SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE STANDARD

SAE AS1895 | REV. B

Issued 1985-12-01
Revised 1992-06-01

Submitted for recognition as an American National Standard

COUPLING ASSEMBLY, V-RETAINER, HIGH PRESSURE HIGH TEMPERATURE, PNEUMATIC TUBE

1. SCOPE:

1.1 This SAE Aerospace Standard establishes the requirements for a grooved clamp coupling, flanges, and seal suitable for joining high pressure and high temperature ducting in aircraft bleed air systems. The rigid coupling joint assembly, hereafter referred to as "the joint", shall operate within the temperature range of -65 to +1200 °F.

1.2 Types:

The joint shall be classified into two basic flange profiles:

1.2.1 Type I: Standard Profile - Per MS24563 Figure 2A (1.50 to 7.00 in duct size)

1.2.2 Type II: Low Profile - Per MS24563 Figure 1 (1.00 to 7.00 in duct size)

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of all SAE Technical Reports shall apply.

2.1 SAE Publications:

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

AS478	Identification Marking Method
AIR869	Application of V-Band Couplings
AS4108	T-Bolt and Eyebolt, A-286 Cres, 1000 °F Fatigue Rated

2.2 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-W-6858	Welding, Resistance: Spot and Seam
MIL-N-7873	Nut, Self-Locking 1200 °F
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for
DOD-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-831	Test Reports, Preparation of
MIL-STD-2219	Fusion Welding for Aerospace Applications
MS24563	Coupling Flange, V-Band, Profile Dimensions For

2.3 Definitions:

2.3.1 LIMIT LOAD: Limit load is two times operating load. Permanent deformation in excess of .2% residual strain of parts is not allowed and allowable leakage rate shall not exceed .06 SCFM per inch diameter.

2.3.2 ULTIMATE LOAD: Ultimate load is three times operating load. Allowable leakage may be exceeded, deformation of parts may occur, but the joint shall remain connected.

2.3.3 BREAK LOOSE TORQUE: The torque required to produce nut rotation from the seated condition.

2.3.4 BREAKAWAY TORQUE: The torque required to produce nut rotation in the unseated condition. Usually one full turn minimum from the seated condition.

2.3.5 RUNNING TORQUE: Sometimes called prevailing torque, is the torque required to produce continuous nut rotation. This torque is used to measure nut drag caused by the self-locking device.

2.3.6 MAXIMUM SELF-LOCKING TORQUE: The maximum acceptable running torque value (40 lb-in).

2.3.7 INSTALLATION TORQUE: The required nut torque to properly install the coupling.

2.3.8 SUPPLIER: The manufacturer of the items described herein. The supplier is responsible for qualification testing.

2.3.9 USER: The user is the activity procuring the qualified items described herein. It is the users responsibility to verify qualification testing by careful examination of test parts, qualification test procedures, and test reports. The user is also responsible for inspections of parts procured.

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

The joint furnished under this document shall be a product identical to specimens which have successfully passed the tests specified in Section 4. Parts covered by this document are listed in Table 1.

TABLE 1 - Joint Control Numbers

Type	General Description	AS Number
I	Standard profile coupling, single latch	AS1895/1
	Standard profile seam weld male flange	AS1895/2
	Standard profile seam weld female flange	AS1895/3
II	Low profile coupling, single latch	AS1895/4
	Low profile seam weld male flange	AS1895/5
	Low profile seam weld female flange	AS1895/6
I & II	Seal	AS1895/7
II	Low profile buttweld male flange	AS1895/8
	Low profile buttweld female flange	AS1895/9
I	Standard profile buttweld male flange	AS1895/10
	Standard profile buttweld female flange	AS1895/11
I	Standard profile male flange end	AS1895/12
	Standard profile female flange end	AS1895/13
II	Low profile male flange end	AS1895/14
	Low profile female flange end	AS1895/15
II	Low profile male flange integral weld ring	AS1895/16
	Low profile female flange integral weld ring	AS1895/17
I	Standard profile male flange integral weld ring	AS1895/18
	Standard profile female flange integral weld ring	AS1895/19
II	Low profile coupling double latch	AS1895/20
I & II	Installation, V-retainer coupling assembly	AS1895/21
I	Standard profile coupling double latch	AS1895/22

3.2 Materials:

The joint materials shall be uniform in quality, free from defects, suitable for service, consistent with good manufacturing practices, and in conformance with the applicable specifications and requirements stated herein. Specific materials used in the joint components shall be specified on the applicable AS standard drawing. Cadmium and zinc plating shall not be used.

3.3 Design and Fabrication:

The Type I (standard profile) and Type II (low profile) joints consisting of couplings, flanges, and seals as listed in Table 1 shall fulfill all design and performance requirements of this document. Mating flange profiles shall conform to MS24563 Figure 2A for Type I and MS24563 Figure 1 for Type II.

3.3.1 Coupling: The material of the coupling shall be corrosion and heat resistant alloy as specified on the applicable AS drawing. The coupling shall be fabricated with integral lugs for coupling hinge and latch. No welding is allowed. The coupling half shall be wrought, forged, or fully machined. The inside surface of the V-retainer shall be coated with dry film lubricant capable of meeting the requirements specified herein.

3.3.1.1 Coupling Half Strength: The coupling shall maintain joint integrity at operating pressure in the event of coupling half failure. The coupling shall be so designed that three-fourths of the coupling half circumference shall be sufficient to hold the joint and leakage shall not exceed 6.0 SCFM (standard cubic feet per minute) per inch of diameter at operating pressure of Table 2.

3.3.2 Flanges: The material of the flanges (male and female) shall be corrosion and heat resistant alloy as specified on the applicable AS drawing shown in Table 1. The flange shall be designed for seam, butt, or orbital welding to tubing. The seam, butt, and orbital weld flanges shall be intermateable. All qualification flanges must fully conform to the appropriate AS drawing prior to and after welding. Flanges are not to be machined after welding to tubing.

3.3.3 Seal: The material of the seal shall be corrosion and heat resistant alloy as specified on the applicable AS drawing. Plating, to enhance sealing capability, shall be allowed providing it is within the limits specified on the applicable AS drawing specified in Table 1. The plating, if used, shall be free from blistering, flaking, chipping, or scaling at temperatures from -65 to 1200 °F for not less than 1000 h. The seal geometry shall be such that the seal, for a specific duct size, will fit the standard and low profile flanges and be retained as specified. The seal shall not permanently deform when installed in a completed joint and subjected to the loads imposed by the requirements stated herein. The seal shall be reusable, under normal conditions, for the life of the joint; however, if a seal must be replaced during qualification testing, the reason for replacement must be noted in the test report.

