AEROSPACE STANDARD

AS4251™	REV. A

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Superseding AS4251

Coupling Assemblies, Non-Locking Probe Style, Self-Aligning, Self-Sealing Disconnects

RATIONALE

This technical report is being stabilized because it covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

STABILIZED NOTICE

This document has been declared “STABILIZED” by SAE G-3, Aerospace Couplings, Fittings, Hose, Tubing Assemblies Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE:

This specification establishes the requirements for a probe type self-sealing, self-aligning, non-locking coupling intended for aerospace hydraulic and cooling systems.

1.1 Classification:

Fluid self-sealing disconnect couplings shall be of the following classes:

Class 500: 500 lbf/in^2 rated pressure (psi)
Class 4000: 4000 lbf/in^2 rated pressure (psi)

2. APPLICABLE DOCUMENTS:

2.1 Issues of Documents:

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

2.1.1 Military Specifications:

MIL-H-5440	Hydraulic Systems: Design, Installation and Test of Aircraft, General Specification for
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft and Ordnance
MIL-H-8775	Hydraulic System Components, Aircraft and Missile, General Specification for
MIL-H-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-P-83461	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance at 275 deg F
MIL-R-8791	Retainer, Packing, Hydraulic and Pneumatic, Tetrafluoroethylene Resin
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Markings of U.S. Military Property
MIL-STD-810	Environmental Test Methods

2.2 Other Publications:

2.2.1 Society of Automotive Engineers (SAE):

AIR1047B	A Guide for the Selection of Quick-Disconnect Couplings for Aerospace Fluid Systems
ARP24B	Determination of Hydraulic Pressure Drop
ARP1383	Impulse Testing of Hydraulic Actuators, Valves, Pressure Containers and Similar Fluid System Components

3. REQUIREMENTS:

3.1 Qualification:

The couplings furnished under this specification shall be a product which has been tested, and has passed the qualification tests specified herein, and has been approved by the Procuring Agency or Prime Contractor.

3.2 General Specification:

The requirements of MIL-H-8775 apply to this specification except as specified herein.

3.3 Materials:

The coupling shall be constructed of materials that will not change the composition of or be adversely affected by specified fluids. Materials, processes and parts shall meet the design requirements and intent of MIL-H-8775 for Classes 500 and 4000, fluids and material compatibility tests shall be conducted by the supplier to demonstrate the satisfactory performance of the couplings.

3.4 Design and Construction:

The configuration, dimensions, and other details of design of the couplings shall conform to applicable Specification Control Drawings. The design objective shall be to obtain the envelope dimensions per Table IV herein and lightest weight commensurate with meeting performance requirements herein. The misalignment provision in the nipple half shall be ±0.020 in radial; angular misalignment shall be specified by the Procuring Agency. When coupled, the coupling shall be such that it will permit fluid flow in either direction in accordance with the rated flow and pressure drop as specified in Table I. Flow shall not be blocked under surge conditions. (Reference Table IV for Envelope Dimensions).

A thermal relief valve shall be incorporated as an optional design feature, if specified by the Procuring Agency.

TABLE I - Rated Flow and Pressure Drop

Dash No.	Equivalent OD Tube Size in Inches	Rated Flow GPM	Maximum Pressure Drop lbf/in^2 Rated Flow	Surge Flow GPM
-04	1/4	1.2	8	6.0
-06	3/8	3.5	8	17.5
-08	1/2	6.0	8	30.0
-10	5/8	10.5	8	52.5
-12	3/4	16.0	8	80.0

3.4.1 Temperature Range: Couplings shall be designed to operate throughout the temperature range specified by 3.6.3.

3.4.2 Sealing and Fluid Loss: The couplings shall, when disconnected, seal the ends of the disconnected lines at the point of disconnection and shall not permit external leakage during any phase of connection or disconnection. Fluid loss (spillage) as specified in Table II is not considered to be external leakage. Both halves of the coupling shall seal fluid under both low and high pressures (see 4.6.4).

