SAE The Engineering Resource For Advancing Mobility

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

AS 1895

Issued 12-85

Revised

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 $-65^{\circ}F$ to $+1200^{\circ}F$.

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 inch to 6.00 inch duct size)

1.2.2 Type II Low Profile
Per MS24563 Figure 1 (1.00 inch to 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 Flanges, V-Band, Profile Deminsions For

2.2.2 Industry

2.2.2.1 Society of Automotive Engineers

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 Section 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.

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 Figure 2A for Type I and MS24563 Figure 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 intermatable.

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°F 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.

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. Nonstabalized 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 PSI and passivate per the AS standard. Bolt threads shall conform to MIL-S-8879, and shall be lubricated using an anti-sieze 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 lbs. The material shall be as specified on the applicable drawing. The nut shall have a minimum life of fifteen (15) complete full on-off cycles without damage to the bolt or nut or threads.

3.3.8 Safety Latch - The coupling shall have a safety latch as shown on AS Drawing AS1895/1 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

3.3.8 (continued)

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°F 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 (.000765 lbs. 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 paragraph 3.5.1 when subjected to the pressures of Table IV Paragraph 4.5.1 and Figure 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 AIR869, see Figure 8, specified in Table II wihout exceeding the leakage requirement of 3.5.1 with respect to the following relationship: $N = N_p + N_b + N_a$.

LIMIT LOAD @ ROOM TEMPERATURE
TABLE II

TUBE OD IN INCHES	STANDARD PROFILE TYPE I			LOW PROFILE TYPE II		
	N LBS/IN	OPERATING PRESSURE PSIG ⚠1	BENDING MOMENT IN IN-LBS ⚠2	N LBS/IN	OPERATING PRESSURE PSIG ⚠1	BENDING MOMENT IN-LBS ⚠2
1.00	-	-	-	559	2,070	1,110
1.25	-	-	-	541	1,630	1,440
1.50	686	1,960	3,310	531	1,350	1,820
1.75	690	1,680	4,020	537	1,180	2,310
2.00	693	1,470	4,800	538	1,040	2,830
2.25	697	1,310	5,670	533	920	3,370
2.50	700	1,180	6,610	526	820	3,940
2.75	694	1,060	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

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 (continued)

⚠1 MAXIMUM OPERATING PRESSURE IS DETERMINED WHEN JOINT IS SUBJECTED TO INTERNAL PRESSURE ONLY AT ROOM TEMERATURE.

⚠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)

N TEMPERATURE CORRECTION FACTOR FOR TYPE I & II JOINTS
TABLE III

TEMPERATURE IN DEGREES F	CORRECTION FACTOR IN % JOINT TUBE OD IN INCHES	
	1.00 - 3.50	4.00 - 6.00
70	100	100
100	97	99
200	89	97
300	84	96
400	79	95
500	76	94
600	73	93
700	71	92
800	70	91
900	68	90
1,000	68	89
1,100	68	87
1,200	68	82

3.5.2.1.1 <u>Pressure</u> - The rated load per inch of circumference due to pressure shall be determined from the following relationship: $N_p = PD_s^2/4D_p$

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 <u>Bending</u> - The rated load per inch of circumference due to bending shall be determined from the following relationship:

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

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 <u>Axial Load</u> - 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.

HYDROSTATIC PROOF PRESSURE EXPANSION VALUES
TABLE IV

PART NUMBER	NOMINAL TUBE SIZE	TEST PRESSURE (PSIG)	COUPLING HALF EXPANSION MAX IN INCHES
AS1895/4-100	1.00	3,950	.007
AS1895/4-125	1.25	3,200	
AS1895/4-150	1.50	2,650	
AS1895/4-175	1.75	2,250	
AS1895/4-200	2.00	2,000	
AS1895/4-225	2.25	1,800	
AS1895/4-250	2.50	1,650	
AS1895/4-275	2.75	1,500	
AS1895/4-300	3.00	1,400	
AS1895/4-325	3.25	1,300	
AS1895/4-350	3.50	1,200	
AS1895/4-400	4.00	1,050	
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	4,100	.017
AS1895/1-175	1.75	3,800	
AS1895/1-200	2.00	3,500	
AS1895/1-225	2.25	3,250	
AS1895/1-250	2.50	3,000	
AS1895/1-275	2.75	2,750	
AS1895/1-300	3.00	2,500	
AS1895/1-325	3.25	2,250	
AS1895/1-350	3.50	2,000	
AS1895/1-400	4.00	1,750	
AS1895/1-450	4.50	1,500	
AS1895/1-500	5.00	1,300	
AS1895/1-550	5.50	1,200	
AS1895/1-600	6.00	1,150	

3.5.2.1.4 <u>Rated Load</u> - Limit (Proof) = 2 times operating load

Ultimate = 3 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 lbs/in. At 600°F N = 702 X .73 = 572 lbs/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 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 .06 SCFM per inch of tube diameter when subjected to 2 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 3 times the operating pressure of Table II for 2 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.