3.3.4 Duct Material: The duct material shall be corrosion and heat resistant alloy. The flanges, when welded to the ducting, shall meet the requirements herein. Nonstabilized corrosion resistant alloys shall not be used.

3.3.5 Welding: Resistance or fusion welding of flanges to ducting shall be in accordance with MIL-W-6858 or MIL-STD-2219. No welding shall be allowed in the fabrication of the couplings.

3.3.5.1 Flange Flatness after Welding: All flanges shall be within the following limits after welding:

a. 1.500 to 4.500 in tube outside diameter = .005 TIR
b. 5.000 to 7.000 in tube outside diameter = .007 TIR

3.3.6 Bolt: Bolt material shall be in accordance with AS4108 and as specified on the applicable AS drawing, with an ultimate tensile strength of 160 000 to 190 000 psi and passivated per the AS standard. Bolt threads shall conform to MIL-S-8879, and shall be lubricated using an anti-seize high temperature lubricant.

3.3.7 Nut: The nut shall be a corrosion and heat resistant self-locking type nut with a running torque of 6.5 to 40 lb-in and shall conform to MIL-N-7873. The material shall be as specified on the applicable drawing. The nut shall have a minimum life of 15 seating torque cycles and be capable of complete removal from the eye bolt on each cycle. The eye bolt threads shall conform to the appropriate standard thread gage at the conclusion of this test.

3.3.8 Safety Latch: The coupling shall have a safety latch as shown on AS Drawing AS1895/1, /4, /20, and /22. The safety latch shall be a permanent part of the coupling and shall engage and maintain joint integrity in the event of primary bolt failure. Joint leakage shall not be in excess of 6.0 SCFM per inch of tube diameter at operating pressure of Table 2 while being supported only by the safety latch (failed bolt case). The safety latch shall not require any tools for its operation or release. The safety latch shall be automatically positioned when the clamp is installed. The safety latch must be designed so that failure of the primary bolt is clearly evident on visual inspection.

3.4 Temperature:

The joints shall meet the requirements of this document under any combination of internal/fluid temperature exposure, within the range of -65 °F to +1200 °F ± 15 °F except as noted.

3.5 Performance:

The values specified herein shall define the requirements for satisfactory performance and shall apply to performance under the conditions as specified in 3.4 at room and elevated temperature.

3.5.1 Static Leakage: The joint, consisting of the coupling, flanges, and seal noted in 3.3, shall show no evidence of leakage in excess of 0.01 SCFM (0.000765 lb dry air per minute) per inch of tube outside diameter when subjected to the requirements specified in 3.5.3.1 or evidence of external wetting sufficient to form a drop (for hydrostatic tests).

3.5.2 Hydrostatic Pressure: The joint shall show no evidence of permanent deformation, permanent set, or leakage sufficient to form a drop when subjected to the pressures of Table 4, 4.5.1 and 4.5.1.1, and Figures 8 and 9 at room temperature with water or hydraulic oil as a fluid medium.

3.5.2.1 Rated Limit and Ultimate Load: The joint shall be capable of carrying the total limit load "N" in accordance with AIR869, see Figure 8, specified in Table 2 without exceeding the leakage requirement of 3.5.1 except as noted herein with respect to the following relationship in Equation 1:

$$N = N_p + N_b + N_a \qquad \text{(Eq.1)}$$

where:

N_p = Load, pounds per inch of circumference due to pressure
N_b = Load, pounds per inch of circumference due to bending
N_a = Load, pounds per inch of circumference due to axial loading

3.5.2.1.1 Pressure: The rated load per inch of circumference due to pressure shall be determined from the following relationship in Equation 2:

$$N_p = PD_s^2/4D_p \qquad \text{(Eq.2)}$$

where:

N_p = Load, pounds per inch of circumference due to pressure
P = Load, pressure in psig
D_s = Diameter at seal line, in inches
D_p = Theoretical contact line of V-retainer to flange, in inches.

3.5.2.1.2 Bending: The rated load per inch of circumference due to bending shall be determined from the following relationship in Equation 3:

$$N_b = 4M/\pi D_p^2 \qquad \text{(Eq.3)}$$

where:

N_b = Load, pounds per inch of circumference due to bending (limit)
M = Bending moment in inch pounds
D_p = Theoretical contact line of V-retainer to flange, in inches

3.5.2.1.3 Axial Load: The rated load per inch of circumference due to axial loading shall be determined from the following relationship in Equation 4:

$$N_a = E/\pi D_p \qquad \text{(Eq.4)}$$

TABLE 2 - Limit Load at Room Temperature

Tube OD in Inches	Standard Profile Type I N lb/in	Standard Profile Type I Operating Pressure ±5 psig /1/	Standard Profile Type I Bending Moment In ±10 lb-in /2/	Low Profile Type II N lb/in	Low Profile Type II Operating Pressure ±5 psig /1/	Low Profile Type II Bending Moment ±10 lb-in /2/
1.00	--	--	--	559	2070	1 110
1.25	--	--	--	541	1630	1 440
1.50	686	1960	3 310	531	1350	1 820
1.75	690	1680	4 020	537	1180	2 310
2.00	693	1470	4 800	538	1040	2 830
2.25	697	1310	5 670	533	920	3 370
2.50	700	1180	6 610	526	820	3 940
2.75	694	1060	7 520	514	730	4 490
3.00	702	980	8 660	521	680	5 260
3.25	700	900	9 750	522	630	6 030
3.50	705	840	11 020	517	580	6 780
4.00	885	918	17 210	655	645	10 900
4.50	877	806	20 660	665	583	13 610
5.00	887	732	24 900	659	521	16 275
5.50	895	670	29 510	655	471	19 200
6.00	888	608	33 975	658	434	22 575
6.50	825	520	34 600	620	379	23 600
7.00	770	450	35 850	580	329	25 350

/1/ Maximum operating pressure is determined when joint is subjected to internal pressure only at room temperature.

/2/ Maximum bending moment is determined when joint is subjected to room temperature bending only (no internal pressure, torsion, or axial load applied).

3. For elevated temperatures, use with Table 3.

3.5.2.1.3 (Continued):

where:

N_a = Load, pounds per inch due to axial load
E = Axial tension load in pounds
D_p = Theoretical contact line of V-retainer to flange, in inches

3.5.2.1.4 Rated Load: Limit (Proof) = two times operating load

Ultimate = three times operating load - leakage, 3.5.1, may be exceeded. Deformation may occur but the joint shall remain permanently connected.

N limit load shown in Table 2 is at room temperature and must be corrected for elevated temperature per Table 3.

EXAMPLE: N Load for 3.00 Type I joint is 702 lb/in. At 600 °F N = 702 x .73 = 572 lb/in.