TABLE II - Air Inclusion and Fluid Loss

Dash No.	Equivalent OD Tube Size in Inches	Air Inclusion Standard Cubic Centimeters Maximum	Average Fluid Loss (Spillage)/Operating Cycle, Cubic Centimeters Maximum
-04	1/4	0.10	0.05
-06	3/8	0.20	0.10
-08	1/2	0.40	0.20
-10	5/8	0.60	0.30
-12	3/4	1.00	0.50

3.4.3 Seals: The MIL-P-83461 Packing Material and MIL-R-8791 Retainer Material shall be used with MIL-H-5606, or MIL-H-83282 Hydraulic Fluid. Packing and retainer material for other fluids shall be specified by the Procuring Agency. However, the supplier shall demonstrate that the performance of the coupling is satisfactory with the packing and retainer materials used.

3.4.4 Operation: The couplings shall be so designed that they can be connected and disconnected while mounted in their respective manifolds or fixtures. It shall be possible to connect and disconnect with an internal pressure, as shown in Table III, applied to both halves and to each one-half respectively (see 4.6.10).

TABLE III - Coupling Forces and Separating Force With the Pressure Indicated in Both Halves

Dash Number	Internal Pressure lbf/in^2 (gage)	Axial Coupling Force in Pounds	Maximum Separating Force in Pounds	
			500 lbf/in^2 (gage) Internal Pressure	4000 lbf/in^2 (gage) Internal Pressure
-04	60	30	80	350
-06	60	35	110	385
-08	60	40	160	1100
-10	60	45	185	1540
-12	60	55	275	2420

TABLE IV - Envelope Dimensions

NOMINAL BODY SIZE IN	DIMENSIONS IN INCHES (MILLIMETERS)						
	A MAX	B MAX	C	D MAX	E MAX	F MAX	G
1/4	0.25	0.885	0.57	1.135	0.875	0.735	0.480
	(6.35)	(22.2)	(14.5)	(28.8)	(22.2)	(18.7)	(12.2)
3/8	0.25	1.000	0.59	1.320	1.200	0.990	0.610
	(6.35)	(24.4)	(15.0)	(33.6)	(30.5)	(25.10)	(15.5)
1/2	0.25	1.070	0.62	1.590	1.375	1.175	0.750
	(6.35)	(27.2)	(15.7)	(40.4)	(34.9)	(29.8)	(19.1)
5/8	TBD	-	-	-	-	-	-
3/4	TBD	-	-	-	-	-	-

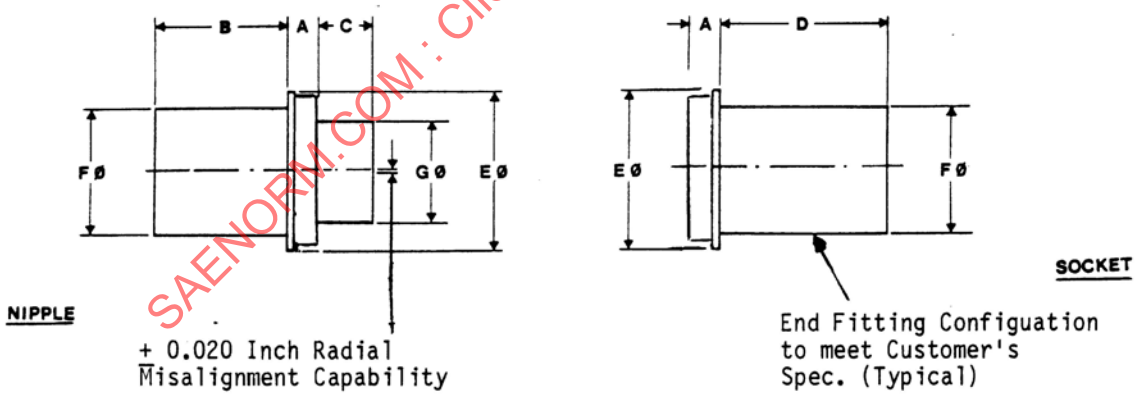

Figure For
Envelope Dimensions

3.5 Interchangeability:

It shall be impossible to interconnect different tube sizes and couplings of different pressure classes shall not be capable of cross-coupling. Coupling halves of the same part number shall be interchangeable and cross-couple all referenced mating halves.