TORSIONAL MOMENT

TABLE V

STANDARD PROFILE TYPE I		LOW PROFILE TYPE II	
TUBE OD IN INCHES	TORSIONAL MOMENT IN INCH-LBS	TUBE OD IN INCHES	TORSIONAL MOMENT IN INCH-LBS
----	---	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

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. 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/or 4.5.7 at the specified pressure of Table VII. Testing per 4.5.6 and/or 4.5.7 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 FSCM No. _____________

Date of Manufacture _____________

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

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 & 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.

4.1.1 (continued)

If 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

QUALIFICATION TEST
TABLE VI

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 Cycling	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 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 exists, this 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 manufacturer will qualify smaller joints of the same type 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 $75^{\circ}F \pm 10^{\circ}F$. Elevated temperature shall be $1200^{\circ}F \pm 10^{\circ}F$. Standard pressure shall be 760mm 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 specification and the appropriate AS drawing with respect to dimensions, weight, material, workmanship, finish, construction, marking and identification of product reported.

4.5 Test Methods

4.5.1 Hydrostatic Pressure - Prior to performing any pneumatic pressure testing, the test joint shall be enclosed in a protective enclosure and hydrostatically pressurized to the test pressure of Table IV and paragraph 3.5.3, 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 Figure 8 shall be measured and recorded. The joint shall be repressurized to the values in Table IV and the expansion as shown in Figure 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 joint shall be mounted on a test fixture and installed in a temperature chamber as shown in Figure 1. The test joint 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 assembly, shall be measured as leakage through the joint. While at ambient temperature, the test joint shall be slowly pressurized to operating pressure of Table II. After the pressure within the joint has stabilized, the pressure shall be maintained for a period of fifteen (15) minutes. The joint leakage rate shall be monitored and recorded while at operating pressure and ambient temperature.

The internal pressure shall be slowly increased to 2 times the operating pressure of Table II. After the pressure within the joint has stabilized, the proof pressure shall be maintained for a period of fifteen (15) minutes. The joint 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 twenty (20) minutes minimum shall be allowed after the temperature has been reached to assure stablilization of the test joint.

The joint leakage rate shall be monitored and recorded while at the operating pressure of Table II and at elevated temperature. The joint internal pressure shall be slowly increased to 2 times the operating pressure of Table II (corrected per Table III) and maintained at that pressure for a period of fifteen (15) minutes. The joint 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 joint shall meet the requirements of 3.5.3.1 and 3.5.3.2.

4.5.3 Torsional Moment - The test joint 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 joint shall be placed in the holding fixture as shown in Figure 2. One end of the joint shall be rigidly clamped to prevent rotation. The other end of the joint shall be free to rotate in the holding fixture and only secure enough to prevent the introduction of excessive bending moment. The test joint 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 joint 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 zero inch-pounds to the value noted in Table V shall be slowly applied to one end of the test joint. The joint 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 joint 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 joint pressurized at operating pressure of Table II. The test joint shall be subjected to sinusoidal vibration with the frequency varying between 5 Hz and 2000 Hz. The rate of change of frequency shall be approximately logarithmic and shall be such that a complete cycle (5 Hz to 2000 Hz to 5 Hz) will consume approximately fifteen (15) minutes. The test amplitude shall be that given by Curve II of Figure 4. The joint 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 joint shall be installed as in 4.5.4 and shall be subjected to sinusoidal vibration with the frequency varying between 5 Hz and 2000 Hz. The rate of change of frequency shall be approximately logarithmic and shall be such that a complete cycle (5 Hz - 2000 Hz - 5 Hz) will consume approximately fifteen (15) minutes. The test amplitude shall be that given by Curve 1, Figure 4. The test shall continue for a minimum of sixty (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 Hz and 2000 Hz. The sweep shall be held at the resonant frequency while oscillating for ten (10) minutes. If no resonant frequency is found, the dwell shall occur at 2000 Hz for ten (10) minutes. Upon completion of test along each axis, the joint components shall be visually examined for any mechanical failures, excessive wear or loosened parts. The joint condition shall be noted.