TABLE 3 - N Temperature Correction Factor Type I and II Joints

Temperature in °F	Correction Factor Joint Tube OD in inches 1.00 - 3.50	Correction Factor Joint Tube OD in inches 4.00 - 7.00
70	1.00	1.00
100	.97	.99
200	.89	.96
300	.84	.96
400	.79	.92
500	.76	.92
600	.73	.89
700	.71	.88
800	.70	.87
900	.68	.87
1000	.68	.85
1100	.68	.81
1200	.68	.73

TABLE 4 - Hydrostatic Proof Pressure Expansion Values

Part Number	Nominal Tube Size	Test Pressure ±10 psig	Fixture or Coupling Half Expansion Max in inches
AS1895/4 & /20-100	1.00	3950	.007
AS1895/4 & /20-125	1.25	3200	.007
AS1895/4 & /20-150	1.50	2650	.007
AS1895/4 & /20-175	1.75	2250	.007
AS1895/4 & /20-200	2.00	2000	.007
AS1895/4 & /20-225	2.25	1800	.007
AS1895/4 & /20-250	2.50	1650	.007
AS1895/4 & /20-275	2.75	1500	.007
AS1895/4 & /20-300	3.00	1400	.007
AS1895/4 & /20-325	3.25	1300	.007
AS1895/4 & /20-350	3.50	1200	.007
AS1895/4 & /20-400	4.00	1050	.007
AS1895/4 & /20-450	4.50	900	.007
AS1895/4 & /20-500	5.00	800	.007
AS1895/4 & /20-550	5.50	750	.007
AS1895/4 & /20-600	6.00	700	.007
AS1895/20-650	6.50	650	.007
AS1895/20-700	7.00	600	.007
AS1895/1 & /22-150	1.50	4100	.017
AS1895/1 & /22-175	1.75	3800	.017
AS1895/1 & /22-200	2.00	3500	.017
AS1895/1 & /22-225	2.25	3250	.017
AS1895/1 & /22-250	2.50	3000	.017
AS1895/1 & /22-275	2.75	2750	.017
AS1895/1 & /22-300	3.00	2500	.017
AS1895/1 & /22-325	3.25	2250	
AS1895/1 & /22-350	3.50	2000	.017
AS1895/1 & /22-400	4.00	1750	.017
AS1895/1 & /22-450	4.50	1500	.017
AS1895/1 & /22-500	5.00	1300	.017
AS1895/1 & /22-550	5.50	1200	.017
AS1895/1 & /22-600	6.00	1150	.017
AS1895/1 & /22-650	6.50	1040	.017
AS1895/1 & /22-700	7.00	900	.017

3.5.3 Pneumatic Pressure:

3.5.3.1 Operating Pressure: The joint shall show no evidence of deformation or leakage in excess of that stated in 3.5.1 when subjected to the operating pressure of Table 2.

3.5.3.2 Proof Pressure: The joint shall show no evidence of residual strain in excess of .2% of any dimension or leakage in excess of .06 SCFM per inch of tube diameter when subjected to two times the operating pressure of Table 2 for 15 min.

3.5.3.3 Burst Pressure: The joint shall not rupture and shall remain intact when subjected to three times the operating pressure of Table 2 for 2 min. Deformation shall be allowed.

3.5.4 Torsional Moment: The joint shall not permanently deform or rotate when subjected to torsional moment specified in Table 5 at operating pressure of Table 2. Leakage shall be within the limits of 3.5.1.

TABLE 5 - Torsional Moment

Standard Profile Type I Tube OD in Inches	Standard Profile Type I Torsional Moment in lb-in ±10 lb-in	Low Profile Type II Tube OD in Inches	Low Profile Type II Torsional Moment in lb-in ±10 lb-in
--	--	1.00	600
--	--	1.25	800
1.50	2 200	1.50	1 000
1.75	2 600	1.75	1 200
2.00	3 200	2.00	1 800
2.25	3 600	2.25	2 000
2.50	4 100	2.50	2 500
2.75	4 600	2.75	2 900
3.00	5 200	3.00	3 600
3.25	5 800	3.25	4 200
3.50	6 500	3.50	5 100
4.00	9 600	4.00	8 000
4.50	13 600	4.50	11 900
5.00	18 000	5.00	17 200
5.50	21 000	5.50	20 000
6.00	26 000	6.00	25 000
6.50	29 000	6.50	28 000
7.00	33 000	7.00	32 000

3.5.5 Sinusoidal Vibration: The joint shall maintain joint integrity and show no evidence of leakage in excess of that specified in 3.5.1 during or after exposure to vibration levels per 4.5.4.1 with a 10 min dwell at resonant frequencies at operating pressure of Table 2 and at room temperature.

3.5.6 Pressure Cycling: The joint shall not permanently deform, or show evidence of fatigue failure after being subjected to 25 000 pressure impulse cycles per 4.5.5 at operating pressure of Table 2, for joints intended for military applications or a minimum of 200 000 cycles in accordance with 4.5.7 and Table 8 for joints intended for civil applications. Testing to civil airliner requirements exceeds the military requirements; joints having satisfied civil requirements shall be deemed acceptable for military use. Leakage during or after pressure cycling shall not exceed that specified in 3.5.1.

3.5.7 Flexure Cycling: The joint shall not permanently deform, or show evidence of fatigue failure, and shall meet the leakage requirements of 3.5.1 during and after subjection to flexure cycling per 4.5.6 and the specified pressure of Table 7, for a minimum of 25 000 cycles for joints intended for military applications or a minimum of 200 000 cycles in accordance with 4.5.7 and Table 8 for joints intended for civil applications. Testing to civil airliner requirements exceeds the military requirements; joints having satisfied civil requirements shall be deemed acceptable for military use. Testing per 4.5.6 or 4.5.7 or both shall be agreed upon between user and supplier.

3.6 Interchangeability:

The joint components shall be completely interchangeable and intermateable between suppliers approved by the user such that a mixed assembly will meet the requirements of this document.

3.7 Part Numbering of Interchangeable Parts:

All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. Item identification, part numbers and changes shall be in accordance with DOD-STD-100.

3.8 Identification of Product:

3.8.1 Coupling: The coupling shall be marked for identification in accordance with AS478 Class D and shall include the following as a minimum:

AS Number _____
Supplier Part No. _____
Supplier Name or Trademark and CAGE Code _____
Date of Manufacture _____
Torque - "Caution. Torque to (see applicable AS drawing) lb-in"

3.8.2 Seal and Flanges: The seal and flange packaging shall be marked for identification in accordance with the AS drawing and MIL-STD-130 with the AS part number and the supplier's identification. Flange marking shall be on the flange skirt as close as possible to the radius, with the 20° angle surface.

