosion. Threads, connecting surfaces and sealing surfaces shall be free of corrosion. The coupling shall be capable of passing the proof pressure test (see 4.6.2).

3.6.7 Sand and Dust: The coupling assembly shall show no damage such as cracking of internal parts, evidence of malfunction when tested as specified in 4.6.7 and shall pass the proof pressure test (see 4.6.2).

3.6.8 Flexure Performance: The coupling assembly, when tested as specified in 4.6.8 with a 3° tubing misalignment and flexed at ±0.5° for 28,800 cycles followed by the proof pressure test, shall show no evidence of leakage, rupture, permanent set, permanent deformation or damage.

3.6.9 Surge Pressure: The coupling assembly shall withstand 50,000 pressure surge cycles without evidence of malfunction or leakage when tested at room temperature as specified in 4.6.9.

3.6.10 Burst Pressure at Temperature Extremes: The coupling assembly shall not rupture nor show evidence of leakage at any pressure when tested as specified in 4.6.10.1.

3.6.10.1 Burst Pressure at Room Temperature: The coupling assembly shall not rupture nor show evidence of leakage at any pressure when tested as specified in 4.6.10.2.

3.6.11 Electrical Bonding: The electrical resistance of the coupling assembly when measured from tube to tube, across the coupling, shall not exceed 1.0 Ω when tested as specified in 4.6.11.

3.7 Maintainability:

The coupling assembly when installed in aircraft shall not require periodic maintenance. The seals installed in the coupling shall be easily replaceable with no damage to other parts and shall be able to be removed with a minimum of disturbance or displacement of the installed coupling and tubing. The coupling system maintainability requirements shall be integrated with the overall aircraft system maintainability programs and shall comply with the requirements of MIL-STD-470. Details relating to component and subsystem performance maintainability shall be in accordance with MIL-STD-471.

3.8 Reliability:

The coupling assembly shall be designed to withstand the strains, vibrations, temperature environment incident to aircraft installation and services usage. The reliability of the coupling assembly shall be an integral part of reliability requirements of the total aircraft systems. The overall reliability program shall be in accordance with MIL-STD-785.

3.9 Part Numbering of Interchangeable Parts:

All parts having the same design activity, contracting activity and government activity (CAGE) code and manufacturer's part number shall be interchangeable as defined in MIL-STD-100. Each lot shall be manufactured by the same manufacturer and have the same manufacturer's part number, made out of the same material and process at the same time.

3.10 Identification Marking of Product:

The coupling assemblies shall be marked for identification in accordance with MIL-STD-130. In addition, the coupling assembly shall have the following markings (see 6.5):

M85061-XXX (size, material and type in dash number)
Manufacturer's name and part number
Materials code
Type (Type 1 or Type 2)

3.11 Workmanship:

The coupling shall be fabricated and finished with no defects, cracks, burrs, tool marks, or sharp edges. Where dimensions are critical which shall effect the interchangeability of parts, they shall be kept within the tolerances specified.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his/her own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance: All items shall meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of Inspection:

The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3)
b. Quality conformance inspection (see 4.4)

4.3 First Article Inspection:

First article inspection consists of all examinations and tests specified in Table 4.

TABLE 4 - First Article Test

Item	Test Description	Design Requirement	Test Method
1	Visual examination	3.6.1.1	4.6.1
2	Proof pressure test	3.6.2	4.6.2
3	Fuel resistant test	3.6.3	4.6.3
4	Vibration	3.6.4	4.6.4
5	Repeated assembly	3.6.5	4.6.5
6	Salt fog	3.6.6	4.6.6
7	Sand and dust	3.6.7	4.6.7
8	Flexure	3.6.8	4.6.8
9	Surge pressure	3.6.9	4.6.9
10	Electrical bonding	3.6.11	4.6.11
11	Burst pressure	3.6.10	4.6.10
12	Disassembly and inspection	3.6.10	4.6.10.3
13	Inspection for delivery	3.6.1.2	4.6.1.2

4.3.1 First Article Samples: Unless otherwise specified in the contract or order, as soon as practicable after the award of the contract or order, the manufacturer shall submit sample coupling or couplings of each size and material specified in the contract or order and two complete sets of detail and assembly drawings. The samples shall be representative of the construction, workmanship, components, and materials to be used during production. When a manufacturer is in continuous production of these units from contract to contract, submission of further first article samples on a new contract may be waived at the discretion of the acquiring activity (see 6.2d). Approval of the first article samples or the waiving of the first article inspection does not waive the requirements of submitting to the quality conformance inspection. The first article inspection samples shall be furnished to the Government as directed by the contracting officer (see 6.2e).