4.5.5 Pressure Cycle - The test joint shall be set up and installed as shown in Figure 5. While at ambient temperature, the test joint 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 joint assembly, but shall not exceed 25 cycles per minute.

The joint 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 joint 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 chamber temperature shall be raised to 1200°F and held until stabilization. After stabilization, while at 1200°F, the test assembly 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.

The joint temperature shall be monitored constantly during the elevated temperature pressure cycle test. If the joint temperature drops more than 100°F below the 1200°F at any time during this portion of the test, the cycling shall be stopped and the temperature restabilized. The joint 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 joint 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 joint shall meet the requirements of 3.5.6.

4.5.6 Flexure Cycling - The joint 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 VII.

FLEXURE CYCLING
TABLE VII

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

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

This flexure cycle test shall be continued for a total of 6000 cycles with the joint internal pressure maintained at operating pressure of Table II and at ambient temperature. The leakage rate and test joint pressure shall be monitored frequently throughout the ambient flexure cycle test to assure joint integrity. The joint 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 joint 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, Paragraph 4.5.6.1 shall be repeated for an additional 6000 cycles. The joint 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 cell pressure maintained at operating pressure of Table II, the cyclic bending moment shall be slowly increased to 1050 inch-pounds and flexure cycled for a total of 500 cycles. One flexure cycle is defined as zero inch-pounds, plus 1050 inch-pounds, zero inch-pounds, minus 1050 inch-pounds, zero inch-pounds. After completion of the ambient temperature flexure cycle tests (steps 1, 2 and 3), the joint 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 joint, the test joint shall be reinstalled in the temperature chamber with the coupling bolt positioned as shown in Figure 6, Position A. The test joint shall be pressurized to operating pressure of Table II (corrected per Table III) and the chamber temperature control adjusted to maintain 1200°F until stabilization. A cyclic bending moment load of ±500 inch-pounds shall be applied to the test cell. This flexure cycle test shall be continued for 6000 cycles with

4.5.6.4 (continued)

the joint internal pressure maintained at the corrected operating pressure and at 1200°F temperature. The leakage rate, the internal pressure readings and chamber temperature shall be monitored frequently throughout the elevated temperature flexure cycle test to assure joint integrity. The joint leakage rate shall be recorded prior to the first flexure cycle and every 1000 cycles through 6000 cycles.

4.5.6.5 Flexure Cycling Step 5 - After completion of the flexure cycle test step 4, the test joint 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 joint internal pressure maintained at the corrected operating pressure of Table II and at 1200°F temperature. The joint 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 joint pressure maintained at the corrected operating pressure of Table II and the chamber temperature maintained at 1200°F, the cyclic bending moment shall slowly be increased to 1050 inch-pounds and flexure cycled for a total of 500 cycles. (One flexure cycle = zero inch-pounds plus 1050 inch-pounds, zero inch pounds minus 1050 inch-pounds, zero inch-pounds.) The leakage rate, the test joint pressure and chamber temperature shall be monitored frequently during the 500 cycles to assure joint integrity. The leakage rate shall be recorded at the end of 500 cycles. After completion of the elevated temperatures flexure cycle test, the joint 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 joint 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 joint shall be mounted on a test fixture as shown in Figure 6, Position A, and Figure 7. The joint temperature shall be stabilized 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 joint. One flexure cycle is defined as zero inch pounds, plus maximum bending moment, zero inch-pounds, minus maximum bending moment, plus zero-inch-pounds. 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 joint internal pressure maintained at test pressure of Table VIII and at elevated temperature. The leakage rate and test joint pressure shall be monitored frequently throughout the flexure cycle test to assure joint integrity. The joint leakage rate shall be recorded prior to the first flexure cycle and every 20,000 cycle intervals 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 joint 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. While at 1200°F and at the test pressure of Table VIII the test per Paragraph 4.5.7.1 shall be repeated for an additional 100,000 cycles. The joint leakage rate shall be recorded prior to the first flexure cycle and every 20,000 cycle intervals through 100,000 cycles.