3.9 Workmanship:

The joint components shall be free from defects and imperfections and manufactured and finished in a thoroughly workmanlike manner.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

4.1.1 Supplier's Responsibility: The supplier is responsible for the performance of all quality assurance provisions as specified herein. Accurate records of the testing shall be maintained by the supplier and shall be available to the user for inspection on request. The supplier's test data, subject to the approval of the user, shall be considered adequate for product qualification. In the event the supplier is to perform testing for approval, the supplier shall submit a test procedure to the user defining in detail the tests to be performed, the method, and samples correlated to the tests. The supplier, upon approval by the user, shall conduct the tests per the approved test procedure and document the results in a test report per MIL-STD-831.

Rejected joint components shall not be submitted for reinspection without furnishing full particulars concerning previous rejection and measures taken to overcome the defects.

If the investigation indicates that the defect causing the rejection may exist in joint components previously supplied to the user, the supplier shall advise the user of this condition, method of identifying these parts, and corrective action or disposition of the rejected parts.

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

a. Dimensional configuration
b. Marking
c. Size
d. Functional capability

TABLE 6 - Qualification Test

Test	Requirement Paragraph	Method Paragraph
Examination	--	4.4.1, 4.5.11
Static Leakage	3.5.1	--
Hydrostatic Pressure	3.5.2	4.5.1
Operating Pressure	3.5.3.1	4.5.2
Proof Pressure	3.5.3.2	4.5.2
Burst Pressure	3.5.3.3	4.5.12
Torsional Moment	3.5.4	4.5.3
Sinusoidal Vibration	3.5.5	4.5.4
Pressure Cycling	3.5.6	4.5.5
Flexure Cycling	3.5.7	4.5.6, 4.5.7
Coupling Half Strength Test	3.3.1.1	4.5.8
Safety Latch Evaluation	3.3.8	4.5.9
Nut Life	3.3.7	4.5.10

4.2 Classification of Tests:

Inspection and testing of joint components shall be classified as:

a. Qualification test (4.2.1)
b. Quality conformance test and verification (4.2.2)

4.2.1 Qualification Test: Qualification tests specified in Table 6 are intended to qualify a manufacturer's parts. The configuration shall be as described on the standard pages. The witnessing of qualification tests by the user's representative(s) shall be optional. In the event the supplier already has performed the required testing, copies of the test report shall be submitted to the user for approval and shall conform to MIL-STD-831.

4.2.1.1 Sampling Instruction: Unless otherwise specified, one joint minimum of the size specified by the user, or, if not specified, the maximum size shall be subjected to the qualification test by the supplier. In the event test data already exist, these data shall be submitted to the user for approval. Any further testing deemed necessary shall be performed by mutual agreement between the user and the supplier.

4.2.1.2 Test Sample Identification: Each component of the joint assembly shall be permanently identified. Marking shall be such that legibility can be maintained throughout the qualification testing. Seal identification may be maintained external to the part. In addition to part identification, 3.8, the words "Test Sample (#1, #2, #3, etc.)" shall be marked on the test parts.

4.2.1.3 Qualification By Similarity: Qualification of larger joints of the same type, material, identity, and manufacturer may qualify smaller joints of the same type of material and identity for that manufacturer. Qualification of smaller joints will not qualify the larger joints. Qualification of lower strength alloy couplings shall qualify higher strength alloy couplings of the same cross section and size.

4.2.2 Quality Conformance Test and Verification: All items shall be examined and tested to the extent necessary to verify that all requirements of the AS drawings and this document have been met.

4.3 Test Conditions:

4.3.1 Pressure and Temperature: Unless otherwise specified, the ambient standard temperature shall be 75 °F ± 15 °F. Elevated temperature shall be 1200 °F ± 15 °F internal. Standard pressure shall be 760 mm Hg ± 5% baseline. Elevated pressure shall be as specified in the test paragraphs ±25 psig.

4.3.2 Test Assembly: The joint shall be torqued in accordance with the applicable AS drawing. The ducting shall be free to move axially to accommodate end loads due to internal pressure and temperature.

4.3.3 Fluid Medium: The fluid medium for pneumatic tests specified herein shall be dry air (ambient lab air) or gaseous nitrogen unless otherwise specified.

4.4 Examination:

4.4.1 Examination of Product: The test joint components shall be examined to determine conformance to this document and the appropriate AS drawing with respect to dimensions, weight, material, workmanship, finish, construction, marking, and identification of the product reported.

4.5 Test Methods:

4.5.1 Hydrostatic Pressure: Prior to performing any pneumatic pressure testing, the test specimen shall be enclosed in a protective enclosure and hydrostatically pressurized to the test pressure of Table 4 and 3.5.2, at room temperature as follows:

The coupling shall be assembled on the flanges (including seal) and the assembly shall be filled with water or hydraulic oil. The coupling shall be torqued to the value specified on the coupling standard. The assembly shall be pressurized to one-half the test pressure specified in Table 4. The pressure shall then be released. The coupling half expansion of each segment shown in Figure 8 shall be measured and recorded. The joint shall be repressurized to the values in Table 4 and the expansion as shown in Figure 8 shall be measured and recorded. The differential expansion shall not exceed the values in Table 4. The pressure shall be released. The expansion shall again be measured and shall not exceed the initial expansion.

4.5.1.1 Hydrostatic Pressure-Alternate Test and Acceptance Test: Prior to performing any pneumatic pressure testing, the specimen shall be enclosed in a protective enclosure and hydrostatically pressurized to the test pressure of Table 4 and 3.5.2, at room temperature as follows:

The coupling shall be assembled on the test fixture per Figure 9 and the assembly shall be filled with water or hydraulic oil. The coupling shall be torqued to the value specified on the coupling standard if the self-locking nut is employed. Free running brass nuts may be used, but the value to which these nuts are torqued shall be as stated on the coupling standard, minus 40 lb-in. The assembly shall be pressurized to one-half the test pressure specified in Table 4. The pressure shall then be released. An initial measurement of the midspan coupling half width, dimension ("expansion max") in Figure 8, shall be made and recorded. An initial measurement of the fixture at "X", Figure 9, shall be made and recorded. The joint shall be repressurized to the values in Table 4 and the expansion of the test fixture as shown in Figure 9 shall be measured while the joint remains pressurized and recorded. The differential expansion of the test fixture shall not exceed the values in Table 4. The pressure shall be released. The midspan coupling half width shall be remeasured and recorded and shall not exceed the initial measurement value.

