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AEROSPACE STANDARD

AS1895

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Submitted for recognition as an American National Standard

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

1. SCOPE:

1.1 This specification defines 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 - +1200°F.

1.2 Types - The joint shall be classified into two basic flange profiles:

1.2.1 Type I Standard Profile
Per MS24563 Fig. 2A (1.50 - 6.00 inch duct size)

1.2.2 Type II Low Profile
Per MS24563 Fig. 1 (1.00 - 6.00 inch duct size)

2. APPLICABLE DOCUMENTS:

The following documents of the issues in effect on the date of invitation for bid or request for proposal shall form a part of this specification to the extent specified herein.

2.1 Specifications:

2.1.1 Military:

MIL-W-6858 - Welding, Resistance: Spot and Seam

MIL-W-8611 - Welding, Metal Arc and Gas, Steels and Corrosion and Heat Resistant Alloys; Process for

MIL-S-8879 - Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for

2.2 Standards:

2.2.1 Military:

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-810 - Environmental Test Methods and Engineering Guidelines

MS24563 - Coupling Flange, V-Band, Profile Dimensions For

2.2.2 Industry:

2.2.2.1 SAE:

AIR 869 - Application of V-Band Couplings

3. REQUIREMENTS:

3.1 Qualification: The joint furnished under this specification shall be a product identical to specimens which have successfully passed the tests specified in 4 of this specification. Parts covered by this document are listed in Table I.

Joint Control Numbers
Table I

TYPE	DESCRIPTION	AS NUMBER
I	Standard Profile Coupling Standard Profile Seam Weld Male Flange Standard Profile Seam Weld Female Flange	AS1895/1 AS1895/2 AS1895/3
II	Low Profile Coupling Low Profile Seam Weld Male Flange Low Profile Seam Weld Female Flange	AS1895/4 AS1895/5 AS1895/6
I & II	Seal	AS1895/7
II	Low Profile Buttweld Male Flange Low Profile Buttweld Female Flange	AS1895/8 AS1895/9
I	Standard Profile Buttweld Male Flange Standard Profile Buttweld Female Flange	AS1895/10 AS1895/11
I	Standard Profile Male Flange End Standard Profile Female Flange End	AS1895/12 AS1895/13
II	Low Profile Male Flange End Low Profile Female Flange End	AS1895/14 AS1895/15

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 plating shall not be used.

3.3 Design and Construction: The Type I (Standard Profile) and Type II (Low Profile) joints consisting of couplings, flanges and seals, as listed in Table I shall fulfill all design and performance requirements of this specification. Mating flange profiles shall conform to MS24563 Fig. 2A for Type I and MS24563 Fig. 1 for Type II.

3.3.1 Coupling: The material of the coupling shall be corrosion 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 specified on the standard drawings.

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 3/4 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 II.

3.3.2 Flanges: The material of the flanges (male and female) shall be corrosion resistant alloy as specified on the applicable AS drawing shown in Table I. The flange shall be designed for either seam or butt welding. The seam and butt weld flanges shall be intermateable.

3.3.3 Seal: The material of the seal shall be corrosion 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 I. 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 hours. 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, only one seal shall be used for all tests specified for each test joint.

3.3.4 Duct Material: The duct material shall be corrosion 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-W-8611. No welding shall be allowed in the fabrication of the couplings.

3.3.6 Bolt: Bolt material shall be as specified on the applicable AS drawing, with a minimum ultimate tensile strength of 160 000 lbf/in^2 and passivated per the AS standard. Bolt threads shall conform to MIL-S-8879, and shall be lubricated using an anti-seize high temperature lube.

3.3.7 Nut: The nut shall be a corrosion resistant self-locking type with a running torque of 6.5 to 40 inch-lb. The material shall be as specified on the applicable drawing. The nut shall have a minimum life of 15 complete full on-off cycles without damage to the bolt, nut or threads.