4.3.2 First Article Data: Upon completion of the first article inspection program, the activity responsible for conducting the program (see 6.2d) shall report to the contracting officer the results of the program, with appropriate recommendations (6.3).

4.4 Quality Conformance Inspection:

Quality conformance inspection shall consist of:

a. Individual inspection (see 4.4.1)
b. Sampling inspection (see 4.4.2)

4.4.1 Individual Inspection: Each coupling shall be visually examined to determine that the coupling complies with the requirements specified in 4.6.1. Any coupling failing to pass the examination shall be rejected.

4.4.2 Sampling Inspection: The sample size shall be selected in accordance with ANSI/ASQCZ1.4 inspection level I, acceptable quality level AQL as specified in the contract and shall pass the tests listed in Table 5, except to be performed at room temperature. If this sample fails to pass this test, the lot represented by this sample shall be rejected.

TABLE 5 - Quality Conformance Inspection

Item	Test Description	Design Requirement	Test Method
1	Visual examination	3.6.1.1	4.6.1.1
2	Proof pressure test	3.6.2	4.6.2
3	Fuel resistance test	3.6.3	4.6.3
4	Vibration test	3.6.4	4.6.4
5	Repeated assembly test	3.6.5	4.6.5
6	Electrical bonding	3.6.11	4.6.11

4.4.3 Rejection and Retest: When one or more items from a lot fail the specified test, acceptance of all items in the lot shall be withheld until the extent and cause of failure are determined. When corrections have been made, all tests shall be repeated (see 6.3).

4.4.3.1 Resubmitted Lot: Where a lot has been rejected by the acquiring activity or contracting activity and before it can be resubmitted for first article test, the cause of rejection and the action taken shall be furnished in writing by the contractor and submitted to the contracting or acquiring activity (see 6.3).

4.5 Test Conditions:

4.5.1 Test Fluid: Unless otherwise specified, the test fluid shall be in accordance with TT-S-735 Type I or Type III.

4.5.2 Pressure and Temperature: The pressure and temperatures specified in Table 6 shall apply to all tests required by this specification.

TABLE 6 - Temperatures and Pressures

Fluid	Temperature (±5 °F) Fluid and Ambient	Pressure (±5 psi) Operating	Pressure (±5 psi) Proof	Pressure (±5 psi) Burst
TT-S-735	-65 to +200 °F	125	250	375

4.5.3 Test Assembly: Each assembly shall consist of 2 pieces of tubing, approximately 12.75 in long, with a MS33660 bead on one end of each tube. The tube assemblies shall be joined by the test coupling as shown in Figure 1 to make up the test assembly. For the fuel resistance test each test assembly shall be closed on one end. Unless otherwise specified, O-ring seals shall conform to MIL-P-5315, MS29512 and MS29513. If seal leakage occurs during testing, the test coupling shall not be retorqued. If seal leakage occurs during the tests specified in 4.6.2 (proof pressure test), 4.6.3.1 (high temperature fuel aging phase I), 4.6.3.2 (high temperature fuel aging phase II), 4.6.3.3 (low temperature fuel aging), and 4.6.4 (vibration tests), record the cause of failure, the name of the test and when failure occurred, install a new seal or seals and continue the test (see 6.3).

4.5.4 Tubing Wall Thickness: The tubing used in testing the coupling shall have a minimum wall thickness as specified in Table 3.

4.6 Inspection Methods:

4.6.1 Visual Examination:

4.6.1.1 Coupling: The coupling shall be visually examined to determine conformance to this specification with respect to configuration, dimensions, weight and all the requirements not covered by tests specified herein.

4.6.1.2 Inspection for Delivery: The fully prepared shipping container, containing couplings, shall be visually examined to determine that the packaging, packing and marking conform to Section 5 of this specification.