4.5.2 Static Operating and Proof Pressure Leakage Test: The test specimen shall be mounted on a test fixture and installed as shown in Figure 1. The test specimen shall be pressurized with air or gaseous nitrogen by allowing the pressurizing medium to flow through a flowmeter while maintaining the required test pressures by means of a manually operated control valve placed between the pressure source and pressure gage. Any flow occurring after the required pressure has been reached, within the test specimen, shall be measured as leakage through the specimen. While at ambient temperature, the test specimen shall be slowly pressurized to operating pressure of Table 2. After the pressure within the specimen has stabilized, the pressure shall be maintained for a period of 15 min. The specimen leakage rate shall be monitored and recorded while at operating pressure and ambient temperature.

The internal pressure shall be slowly increased to two times the operating pressure of Table 2. After the pressure within the specimen has stabilized, the proof pressure shall be maintained for a period of 15 min. The specimen leakage rate shall be monitored and recorded while at proof pressure and ambient temperature.

The internal pressure shall then be reduced and maintained at operating pressure. The internal temperature control within the specimen shall be adjusted to maintain the elevated operating temperature of 1200 °F ± 15 °F. An additional soak time of 20 min minimum shall be allowed after the temperature has been reached to assure stabilization of the test specimen.

4.5.2 (Continued):

The specimen leakage rate shall be monitored and recorded while at the operating pressure of Table 2 and at elevated temperature. The specimen internal pressure shall be slowly increased to two times the operating pressure of Table 2 (corrected per Table 3) and maintained at that pressure for a period of 15 min. The specimen leakage rate shall be monitored and recorded. After completion of the static operating and proof pressure leakage tests, the coupling components shall be allowed to cool and visually examined for evidence of structural damage as a result of the static pressure tests. Any indications of deformation shall be recorded. The specimen shall meet the requirements of 3.5.3.1 and 3.5.3.2.

4.5.3 Torsional Moment: The test specimen shall meet the requirements of 3.5.4 when subjected to the torsional moment of Table 5 at operating pressure of Table 2. Both ends of the test specimen shall be placed in the holding fixture as shown in Figure 2. One end of the specimen shall be rigidly clamped to prevent rotation. The other end of the specimen shall be free to rotate in the holding fixture and only secure enough to prevent the introduction of excessive bending moment. The test specimen shall be fitted with lugs, sockets, or similar fittings suitable for use with torque devices. The lugs, etc., shall be located as shown in Figure 2 on the side which permits rotation. The test specimen internal temperature shall be 1200 °F ± 15 °F. After temperature stabilization, the internal pressure shall be adjusted to the operating pressure of Table 2 (corrected per Table 3). While at operating pressure of Table 2 and 1200 °F ± 15 °F, a torsional moment of 0 lb-in to the value noted in Table 5 shall be slowly applied to one end of the test specimen. The specimen leakage rate shall be monitored and recorded prior to applying the torsional moment and after application of torsional moment.

4.5.4 Vibration-Performance: The test specimen shall be installed as shown in Figure 3. The vibration test shall be conducted along three mutually perpendicular axes as shown in Figure 3 with the test specimen pressurized at operating pressure of Table 2 while at room temperature. The test specimen shall be subjected to one cycle of sinusoidal vibration with the frequency varying between 5 and 2000 Hz for each axis. The rate of change of frequency 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 2 of Figure 4.

4.5.4.1 Vibration-Structural Integrity: The test specimen shall be installed as in 4.5.4 and shall be subjected to sinusoidal vibration with the frequency varying between 5 and 2000 Hz. The rate of change of frequency 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 1, Figure 4.

4.5.4.2 Resonance Search: The test specimen shall be installed as shown in 4.5.4 and subjected to a vibration sweep (5 to 2000 Hz) with each resonance being measured and recorded. The sweep shall be held at the resonant frequency while oscillating for 10 min. If more than four resonant frequencies are found, dwell shall occur at the four most severe for 10 min at each resonant frequency. If no resonant frequency is found, the dwell shall occur at 2000 Hz for 10 min. A resonance is defined as a magnification of output to input levels by a factor of two or more. The test specimen shall be subjected to sinusoidal vibration and searched for resonance while at the operating pressure of Table 2 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 1, Figure 4. 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.

4.5.5 Pressure Cycle: The test specimen shall be set up and installed as shown in Figure 5. While at ambient temperature, the test specimen shall be pressurized to operating pressure of Table 2 and pressure cycled for a total of 12 500 pressure cycles. One pressure cycle is defined as venting the pressure from operating pressure of Table 2 to atmosphere and repressurizing to operating pressure of Table 2. This test shall be conducted at a rate compatible with the internal volume of the test specimen, but shall not exceed 25 cpm.

The specimen leakage rate shall be recorded prior to the first pressure cycle and after completion of the 12 500 pressure cycles. After completion of the ambient temperature pressure cycle test, the specimen components shall be visually examined for evidence of structural damage. Any indications of deformation shall be recorded. After the ambient pressure cycle test, the test specimen temperature shall be raised to 1200 °F internal temperature and held until stabilization. After stabilization, while at 1200 °F, the test specimen shall be pressure cycled between operating pressure of Table 2 (corrected per Table 3) and the atmosphere for an additional 12 500 cycles at a cycle rate not exceeding 25 cpm.

The specimen temperature shall be monitored constantly during the elevated temperature pressure cycle test. If the specimen temperature varies more than 15 °F above or below the 1200 °F, i.e., (1175 to 1225 °F), at any time during this portion of the test, the cycling shall be stopped and the temperature restabilized. The specimen leakage rate shall be recorded prior to the first (12 501) pressure cycle and after completion of 25 000 pressure cycles. After completion of the elevated temperature pressure cycle test, the specimen components shall be visually examined for evidence of structural damage as a result of the pressure cycle test. Any indications of deformation shall be recorded. The specimen shall meet the requirements of 3.5.6.

4.5.6 Flexure Cycling: The specimen shall meet the requirements of 3.5.7 after being subjected to the six steps of flexure cycling as shown in Table 7 at the test pressure of Table 8.

TABLE 7 - Flexure Cycling

Step	Temperature	Cycles Per Test	Cycles Total	Bending Moment lb-in	Coupling Position
1	Ambient	6000	6000	±500	0°
2	Ambient	6000	12000	±500	90°
3	Ambient	500	12500	±1050	90°
4	+1200 °F ± 15	6000	18500	±500	0°
5	+1200 °F ± 15	6000	24500	±500	90°
6	+1200 °F ± 15	500	25000	±1050	90°

4.5.6.1 Flexure Cycling Step 1: The specimen shall be mounted on a test fixture as shown in Figure 6, Position A, and Figure 7. While at ambient temperature, the test specimen shall be slowly pressurized to the operating pressure of Table 2 and a cyclic bending moment load of ±500 lb-in shall be applied to the test specimen. One flexure cycle is defined as 0 lb-in, plus 500 lb-in, 0 lb-in, -500 lb-in, 0 lb-in. The cycling rate shall not exceed 60 cpm.