3.3.8 Safety Latch: The coupling shall have a safety latch as shown on AS Drawing AS 1895/1 and /4. 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 II 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 specification under any combination of ambient/fluid temperature exposure, within the range of -65 to +1200°F.

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 deformation, permanent set, or leakage in excess of that shown in 3.5.1 when subjected to the pressures of Table IV, 4.5.1, and Fig. 8 at room temperature with water 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 AIR 869, see Fig. 8, specified in Table II without exceeding the leakage requirement of 3.5.1 except as noted herein with respect to the following relationship: $N = N_p + N_b + N_a$.

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.

TABLE II - Limit Load at Room Temperature

TUBE OD IN INCHES	STANDARD PROFILE TYPE I			LOW PROFILE TYPE II		
	N LB/IN	OPERATING PRESSURE PSIG (1)	BENDING MOMENT IN IN-LB (2)	N LB/IN	OPERATING PRESSURE PSIG (1)	BENDING MONENT IN-LB (2)
1.00	-	-	-	559	2070	1110
1.25	-	-	-	541	1630	1440
1.50	686	1960	3310	531	1350	1820
1.75	690	1680	4020	537	1180	2310
2.00	693	1470	4800	538	1040	2830
2.25	697	1310	5670	533	920	3370
2.50	700	1180	6610	526	820	3940
2.75	694	1060	7520	514	730	4490
3.00	702	980	8660	521	680	5260
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

(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).

(For elevated temperatures, use with Table III.)

3.5.2.1 (Cont'd.)

TABLE III - N Temperature Correction Factor Type I & II Joints

TEMPERATURE IN °F	CORRECTION FACTOR	
	JOINT TUBE OD IN INCHES	
	1.00 - 3.50	4.00 - 6.00
70	1.00	1.00
100	0.97	0.99
200	0.89	0.96
300	0.84	0.96
400	0.79	0.92
500	0.76	0.92
600	0.73	0.89
700	0.71	0.88
800	0.70	0.87
900	0.68	0.87
1000	0.68	0.85
1100	0.68	0.81
1200	0.68	0.73

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

$$N_p = PD_s^2/4Dp$$

Where: N_p = Load, pounds per inch of circumference due to pressure

P = Load, pressure in lbf/in^2 (gage)

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:

$$N_b = 4M/\pi D_p^2$$

3.5.2.1.2 (Cont'd.)

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.

$$N_a = E/\pi D_p$$

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

TABLE IV - Hydrostatic Proof Pressure Expansion Values

PART NUMBER	NOMINAL TUBE SIZE	TEST PRESSURE lbf/in^2	COUPLING HALF EXPANSION MAX IN INCHES
AS1895/4-100	1.00	3950	0.007
AS1895/4-125	1.25	3200	
AS1895/4-150	1.50	2650	
AS1895/4-175	1.75	2250	
AS1895/4-200	2.00	2000	
AS1895/4-225	2.25	1800	
AS1895/4-250	2.50	1650	
AS1895/4-275	2.75	1500	
AS1895/4-300	3.00	1400	
AS1895/4-325	3.25	1300	
AS1895/4-350	3.50	1200	
AS1895/4-400	4.00	1050	
AS1895/4-450	4.50	900	
AS1895/4-500	5.00	800	
AS1895/4-550	5.50	750	
AS1895/4-600	6.00	700	
AS1895/1-150	1.50	4100	0.017
AS1895/1-175	1.75	3800	
AS1895/1-200	2.00	3500	
AS1895/1-225	2.25	3250	
AS1895/1-250	2.50	3000	
AS1895/1-275	2.75	2750	
AS1895/1-300	3.00	2500	
AS1895/1-325	3.25	2250	
AS1895/1-350	3.50	2000	
AS1895/1-400	4.00	1750	
AS1895/1-450	4.50	1500	
AS1895/1-500	5.00	1300	
AS1895/1-550	5.50	1200	
AS1895/1-600	6.00	1150	

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 II is at room temperature and must be corrected for elevated temperature per Table III. Example: N Load for 3.00 Type I joint is 702 lb/in. At 600°F N = 702 x .73 = 572 lb/in.