3.6 Performance:

The self-sealing couplings furnished under this specification shall perform satisfactorily when conforming to the following performance requirements.

3.6.1 Envelope, Weight, Materials: Each coupling half must conform to the applicable purchaser and supplier envelope dimensions, weight control, materials, and finishes. Table IV is provided with some envelope dimension guidelines.

3.6.2 Proof Pressure: Each coupling half must meet operational and leakage requirements after being subjected to proof pressure of 150% of rated pressure for a period of 1 min (see 4.6.2).

3.6.3 Extreme Temperature Functioning: Each coupling half shall show no malfunction during or after being subjected to extreme temperature testing from -65 to 275 °F unless otherwise specified (see 4.6.3).

3.6.4 Leakage: Coupling halves shall meet specified leakage requirements at 30 in static head of test fluid and at rated pressure (see 4.6.4).

3.6.5 Vacuum: The connected and disconnected coupling shall meet inward leakage requirements with no evidence of malfunction or degradation, with equivalent of 10 in of Hg applied and lines closed for 5 min (see 4.6.5).

3.6.6 Surge Flow: Coupling halves shall meet leakage, operational and pressure drop requirements after being subjected to a surge flow of five times the rated flow in each direction (see 4.6.6) as specified in Table I.

3.6.7 Vibration: Unless otherwise specified, the connected and disconnected coupling must be capable of withstanding the vibration environment specified without experiencing any malfunction or degradation. Couplings shall be pressurized with 15 lbf/in^2 (gage) pressure (see 4.6.7). The level of vibration shall be per Fig. 2 and the test set-up per Fig. 1.