4.6.2 Proof Pressure: The coupling test assembly shall be subjected to a proof pressure of 250 psig at +200 °F for 5 min using TT-S-735, type III test fluid. After completion of this test, drain the test assembly and refill with TT-S-735 type I test fluid and repeat proof pressure test at 250 psig and -65 °F for a period of 5 min. Any leakage, rupture, permanent set, permanent deformation, or damage of any part of the test coupling shall be cause for rejection.

4.6.3 Fuel Resistance Test:

4.6.3.1 Phase I - High Temperature Fuel Aging: TT-S-735 type III test fluid shall be circulated in a coupling test assembly for 72 h while at 200 °F and 250 psig. During the final 8 h of this test, the assembly shall be vibrated in accordance with 4.6.4. Upon completion, and while still mounted in accordance with 4.6.4, the coupling test assembly shall be proof tested at 250 psig and +200 °F and held at that pressure and temperature for a minimum of 1 min. There shall be no evidence of leakage or deformation of the coupling. Any leakage or damage to the coupling shall be cause for rejection.

4.6.3.2 Phase II - High Temperature Fuel Aging: TT-S-735 type I test fluid shall be circulated in a coupling test assembly for 72 h with the fluid at +200 °F and 250 psig. During the final 8 h of this test, the assembly shall be vibrated in accordance with 4.6.4. Upon completion of the vibration test, and while still mounted in accordance with 4.6.4, the coupling test assembly shall be proof tested at 250 psig and +200 °F with the pressure and temperature held for a minimum of 1 min. There shall be no evidence of leakage or deformation of the coupling. Any leakage or damage to the coupling shall be cause for rejection.

4.6.3.3 Low Temperature Fuel Aging: TT-S-735 type I test fluid shall be circulated in a coupling test assembly for 72 h with the fluid at 250 psig and -65 °F. During the final 8 h of this test, the coupling assembly shall be vibrated in accordance with 4.6.4. Upon completion of the vibration test, and while still mounted in accordance with 4.6.4, the assembly shall be proof tested at 250 psig and at -65 °F with the pressure and temperature held for a minimum of 1 min. There shall be no evidence of leakage or deformation of the coupling. Any leakage or damage to the coupling shall be cause for rejection.

4.6.3.4 Air Dry Out: Upon completion of the low temperature fuel aging test, the coupling test assembly shall be drained, cap or caps removed, and the coupling test assembly with both ends open shall be placed in an air oven for 168 h at +200 °F. The low temperature fuel aging test of 4.6.3.3 shall be repeated upon completion of the air dry out test.

4.6.4 Vibration Test:

4.6.4.1 Vibration Test Setup: The coupling test assembly shall be mounted on a vibration test fixture as shown in Figure 2 with an angular displacement of 3° between tube centerline. The distance between test assembly table supports, with the coupling located in the center of the assembly, shall be 20 inches for all sizes. The X and Y axes of the test assembly shall be parallel to the vibration table and the direction of vibration shall be perpendicular to the vibration table.