Flexure Cycling (Alternate Test)
Table VIII

	SPECIMEN TUBE SIZE	NO. OF CYCLES POSITION A	POSITION B	BENDING MOMENT (IN-LBS)	TEST PRESSURE (PSIG)
STANDARD PROFILE	150	100,000	100,000	1,092	500
	175	100,000	100,000	1,095	500
	200	100,000	100,000	1,179	500
	225	100,000	100,000	1,408	500
	250	100,000	100,000	1,427	500
	275	100,000	100,000	1,345	500
	300	100,000	100,000	1,270	500
	325	100,000	100,000	1,083	500
	350	100,000	100,000	812	500
	400	100,000	100,000	6,709	350
	450	100,000	100,000	6,992	350
	500	100,000	100,000	7,694	350
	550	100,000	100,000	7,995	350
	600	100,000	100,000	7,619	350
LOW PROFILE	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	1,073	300
	250	100,000	100,000	1,132	300
	275	100,000	100,000	1,115	300
	300	100,000	100,000	1.156	300
	325	100,000	100,000	1,137	300
	350	100,000	100,000	1,039	300
	400	100,000	100,000	5,170	200
	450	100,000	100,000	6,071	200
	500	100,000	100,000	6,662	200
	550	100,000	100,000	7,164	200
	600	100,000	100,000	7,734	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. The coupling shall then be installed and pressurized to operating pressure of Table II, Paragraph 3.5.3.1. The joint shall meet the requirements of Paragraph 3.3.1.1.

4.5.9 Safety Latch Evaluation - The coupling joint shall be engaged using the bolt or a device simulating the bolt. The coupling shall be rigged to the full torque condition. The joint 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 each cycle as required. The joint 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 & 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 requirements of 3.3.7.

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

4.5.12 Burst Pressure - The test joint (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 3 times the operating pressure of Table II. Burst pressure shall be held for 2 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 joint 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, environmenetal protection and other pneumatic systems. Operating temperature range for the joint is -65°F to +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 be exceeded.

6.3.2 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.