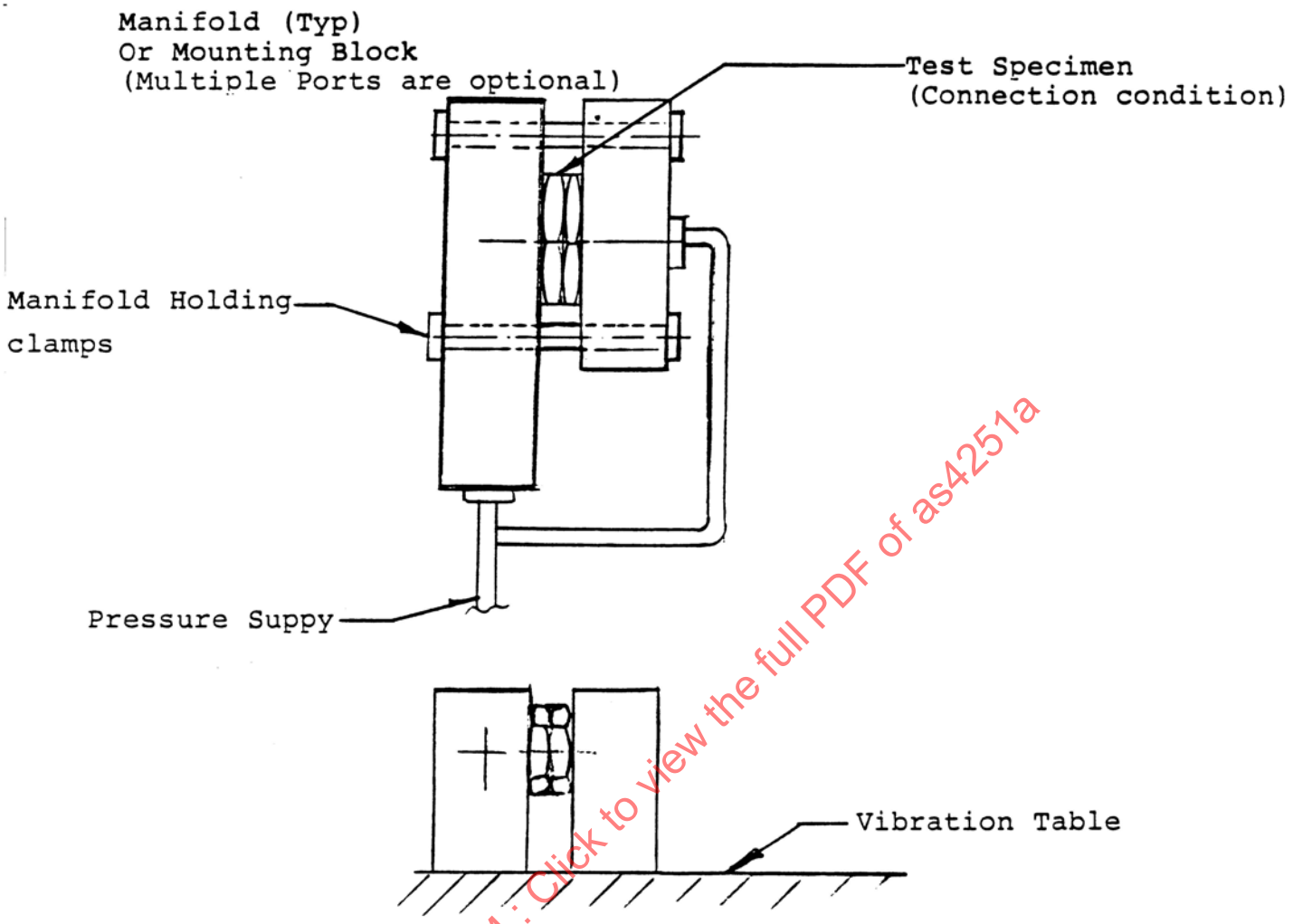

FIGURE 1 - Set-up for Vibration Test

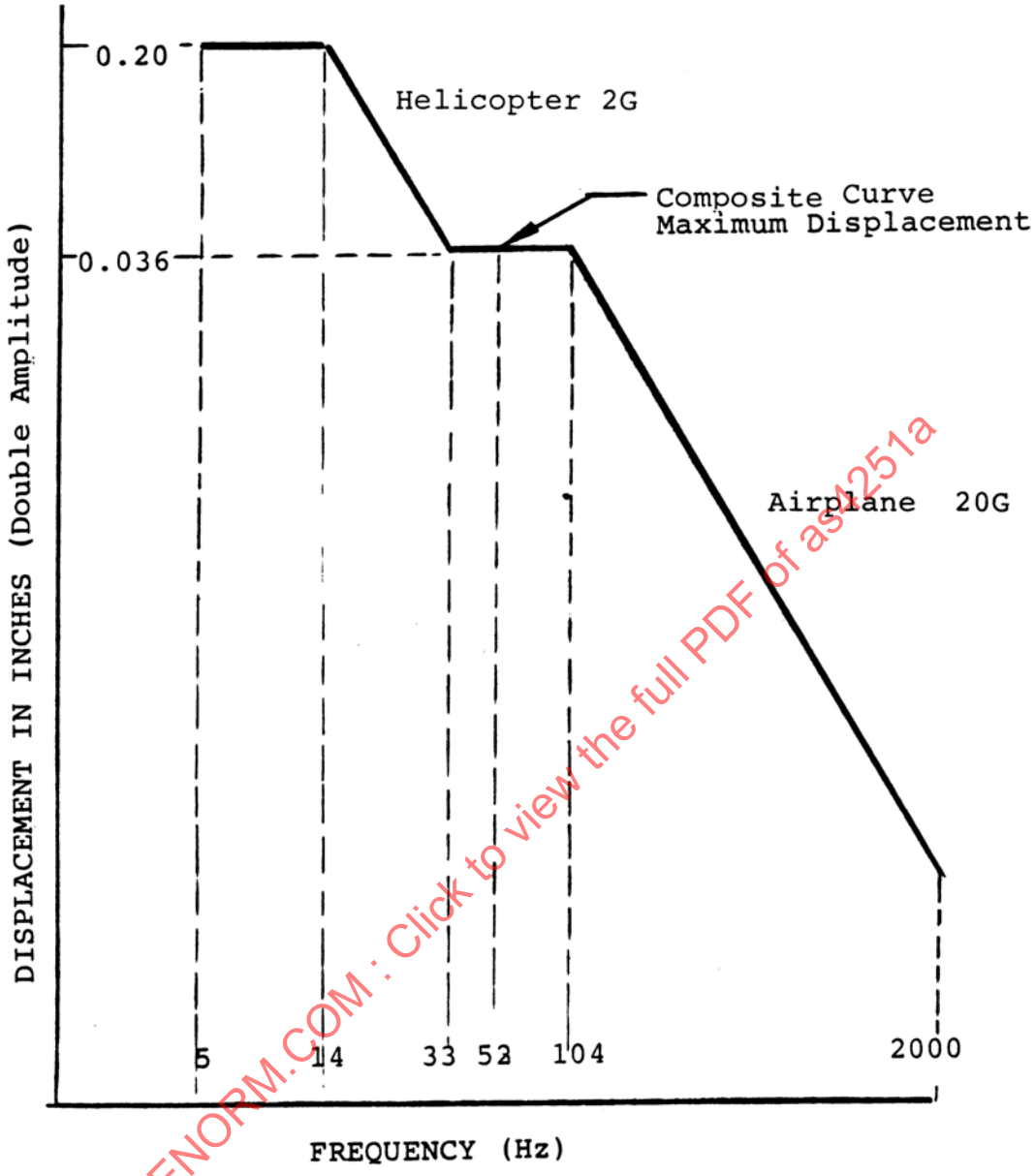

FIGURE 2 - Composite Vibration Test Curve for Equipment Mounted on Helicopters or Airplanes

3.6.8 Impulse: Coupled assemblies shall be capable of withstanding the impulse testing specified per ARP1383 without any indication of malfunction. Pressures, rate of rise and impulse form parameters shall be per Table V and Fig. 3 (see 4.6.8).

TABLE V - Impulse Test

	CLASS 500	CLASS 4000
1. Rated Pressure, Pr	500	4000
2. Peak pressure, +5%	750	6000
3. Temperature (both classes)	at 275°F	62 500 minimum cycles
	at 225°F	187 500 minimum cycles
4. Cycle Rate (CPM)	70 + 10	70 + 10
5. Minimum Rate of Rise lbf/in^2/s:	1800	15 000
Maximum Rate of Rise lbf/in^2/s:	5200	41 000
6. Number of Cycles	250 000	250 000

Trace of Pressure Impulse Cycle (Per ARP1383)