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 II.

3.5.3.2 Proof Pressure: The joint shall show no evidence of deformation or leakage in excess of 0.06 SCFM per inch of tube diameter when subjected to two times the operating pressure of Table II for 15 minutes.

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 II for two minutes. 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 V at operating pressure of Table II. Leakage shall be within the limits of 3.5.1.

TABLE V - Torsional Moment

STANDARD PROFILE TYPE I		LOW PROFILE TYPE II	
TUBE OD IN INCHES	TORSIONAL MOMENT IN INCH-LB	TUBE OD IN INCHES	TORSIONAL MOMENT IN INCH-LB
----	---	1.00	600
----	---	1.25	800
1.50	2200	1.50	1000
1.75	2600	1.75	1200
2.00	3200	2.00	1800
2.25	3600	2.25	2000
2.50	4100	2.50	2500
2.75	4600	2.75	2900
3.00	5200	3.00	3600
3.25	5800	3.25	4200
3.50	6500	3.50	5100
4.00	9600	4.00	8000
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

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-minute dwell at resonant frequencies at operating pressure of Table II 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 II, for joints intended for military applications or a minimum of 200 000 cycles in accordance with 4.5.7 and Table VIII 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 VII, 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 VIII 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 specification.

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 MIL-STD-130 and shall include the following as a minimum:

AS Number _____

Supplier Part No. _____

Supplier Name or Trademark and CAGE No. _____

Date of Manufacture _____

Torque - "Caution. Torque to (see applicable AS drawing) inch-lb"

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.

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.

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 specification are met. Emphasis shall be placed on the following:

(a) Dimensional Configuration
(b) Marking
(c) Size
(d) Functional Capability

TABLE VI - 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

TABLE VI - Qualification Test (Cont'd.)

TEST	REQUIREMENT PARAGRAPH	METHOD PARAGRAPH
Torsional Moment Sinusoidal Vibration	3.5.4 3.5.5	4.5.3 4.5.4
Pressure Cycling Flexure Cycling	3.5.6 3.5.7	4.5.5 4.5.6, 4.5.7
Coupling Half Strength Test Safety Latch Evaluation Nut Life	3.3.1.1 3.3.8 3.3.7	4.5.8 4.5.9 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 VI 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 and material and manufacturer may qualify smaller joints of the same type and material for that manufacturer. Qualification of smaller joints will not qualify the larger joints.

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 specification have been met.

4.3 Test Conditions:

4.3.1 Pressure and Temperature: Unless otherwise specified, the ambient standard temperature shall be 75 ± 10°F. Elevated temperature shall be 1200 + 10°F internal. Standard pressure shall be 760 mm Hg + 5% baseline. Elevated pressure shall be as specified in the test paragraphs ± 25 lbf/in^2 (gage).

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 specification 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 IV 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. The coupling shall be torqued to the value specified on the coupling standard. The assembly shall be pressurized to 1/2 the test pressure specified in Table IV. The pressure shall then be released. The coupling half expansion of each segment shown in Fig. 8 shall be measured and recorded. The joint shall be repressurized to the values in Table IV and the expansion as shown in Fig. 8 shall be measured and recorded. The differential expansion shall not exceed the values in Table IV. The pressure shall be released. The expansion shall again be measured and shall not exceed the initial expansion.

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 Fig. 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

4.5.2 (Cont'd.)

temperature, the test specimen shall be slowly pressurized to operating pressure of Table II. After the pressure within the specimen has stabilized, the pressure shall be maintained for a period of 15 minutes. 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 II. After the pressure within the specimen has stabilized, the proof pressure shall be maintained for a period of 15 minutes. 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. An additional soak time of 20 minutes minimum shall be allowed after the temperature has been reached to assure stabilization of the test specimen.