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

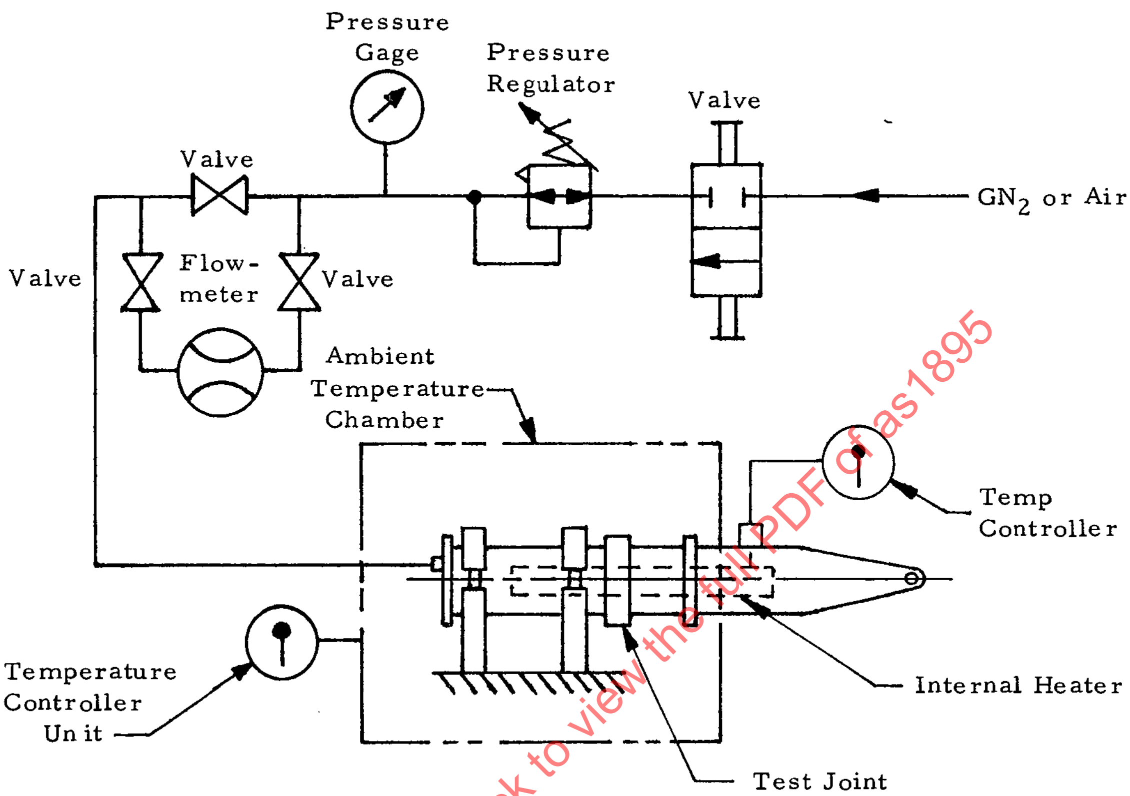

FIGURE 1

Schematic Diagram of Static Pressure Test Set-up

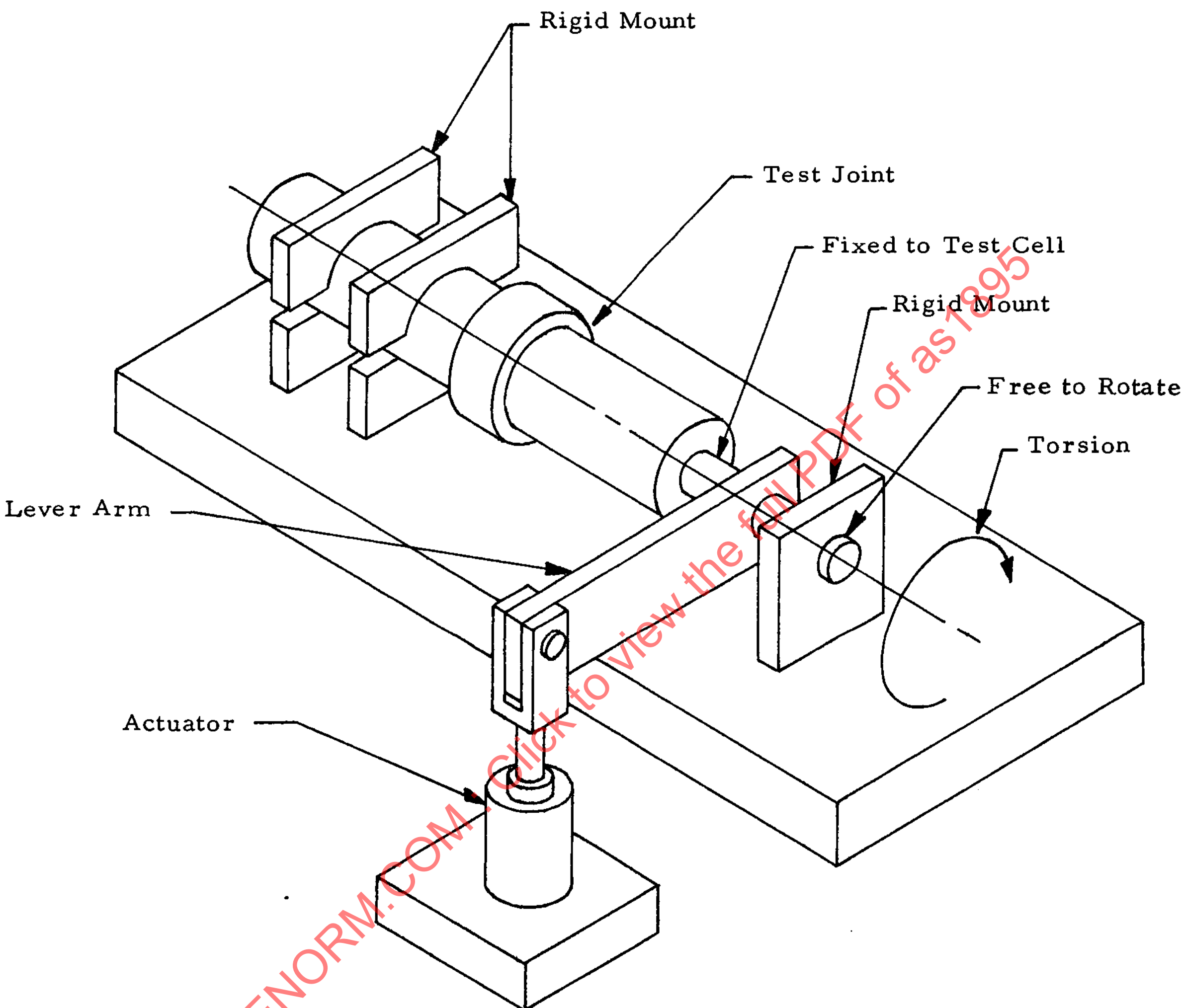

FIGURE 2

Schematic Diagram of Torsion Test Set-Up