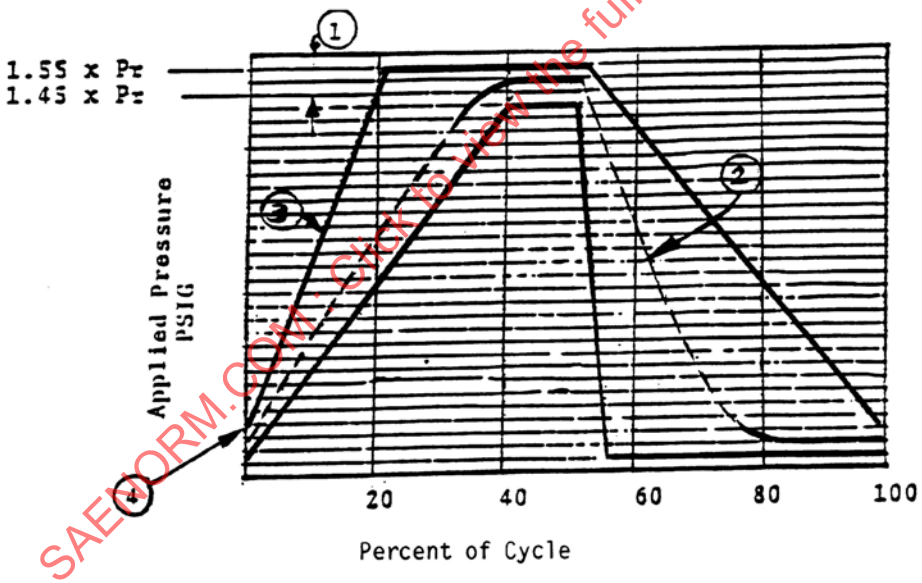

FIGURE 3 - Impulse Test

LEGEND:

1. Peak Pressure shall be within this pressure range, 10 - 25% of cycle.
2. Desired wave form.
3. Pressure rise rate.
4. 50 - 150 lbf/in^2 (gage) back pressure Pr = Rated Pressure

3.6.9 Endurance: Each coupling half shall be capable of withstanding 1000 endurance cycles without any evidence of malfunction or serious degradation, with 15 lbf/in^2 (gage) internal pressure applied to each half (see 4.6.9).

3.6.10 Operation and Separating Force: Coupling halves shall be capable of being tested in accordance with specified requirements with no evidence of malfunction, leakage or spillage beyond the specified limits of Tables II and III (see 4.6.10).

NOTE: Both coupling halves shall be installed in systems capable of accommodating some fluid displacement without pressure rise.

3.6.11 Air Inclusion: The air inclusion for all coupling halves shall be within specified limits per Table II and at 30 in of internal fluid pressure applied (see 4.6.11).

3.6.12 Impact: Unless otherwise specified by the Procuring Agency, connected assemblies shall withstand a 20 g impact test without evidence of damage. Evidence of leakage or malfunction after the test is not permitted (see 4.6.12).

3.6.13 Pressure Drop: Each coupling shall indicate a pressure drop within the limits specified in Table I. The fluid temperature shall be 100 ± 10 °F and test set-up shall be as shown in Fig. 4 (see 4.6.13).