The specimen leakage rate shall be monitored and recorded while at the operating pressure of Table II and at elevated temperature. The specimen internal pressure shall be slowly increased to two times the operating pressure of Table II (corrected per Table III) and maintained at that pressure for a period of 15 minutes. 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 V at operating pressure of Table II. Both ends of the test specimen shall be placed in the holding fixture as shown in Fig. 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 enought 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 Fig. 2 on the side which permits rotation. The test specimen internal temperature shall be 1200°F. After temperature stabilization, the internal pressure shall be adjusted to the operating pressure of Table II (corrected per Table III). While at operating pressure of Table II and 1200°F, a torsional moment of 0 in-lb to the value noted in Table V 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 Fig. 3. The vibration test shall be conducted along three mutually perpendicular axes as shown in Fig. 3 with the test specimen pressurized at operating pressure of Table II. The test specimen 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 - 2000 - 5 Hz) will consume approximately 15 minutes. The test amplitude shall be that given by Curve II of Fig. 4. The specimen leakage rate shall be recorded while at operating pressure of Table II (corrected per Table III) and 1200°F internal temperature prior to starting the vibration test, during and at the conclusion of each axis test.

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 - 2000 - 5 Hz) will consume approximately 15 minutes. The test amplitude shall be that given by Curve I, Fig. 4. The test shall continue for a minimum of 60 minutes. During this period, the vibration sweep shall be surveyed for resonance by slowly varying the applied frequency and halting at each resonant frequency between 5 and 2000 Hz. The sweep shall be held at the resonant frequency while oscillating for 10 minutes. If no resonant frequency is found, the dwell shall occur at 2000 Hz for 10 minutes. Upon completion of test along each axis, 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 Fig. 5. While at ambient temperature, the test specimen shall be pressurized to operating pressure of Table II 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 II to atmosphere and repressurizing to operating pressure of Table II. This test shall be conducted at a rate compatible with the internal volume of the test specimen, but shall not exceed 25 cycles per minute.

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 II (Corrected per Table III) and the atmosphere for an additional 12 500 cycles at a cycle rate not exceeding 25 cycles per minute.

4.5.5 (Cont'd.)

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, 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 (12501) 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 inidcations 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 VII at the test pressure of Table VIII.

TABLE VII - FLEXURE CYCLING

STEP	PRESSURE (see Table VIII)	TEMPERATURE	CYCLES PER TEST	CYCLES TOTAL	BENDING MOMENT IN-LB	COUPLING POSITION
1	Test	Ambient	6000	6000	±500	0°
2	Test	Ambient	6000	12000	±500	90°
3	Test	Ambient	500	12500	±1050	90°
4	Test	+1200° ±15°F	6000	18500	±500	0°
5	Test	+1200° ±15°F	6000	24500	±500	90°
6	Test	+1200 ±15°F	500	25000	±1050	90°

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

4.5.6.1 (Cont'd.)

This flexure cycle test shall be continued for a total of 6000 cycles with the specimen internal pressure maintained at operating pressure of Table II 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, test specimen shall be removed from the test fixture, disassembled, and the coupling rotated 90 deg so the coupling bolt is positioned as shown in Fig. 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 II, the cyclic bending moment shall be slowly increased to 1050 in-lb and flexure cycled for a total of 500 cycles. One flexure cycle is defined as 0 in-lb, plus 1050 in-lb, 0 in-lb, minus 1050 in-lb, 0 in-lb. 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 Fig. 6, Position A. The test specimen shall be pressurized to test pressure of Table VIII (corrected per Table III) and the test specimen temperature control adjusted to maintain 1200°F internal temperature until stabilization. A cyclic bending moment load of + 500 in-lb shall be applied do 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 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 - 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 deg, so the coupling bolt is positioned as shown in Fig. 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 VIII and at 1200°F internal temperature. The specimen leakage rate shall be recorded prior to the first 18 501 flexure cycle and every 1000 cycles 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 II and the test specimen temperature maintained at 1200°F, the cyclic bending moment shall slowly be increased to 1050 in-lb and flexure cycled for a total of 500 cycles. (One flexure cycle = 0 in-lb plus 1050 in-lb, 0 in-lb, minus 1050 in-lb, 0 in-lb.) 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 (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 VIII at the test pressure of Table VIII.