This flexure cycle test shall be continued for a total of 6000 cycles with the specimen internal pressure maintained at operating pressure of Table 2 and at ambient temperature. The leakage rate and test specimen pressure shall be monitored frequently throughout the ambient flexure cycle test to assure specimen integrity. The specimen leakage rate shall be recorded prior to the first flexure cycle and every 1000 cycle intervals through 6000 cycles.

4.5.6.2 Flexure Cycling Step 2: After completion of the flexure cycle test step 1, the test specimen shall be removed from the test fixture, disassembled, and the coupling rotated 90° so the coupling bolt is positioned as shown in Figure 6, Position B, and remounted on the test fixture. While at ambient temperature, 4.5.6.1 shall be repeated for an additional 6000 cycles. The specimen leakage rate shall be recorded prior to the first (6001) flexure cycle and every 1000 cycle intervals through 12 000 cycles.

4.5.6.3 Flexure Cycling Step 3: After completion of the flexure cycle test of step 2 and with the internal test specimen pressure maintained at operating pressure of Table 2, the cyclic bending moment shall be slowly increased to 1050 lb-in and flexure cycled for a total of 500 cycles. One flexure cycle is defined as 0 lb-in, +1050 lb-in, 0 lb-in, -1050 lb-in, 0 lb-in. After completion of the ambient temperature flexure cycle tests (steps 1, 2 and 3), the specimen components shall be visually examined for evidence of structural damage. Any indications of deformation shall be recorded.

4.5.6.4 Flexure Cycling Step 4: Following the visual examination of the test specimen, the test specimen shall be installed with the coupling bolt positioned as shown in Figure 6, Position A. The test specimen shall be pressurized to test pressure of Table 8 (corrected per Table 3) and the test specimen temperature control adjusted to maintain 1200 °F ± 15 °F internal temperature until stabilization. A cyclic bending moment load of ±500 lb-in shall be applied to the test specimen. This flexure cycle test shall be continued for 6000 cycles with the specimen internal pressure maintained at the corrected operating pressure specimen and at 1200 °F ± 15 °F temperature. The leakage rate, the internal pressure readings, and test specimen temperature shall be monitored frequently throughout the elevated temperature flexure cycle test to assure specimen integrity. The specimen leakage rate shall be recorded prior to the first flexure cycle and every 1000 through 6000 cycles.

4.5.6.5 Flexure Cycling Step 5: After completion of the flexure cycle test step 4, the test specimen shall be removed from the test fixture, the coupling rotated 90°, so the coupling bolt is positioned as shown in Figure 6, Position B, and remounted on the test fixture. Paragraph 4.5.6.4 (step 4) shall be repeated for an additional 6000 cycles with the specimen internal pressure maintained at the corrected test pressure of Table 8 and at 1200 °F ± 15 °F internal temperature. The specimen leakage rate shall be recorded prior to the first 18 501 flexure cycles and every 1000 through 24 500 cycles.

4.5.6.6 Flexure Cycling Step 6: After completion of the flexure cycle test of step 5, and with the internal test specimen pressure maintained at the corrected operating pressure of Table 2 and the test specimen temperature maintained at 1200 °F ± 15 °F, the cyclic bending moment shall slowly be increased to 1050 lb-in and flexure cycled for a total of 500 cycles. (One flexure cycle = 0 lb-in, +1050 lb-in, 0 lb-in, -1050 lb-in, 0 lb-in.) The leakage rate, the test specimen pressure, and test specimen temperature shall be monitored frequently during the 500 cycles to assure specimen integrity. The leakage rate shall be recorded at the end of 500 cycles. After completion of the elevated temperatures flexure cycle test, the specimen components shall be visually examined for evidence of structural damage. Any indications of deformation shall be recorded.

4.5.7 Flexure Cycling with Pressure Pulsations (Alternate Test): The specimen shall meet the requirements of 3.5.7 after being subjected to the two steps of flexure cycling as shown in Table 8 at the test pressure of Table 8.

4.5.7.1 Flexure Cycling with Pressure Pulsations (Alternate Test) Step 1: The test specimen shall be mounted on a test fixture as shown in Figure 6, Position A, and Figure 7. The specimen shall be pressurized to the test pressure of Table 8 and produce an internal temperature of 1200 °F ± 15 °F. A cyclic bending moment load per Table 8 shall be applied to the test specimen. One flexure cycle is defined as 0 lb-in, plus maximum bending moment, 0 lb-in, minus maximum bending moment, plus 0 lb-in. After the flexure cycle is completed, the pressure shall be reduced to 0 psig + 10 psig -0 psig and then restored to the pressure of Table 8 for the start of the next cycle. The cycling rate shall not exceed 60 cpm. This flexure cycle test shall be continued for a total of 100 000 cycles with the specimen internal pressure maintained at test pressure of Table 8 and at elevated temperature. The leakage rate and test specimen pressure shall be monitored frequently throughout the flexure cycle test to assure specimen integrity. The specimen leakage rate shall be recorded prior to the first flexure cycle and after every 20 000 cycle interval. The joint may be disassembled and the seal and flange sealing surfaces cleaned after every 40 000 cycles. The joint must be reassembled with the coupling bolt in the original orientation with respect to the original position of the flange and seal. All components are to be reassembled in the original orientation.

4.5.7.2 Flexure Cycling with Pressure Pulsations (Alternate Test) Step 2: After completion of the flexure cycle test step 1, the test specimen shall be removed from the test fixture and the coupling rotated 90° so the coupling bolt is positioned as shown in Figure 6, Position B, and remounted on the test fixture. The specimen shall be pressurized to the test pressure of Table 8 and produce an internal temperature of 1200 °F ± 15 °F and the test per 4.5.7.1 shall be repeated for an additional 100 000 cycles. The specimen leakage rate shall be recorded prior to the first flexure cycle and after every 20 000 cycle interval. The joint may be disassembled and the seal and flange sealing surfaces cleaned after every 40 000 cycles. The joint must be reassembled with the coupling bolt in the original orientation with respect to the original position of the flange and seal. All components are to be reassembled in the original orientation.

4.5.8 Coupling Half Strength Test: The coupling half shall be cut at the corner of the apex, along one leg, for a distance of one-fourth circumference with regard to the nominal diameter (see Figure 10). The coupling shall then be installed in a protective enclosure and pressurized to operating pressure of Table 2, 3.5.3.1. The specimen shall meet the requirements of 3.3.1.1.