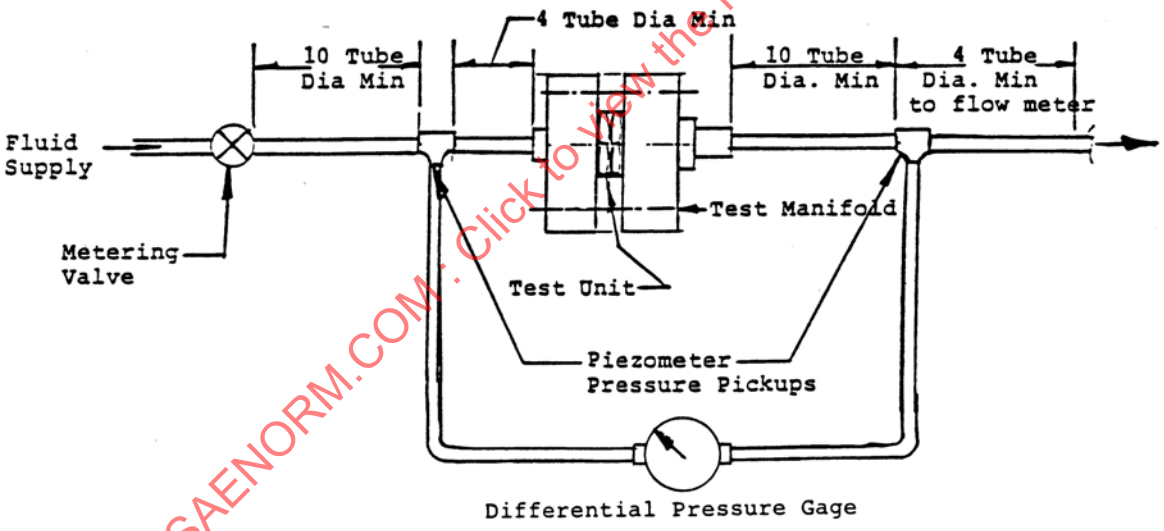

FIGURE 4 - Set-up for Pressure Drop Test (Reference ARP24)

3.6.14 Burst Test: Coupling halves shall be capable of withstanding 250% of rated pressure at 275 °F temperature without fluid loss or rupture (see 4.6.14).

3.7 Identification of Product:

The coupling shall be marked for identification in accordance with MIL-STD-130. In addition, each coupling shall be permanently marked with the customer (NSN, MS, Purchaser Assigned) part number, manufacturer's part number and the manufacturer's name or code identification number. When available surface area precludes complete identification, a tag may be attached.

3.8 Workmanship:

Workmanship shall be of the quality necessary to produce couplings free from all defects that would affect proper functioning in service.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Inspection Responsibility:

The supplier is responsible for the performance of all inspection requirements as specified. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Procuring Agency. Inspection records of the examination and tests shall be kept complete and available to the Procuring Agency as specified in the contract or order. The government or Procuring Agency, or both, reserve the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure suppliers and services conform to prescribed requirements.

4.2 Classification of Tests:

The tests shall consist of qualification tests and acceptance tests (see 4.3 and 4.4 respectively).

4.3 Qualification Tests:

The qualification tests shall consist of the following tests and shall be conducted in the following order. All tests are described under 4.6. Unless otherwise specified, one test sample of each size shall be subjected to all indicated tests. Test samples shall be typical production units.

(a) Examination of Product	(4.6.1)
(b) Proof Pressure	(4.6.2)
(c) Extreme Temperature Functioning	(4.6.3)
(d) Leakage	(4.6.4)
(e) Vacuum	(4.6.5)
(f) Surge Flow	(4.6.6)
(g) Vibration	(4.6.7)
(h) Impulse	(4.6.8)
(i) Endurance	(4.6.9)
(j) Operating and Separating Force	(4.6.10)
(k) Air Inclusion	(4.6.11)
(l) Impact	(4.6.12)
(m) Pressure Drop	(4.6.13)
(n) Burst Pressure	(4.6.14)

4.4 Acceptance Tests:

The acceptance tests shall consist of the following tests. All tests are described under 4.7.

(a) Examination of Product	(4.7.1)
(b) Proof Pressure	(4.7.2)
(c) Leakage	(4.7.3)
(d) Operation	(4.7.4)
(e) Cleanliness Verification	(4.7.5)

4.5 Test Conditions:

4.5.1 Test Fluid: Unless otherwise specified, the fluid for qualification testing for Class 4000 couplings shall be either per MIL-H-5606 or MIL-H-83282; other fluids may be specified by the Procuring Agency, if required. The fluid for Class 500 couplings shall be specified by the Procuring Agency.

4.5.2 Temperature: Except where otherwise specified, the tests of this specification shall be conducted at a room temperature of 70 - 90 °F and with a fluid temperature of 70 - 110 °F, as measured within 12 in of the test sample. The actual temperature of the fluid during the tests shall be recorded in the test reports.

4.5.3 Immersion: The couplings shall be immersed continuously in the specified fluid for a period of 72 h at a maximum specified temperature prior to conducting the qualification test (see 4.3). All internal parts of the coupling shall be in contact with the fluid during this immersion. After the 72 h soak period, the coupling shall be subjected to the next test immediately or remain in the fluid at normal room temperature until such test. Temperature range for the couplings shall be determined by the Procuring Agency.