4.5.7.1 Flexure Cycling (Alternate Test) Step 1: The test specimen shall be mounted on a test fixture as shown in Fig. 6, Position A, and Fig. 7. The specimen temperature shall be stabilized internally at 1200°F and shall be slowly pressurized to the test pressure of Table VIII, a cyclic bending moment load per Table VIII shall be applied to the test specimen. One flexure cycle is defined as 0 in-lb, plus maximum bending moment, 0 in-lb, minus maximum bending moment, plus 0 in-lb. After the flexure cycle is completed, the pressure shall be reduced to 0 lbf/in^2/(gage)+ 10 lbf/in^2 (gage)- 0 lbf/in^2 (gage) and then restored to the pressure of Table VIII for the start of the next cycle. The cycling rate shall not exceed 60 cycles per minute. 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 VIII 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 through 100 000 cycles.

4.5.7.2 Flexure Cycling (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 deg so the coupling bolt is positioned as shown in Fig. 6, Position B, and remounted on the test fixture. While at 1200°F internal temperature, the pressure shall be raised to the value in Table VIII 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 through 100 000 cycles.

Flexure Cycling (Alternate Test)
Table VIII

SPECIMEN TUBE SIZE	NO. OF CYCLES		BENDING MOMENT (IN-LB)	TEST PRESSURE (PSIG)
	POSITION A	POSITION B		
150	100 000	100 000	1092	500
175	100 000	100 000	1095	500
200	100 000	100 000	1179	500
225	100 000	100 000	1408	500
250	100 000	100 000	1427	500
275	100 000	100 000	1345	500
300	100 000	100 000	1270	500
325	100 000	100 000	1083	500
350	100 000	100 000	812	500
400	100 000	100 000	6709	350
450	100 000	100 000	6992	350
500	100 000	100 000	7694	350
550	100 000	100 000	7995	350
600	100 000	100 000	7619	350
100	100 000	100 000	491	300
125	100 000	100 000	605	300
150	100 000	100 000	723	300
175	100 000	100 000	864	300
200	100 000	100 000	991	300
225	100 000	100 000	1073	300
250	100 000	100 000	1132	300
275	100 000	100 000	1115	300
300	100 000	100 000	1156	300
325	100 000	100 000	1137	300
350	100 000	100 000	1039	300
400	100 000	100 000	5170	200
450	100 000	100 000	6071	200
500	100 000	100 000	6662	200
550	100 000	100 000	7164	200
600	100 000	100 000	7734	200

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 1/4 circumference with regard to the nominal diameter (see Fig. 9). The coupling shall then be installed and pressurized to operating pressure of Table II, 3.5.3.1. The specimen shall meet the requirments of Paragraph 3.3.1.1.

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 rigged to the full torque condition. The specimen shall then be pressurized to operating pressure of Table II 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. The installation and breakaway torque shall be recorded. This 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 (Fig. 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 II. Burst pressure shall be held for two minutes. 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.

5.2 Marking of Containers: Interior and exterior containers shall be marked in accordance with MIL-STD-129. 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 - +1200°F. At any pressure up to operating pressure, the leakage rate for the joint shall not exceed 0.01 SCFM per inch of tube diameter.

6.2 Design Use: As a design guide, the joint shall be capable of carrying the total limit load "N" in accordance with AIR 869. Joint "N" values are listed in Table II. For elevated temperatures, "N" values shall be reduced by the factors listed in Table III.