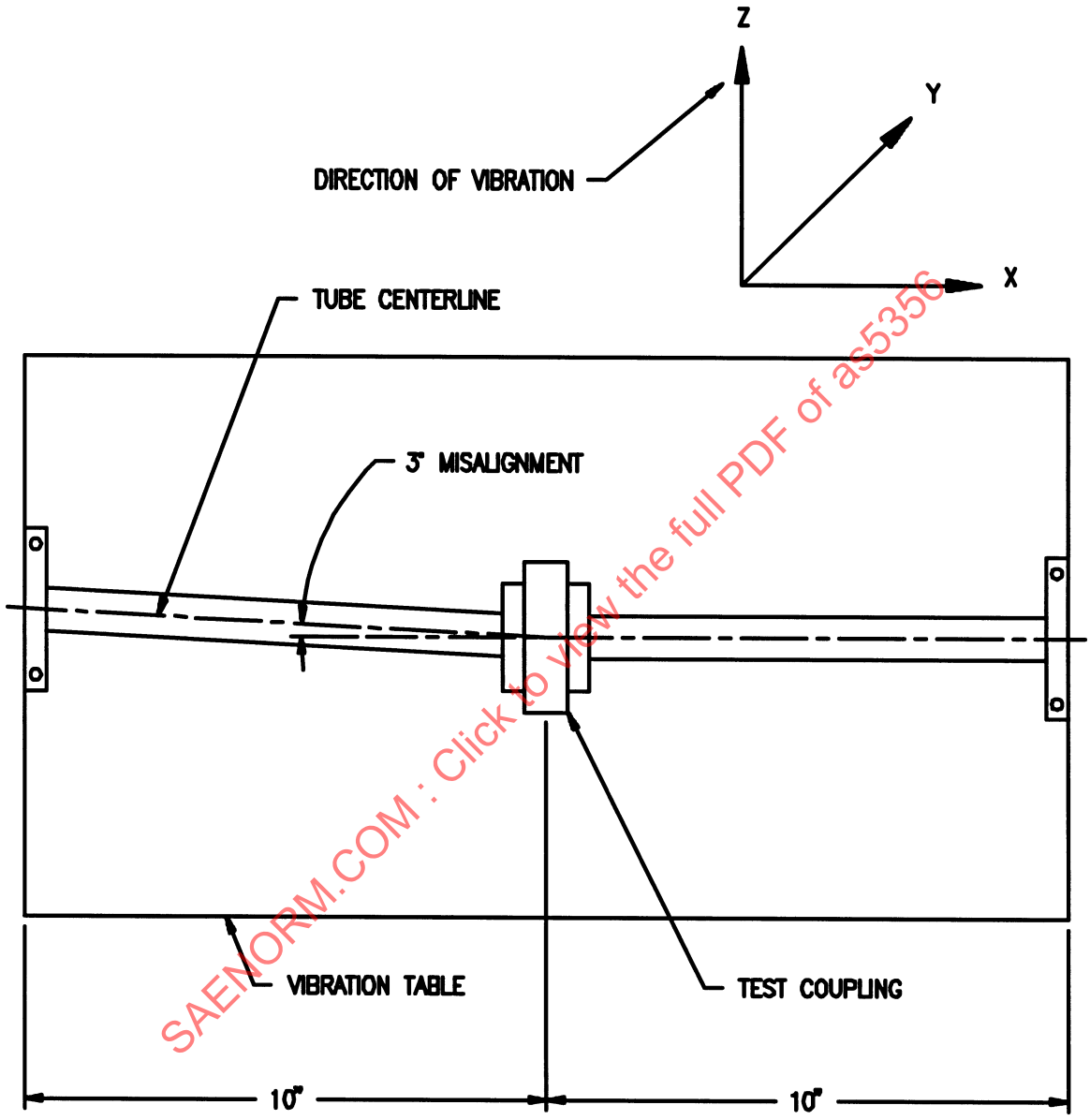

FIGURE 2 - Vibration Test Setup

4.6.4.2 Vibration Test: The vibration shall be conducted in accordance with MIL-STD-810 method 514.3 and the applicable test conditions of Table 7.

TABLE 7 - Vibration Tests

Type of Equipment	MIL-STD-810E Test Procedure	MIL-STD-810E Test Conditions
Propeller aircraft or jet engine	I	I - 3.4.1
Jet aircraft	I	I - 3.4.2
Helicopter	I	I - 3.4.3
Ground vehicles	I	I - 3.4.7

4.6.5 Repeated Assembly: The coupling test assembly shall be tested with repeated assembly and disassembly for 25 operations. There shall be no evidence of damage or degradation in the connecting ability of the coupling. After the repeated assembly, the coupling assembly shall be subjected to the proof pressure test as specified in 4.6.2. Any leakage or malfunction shall be cause for rejection of the coupling assembly.

4.6.6 Salt Fog: The coupling test assembly shall be exposed to salt fog for 168 h in accordance with MIL-STD-810, method 509.2. After the 168 h of exposure the test specimen shall be examined for evidence of corrosion or other damage of the finish. The proof pressure test shall then be performed in accordance with 4.6.2. Any leakage or failure shall be cause for rejection of the test coupling.

4.6.7 Sand and Dust: The coupling test assembly shall be mounted in a dust chamber and the sand and dust test conducted in accordance with MIL-STD-810, method 510.1. After the test, the coupling test assembly shall be subjected to the proof pressure test using TT-S-735, Type III test fluid in accordance with 4.6.2 for leakage and malfunction. Any leakage or malfunction during the test shall be cause for rejection of the test coupling.