Table 8 - Flexure Cycling (Alternate Test)
Pressure and Bending Moment

Specimen Tube Size	Standard Profile Bending Moment (lb-in) ±10%	Standard Profile Test Pressure (psig)	Low Profile Bending Moment (lb-in) ±10%	Low Profile Test Pressure psig
100	--	--	491	300
125	--	--	605	300
150	1092	500	723	300
175	1095	500	864	300
200	1179	500	991	300
225	1408	500	1073	300
250	1427	500	1132	300
275	1345	500	1115	300
300	1270	500	1156	300
325	1083	500	1137	300
350	812	500	1039	300
400	6709	350	5170	200
450	6992	350	6071	200
500	7694	350	6662	200
550	7995	350	7164	200
600	7619	350	7734	200
650	8164	300	8091	175
700	7484	275	6860	175

4.5.9 Safety Latch Evaluation: The coupling specimen shall be engaged using the bolt or a device simulating the bolt. The coupling shall be positioned with the safety latch at the bottom of the specimen such that the safety latch will tend to unhook due to gravity. The coupling shall be rigged to the full torque condition. The specimen shall then be pressurized to operating pressure of Table 2 at 70 °F. While in the full torque condition, the bolt shall be severed or a bolt action duplicating bolt severing may be used. This shall constitute one cycle. The procedure shall be repeated for a total of 10 cycles with a new bolt and a new fail-safe latch after each cycle, as required. The specimen shall meet the requirements of 3.3.8 for each cycle. Examine fail-safe latch for damage and replace if necessary. Record replacement history and extent of damage.

4.5.10 Nut Life: The coupling shall be installed on the flanges and seal. The nut shall be torqued at a rate not to exceed 25 rpm and a maximum nut temperature of 70 °F over ambient to the torque value specified on the applicable coupling standard. The latch gap shall be measured and recorded. The nut shall then be removed from the eye bolt. The installation and breakaway torque shall be recorded. The minimum acceptable value shall be 6.5 lb-in. The breakaway torque shall be read at one turn after the break loose torque has been achieved. The maximum self-locking torque shall be read and recorded and it shall not exceed 40 lb-in. This sequence constitutes one cycle. The nut shall be installed and removed a total of 15 full on-off cycles. The bolt and nut shall meet the requirments of 3.3.7.

4.5.11 Disassembly and Inspection: The test specimen, after all testing (except burst testing), shall be disassembled and the specimen components shall be inspected for conformance to the dimensions of the detail drawing. Any change in dimensions from the initial dimensions recorded during examination of product (4.4), deviations from allowable drawing dimensions, or visible structural damage shall be recorded.

4.5.12 Burst Pressure: The test specimen (Figure 1) shall be placed in a protective enclosure and its temperature shall be increased to 1200 °F by heating internally or raising the ambient temperature, until stabilization. The pressure shall be increased to burst pressure which is three times the operating pressure of Table 2 corrected for 1200 °F ± 15 °F. Burst pressure shall be held for 2 min. No leakage measurements shall be taken during this test. At the conclusion of the test, the sample parts shall be visually examined. The physical condition shall be noted. The test specimen shall meet the requirements of 3.5.3.3.

5. PREPARATION FOR DELIVERY:

5.1 Packaging:

Packaging shall be as necessary to insure delivery of components in a clean and undamaged condition.

5.1.1 Government Packaging:

5.1.1.1 Commercial: Preservation, packaging, and packing shall be in accordance with ASTM D 3951.

5.1.1.2 Military: Preservation, packaging, and packing shall be as specified in the contract or order.

5.2 Marking of Containers:

Interior and exterior containers shall be marked in accordance with MIL-STD-129 or as specified in the contract order. The date of packaging shall be marked on all containers.

6. NOTES:

6.1 Intended Use:

The rigid coupling joints specified herein are intended for use in aircraft engine bleed air, environmental control, environmental protection, and other pneumatic systems. Operating temperature range for the joint is -65 to +1200 °F. The leakage rate for the joint shall not exceed .01 SCFM per inch of tube diameter at any pressure up to proof pressure.

6.2 Design Use:

As a design guide, the joint shall be capable of carrying the total limit load "N" in accordance with AIR869. Joint "N" values are listed in Table 2. For elevated temperatures, "N" values shall be reduced by the factors listed in Table 3.

6.3 Joint Installation:

Recommended procedure for joint installation is as specified in ARP699, AIR869, and AS1895/21.