6.3 Load Definitions:

6.3.1 Limit Load: Limit load is two times operating load. Permanent deformation of parts is not allowed and allowable leakage rate shall not exceed 0.06 SCFM per inch diameter.

6.3.2 Ultimate Load: Ultimate load is three times operating load. Allowable leakage may be exceeded, deformation or parts may occur but the joint shall remain connected.

6.4 Joint Installation: Recommended procedure for joint installation is as specified in ARP 699 and AIR 869.

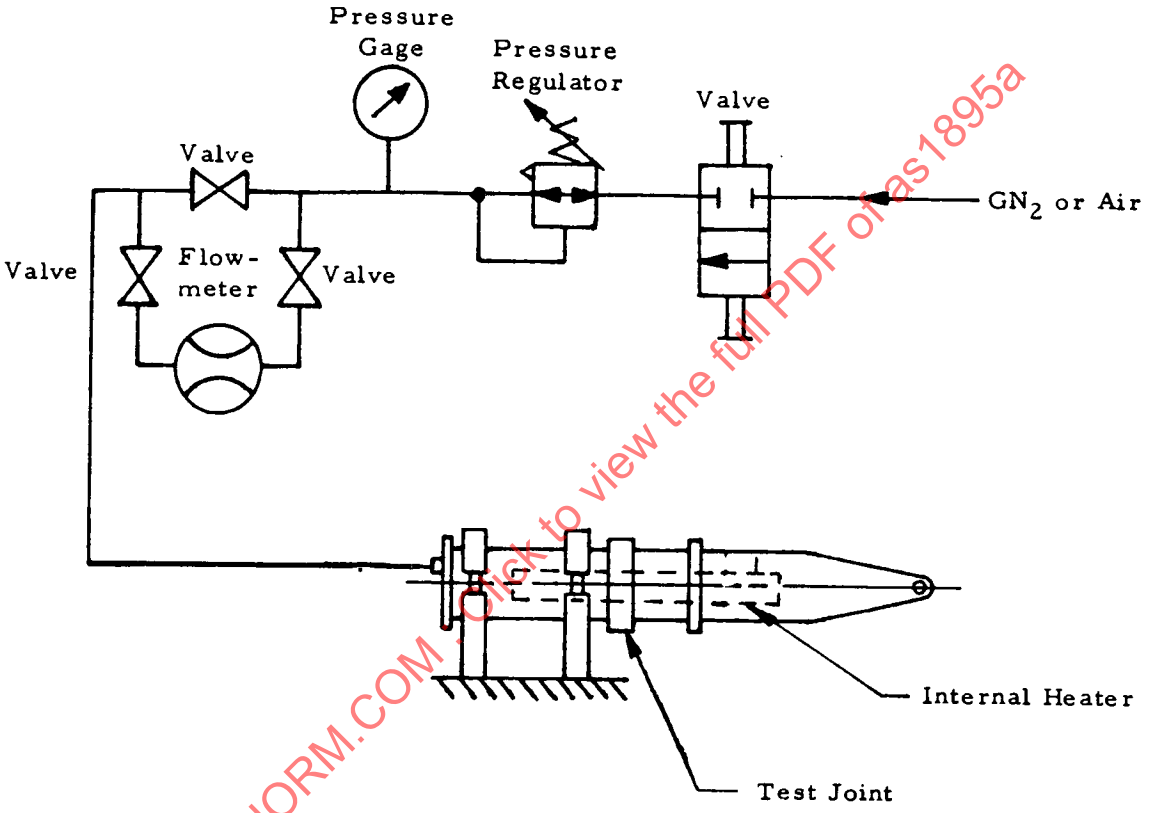

FIGURE 1 - Schematic Diagram of Static Pressure Test Set-up

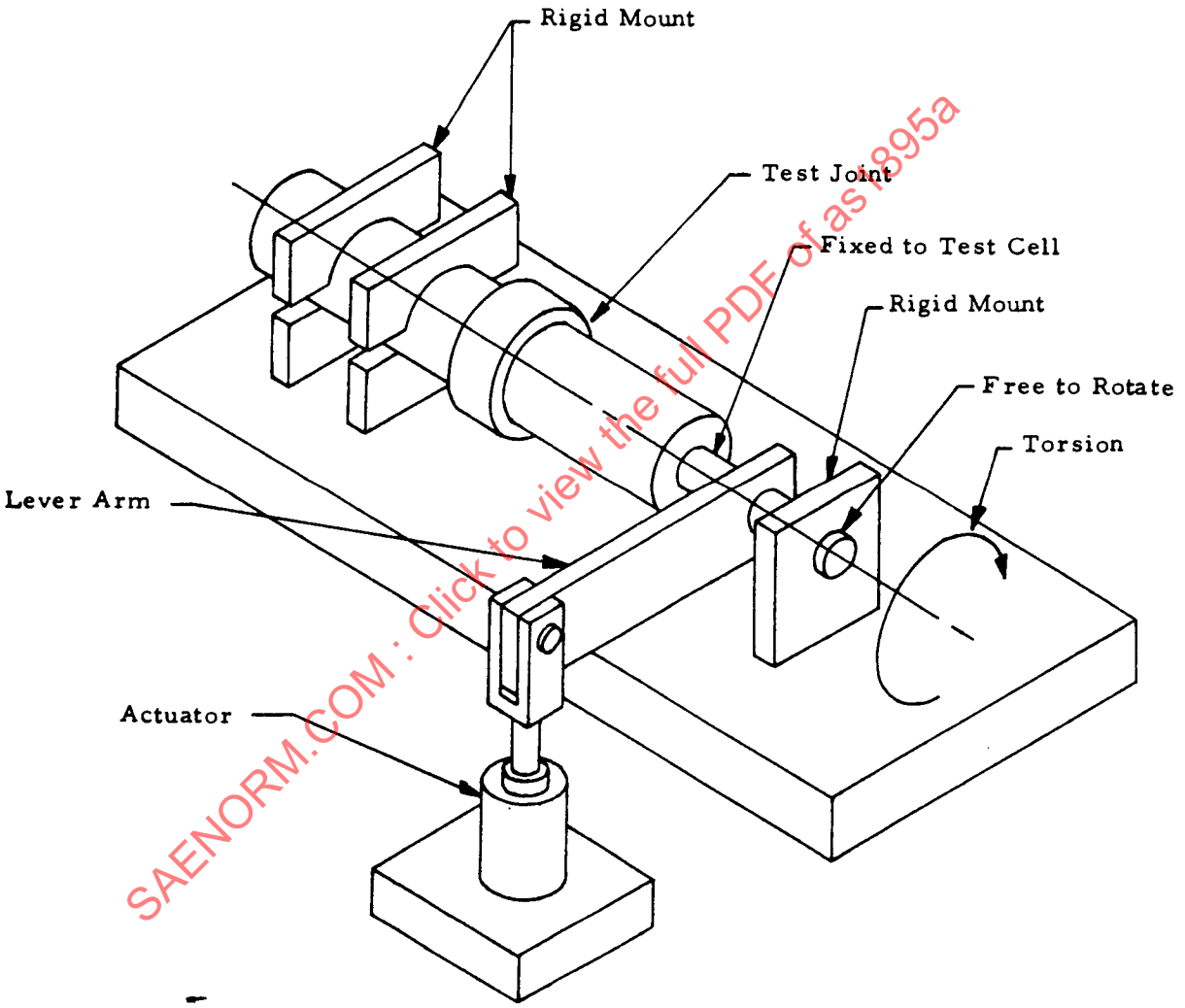

FIGURE 2 - Schematic Diagram of Torsion Test Set-up

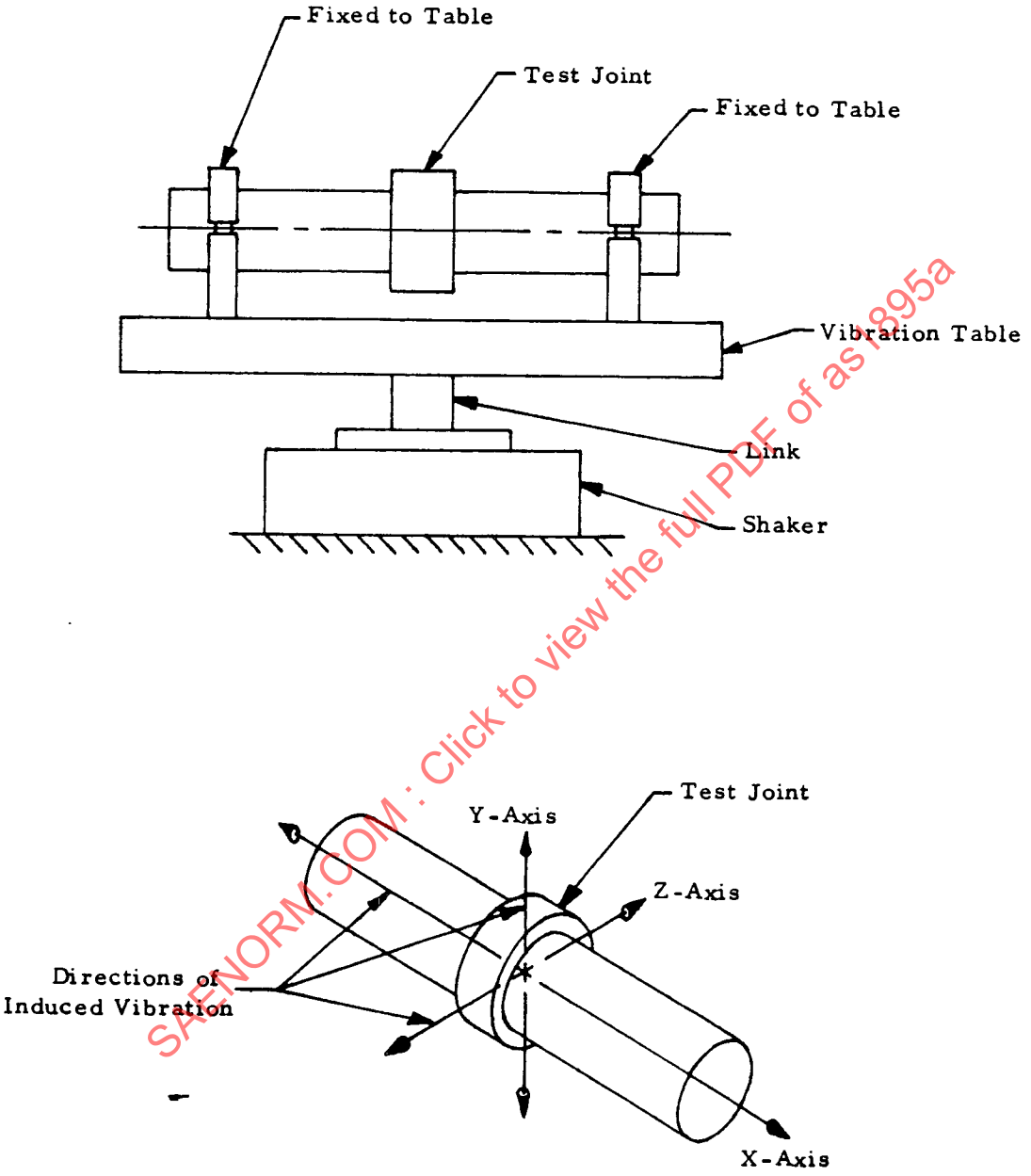

FIGURE 3 - Vibration Diagram