4.6.8 Flexure: The tubing on one side of the coupling test assembly shall be rigidly fixed while the other tube shall be mounted eccentrically on a power driven spindle. The test setup shall provide 1° flexure in any direction with an initial 3° misalignment between the tubing centerlines. TT-S-735, Type I fluid shall be introduced into the coupling test assembly at a pressure of 12 psig (see Figure 3). The test fluid temperature shall be maintained at +200 °F for the first 4 h test period and -65 °F during the second 4 h period. The test assembly shall be flexed for 8 h at a minimum frequency of 60 cpm. At the completion of the test, a proof pressure test shall be conducted at a pressure of 250 psig and -65 °F for 3 min. There shall be no evidence of leakage, rupture, permanent set, permanent deformation or damage of any part of the coupling. Any leakage or damage of the coupling during the test shall be cause for rejection of the test coupling.

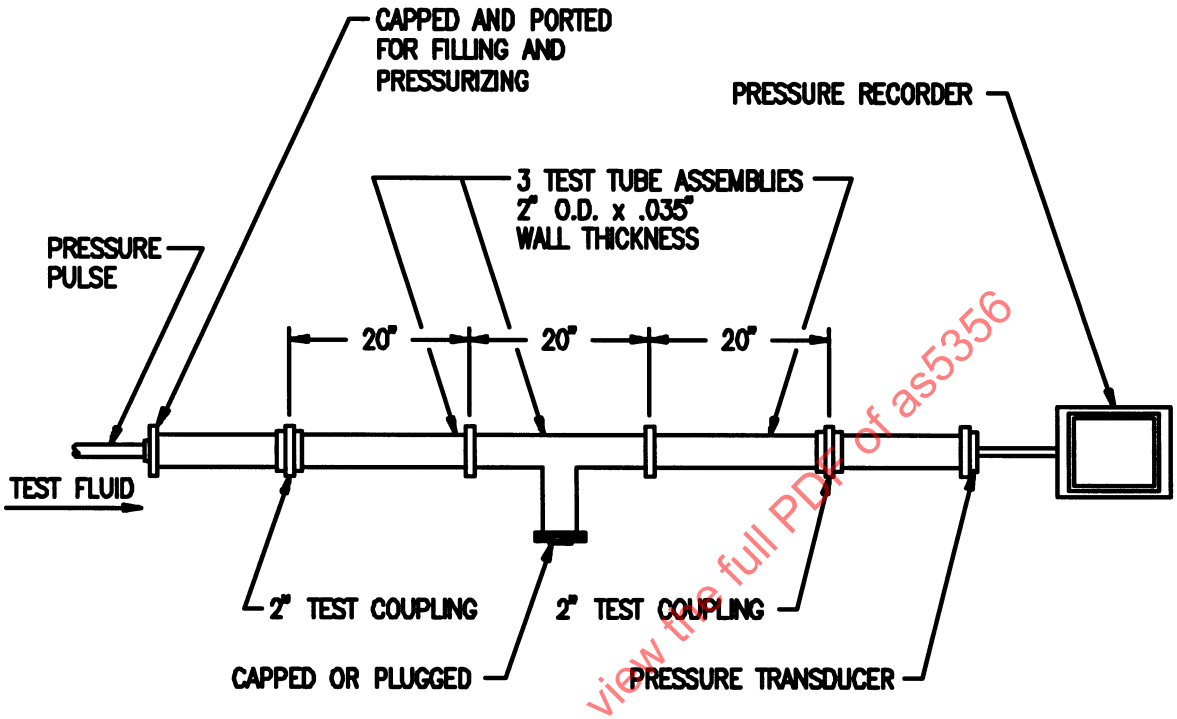

FIGURE 3 - Flexure Test

4.6.9 Surge Pressure:

4.6.9.1 Test Setup: Two 2 in couplings shall be assembled with three lengths of 2 in OD x 0.035 in wall thickness, type 6061-T4 aluminum alloy tubing (see Table 1) to make up a pressure surge cycle test assembly (see Figure 4). Two test assemblies shall be used as shown in Figure 5.

a. The middle section of the tube assemblies shall be in the form of a capped or plugged tee. One end of the assembly shall be capped and ported through the cap for connection of an adapter to provide for filling of fluid and pressurization. The other end shall be capped and ported to accept a pressure transduceer with a response in the order of 30 ms (see Figure 5).

b. Each tube assembly shall be filled with TT-S-735, type I test fluid and mounted so that movement of the tube assemblies shall not be restricted.