4.6 Test Methods:

4.6.1 Examination of Product: Visually inspect the unit to verify good workmanship and correct markings. Physically measure and record all dimensions noted on applicable assembly drawings to verify correct configuration, envelope mounting requirements, interface dimensions and applicable dimensional tolerances. Record dry weight. Visually check finish and material usage. For acceptance tests only, dimensions are not required to be recorded, and weight is only required on a sampling basis.

4.6.2 Proof Pressure: The connected coupling and the disconnected halves shall be subjected to a proof pressure of 150% of the rated pressure for a period of 1 min at room temperature. There shall be no leakage greater than specified, nor any permanent distortion or other malfunctioning of the coupling. The coupling shall couple and uncouple normally and seal hydraulic fluid as required after being subjected to this test. This test shall be repeated after all other tests required have been accomplished but just prior to the burst pressure test (see 4.6.14). This repeat test shall be conducted at 275 ± 5 °F for a duration of 5 min for qualification tests.

4.6.3 Extreme Temperature Functioning: The couplings shall withstand the following tests without malfunctioning or leakage in excess of the values specified (see 4.6.4).

4.6.3.1 High Temperature: After immersion (see 4.5.3) but before being uncoupled, the coupling shall be connected to a 30-in static head of test fluid and subjected to a maximum temperature specified for a period of 6 hours. There shall be no measurable leakage from the connected coupling during the 6-h period. At the end of this time, the coupling shall be cooled to 140 ± 5 °F and at least five cycles of coupling and uncoupling shall be completed. There shall be no binding during any cycle of disconnection and connection. The temperature of the uncoupled halves shall be raised to 225 ± 5 °F and shall be subjected to the leakage at low pressure test and then at high pressure test (see 4.6.4).

4.6.3.2 Low Temperature: After completion of the high temperature tests (see 4.6.3.1), the couplings shall be connected to a 30-in static head of test fluid, and subjected to a minimum temperature specified for a period of 4 h after stabilization. There shall be no measurable leakage from the connected coupling during this period. At the end of this period, at least five cycles of coupling and uncoupling shall be completed. There shall be no binding during any cycle of disconnection and connection. The uncoupled halves shall be subjected to the leakage at low pressure test and then at high pressure test (see 4.6.4). It will be satisfactory for the temperature to rise to -40 °F during this process.

4.6.3.3 Rapid Warm-up: The connected coupling, while attached to a 30-in static head of test fluid, shall be allowed to warm up rapidly from minimum to maximum temperatures specified within a 5-min period and shall be connected and disconnected at least five times during this period without waiting for the fluid, coupling, and ambient air temperature to stabilize. Temperature is to be measured at coupling outer surface. During the coupling and uncoupling process, the coupling shall be observed for any malfunction; there shall be none.

4.6.4 Leakage:

4.6.4.1 Leakage at Low Pressure: The connected coupling and the disconnected halves shall be subject to an internal pressure equal to a head of 30 in of test fluid for 12 minutes. All external surfaces shall be dry at the beginning of this test. There shall be no evidence of any external leakage from the connected coupling. A waiting period of 2 min shall be allowed for the leakage rate to become constant from the disconnected halves. Following this waiting period, leakage shall be measured for the next 10 min and shall not exceed one drop.

4.6.4.2 Leakage at High Pressure: Both the connected coupling and the disconnected halves shall be subjected to a test fluid pressure equal to the applicable rated pressure for 15 minutes. All external surfaces shall be dry at the beginning of this test. There shall be no evidence of any external leakage from the connected coupling. Leakage from the disconnected halves shall not exceed a trace (insufficient to form a drop in 10 min). Fluid loss (spillage), as specified in Table II, is not considered to be external leakage.