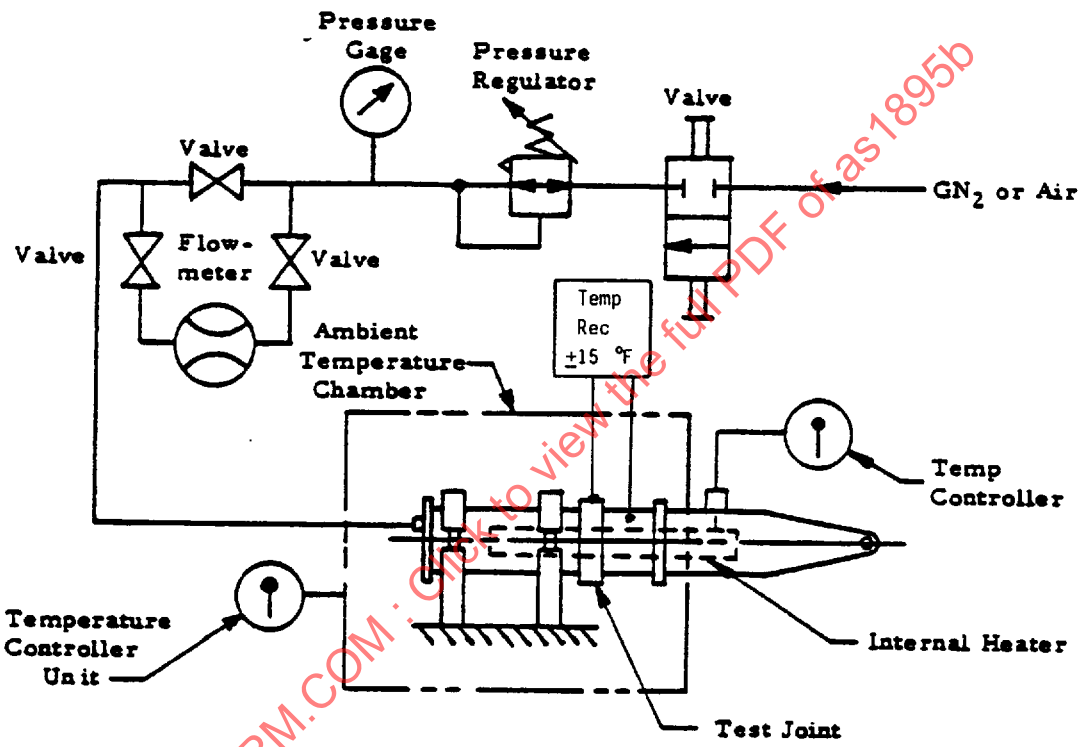


FIGURE 1 - Schematic Diagram of Static Pressure Test Setup

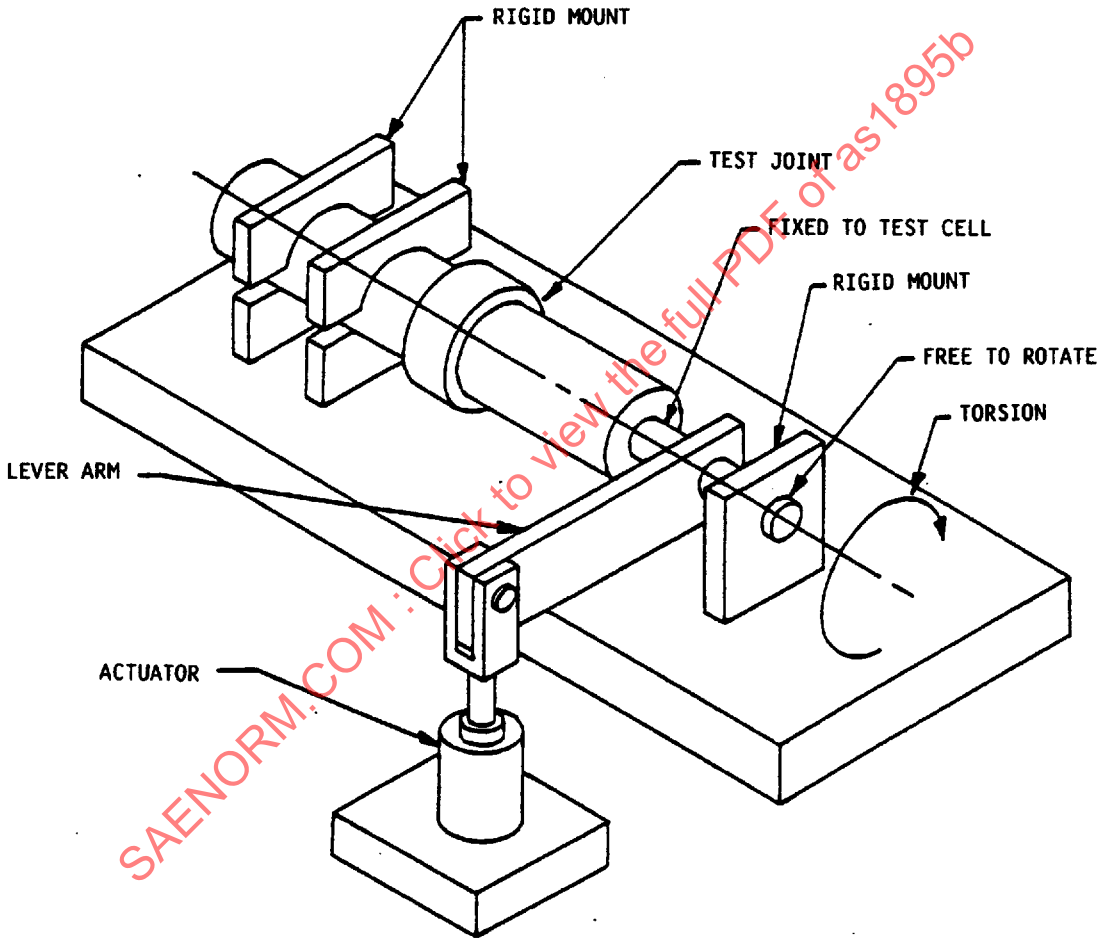
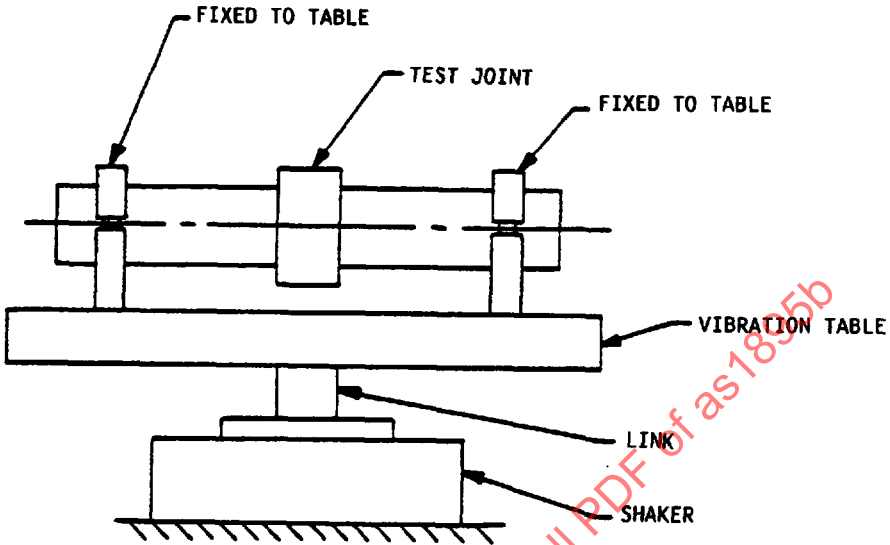


FIGURE 2 - Schematic Diagram of Torsion Test Setup



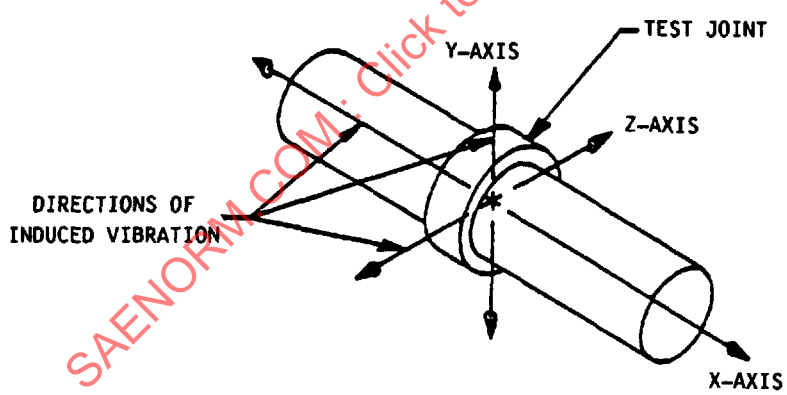


FIGURE 3 - Vibration Diagram