4.6.9.2 Pressurization Source: The pressurization source shall be designed to impose a pressure of 0 to 180 psig and back to 0 psig in a time period of 60 ms with a rate of cycling of one cycle every 2 s. Means shall be provided to vary this pressure to each assembly in alternate operation.

a. The pressurizing system shall also include means to ensure a constant pressure being applied to the assembly at each cycle.

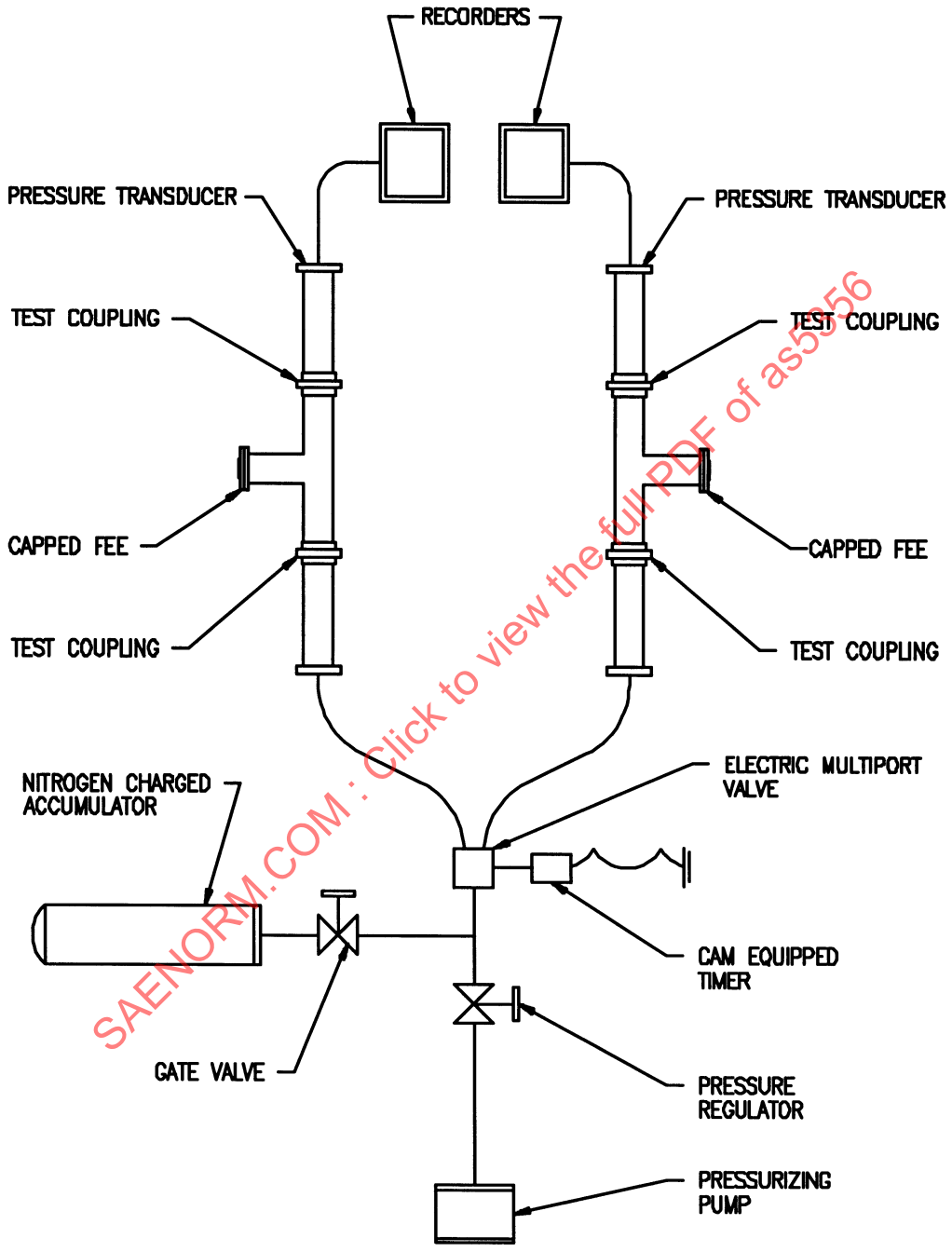

FIGURE 4 - Surge Pressure Test Set Up

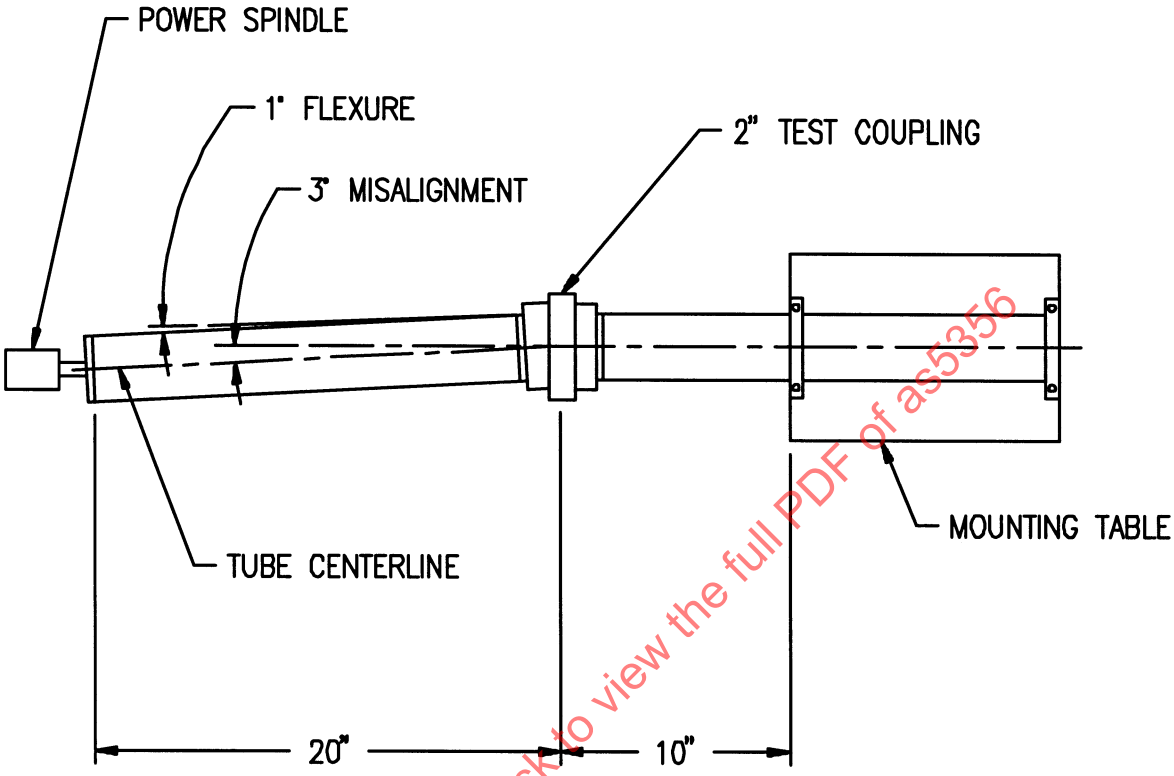

FIGURE 5 - Surge Pressure Test System

4.6.9.3 Instrumentation: Each coupling test assembly shall have its pressure transducer connected to a pressure recorder equipped with a galvanometer and electronic counter to record the cycling pressure of each assembly (see Figure 5).

4.6.9.4 Test Procedure: Coupling test assemblies shall be pressurized by starting the pump in the system. The accumulator gate valve, the pump pressure regulator and the nitrogen charge accumulator shall be adjusted to control the pressure and pressure rise time during the test.

a. The timer or the electrically operated multiport valve shall be adjusted to produce a pressure surge of 0 to 180 psig to 0 psig in 2 s intervals with the pressure surge peaks to be measured in seconds or fraction of a second (see Figure 6).

b. The coupling test assemblies shall be subjected to 50,000 pressure surge cycles. There shall be no evidence of leakage or malfunction from any coupling during the pressure surge cycling.