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Superseding AS1896	

Coupling Assembly, Self-Sealing, One Side Only, Hydraulic**RATIONALE**

AS1896A has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

This document establishes the requirements for aircraft, hydraulic couplings, self-sealing one side only, for use in Type II hydraulic systems (-65 to +275 °F temperature range) as defined by MIL-H-5440. The purpose being to connect a hose or tube to a standard MS33656, MS33514 or MIL-F-85421, or MIL-F-85720 fitting and to provide the self-sealing feature on the hose or tube side of the connection.

1.1 Product Classification:

Hydraulic self-sealing couplings shall be of the following classes

- a. Class 1000: 1000 lbf/in² (gage)
- b. Class 3000: 3000 lbf/in² (gage)
- c. Class 4000: 4000 lbf/in² (gage)
- d. Class 5000: 5000 lbf/in² (gage)

2. REFERENCES:**2.1 Applicable Documents:**

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

ARP24	Hydraulic Pressure, Determination Of
ARP603	Impulse Testing of Hydraulic Hose Assemblies, Tubing, and Fittings
AS604	Hose Assemblies, Teflon, 400 °F, 3000 psi, Hydraulic, Heavy Braid
AS614	Hose Assemblies, Aircraft and Missiles, High Temperature (450 °F), High Pressure (4000 psig)
ARP868	Pressure Drop Test for Fuel System Components
ARP908	Hose Fitting, Installation and Qualification Test Torque Requirements
AIR1047	A Guide for the Selection of Quick Disconnect Couplings for Fluid Systems

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- 2.1.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-F-85421	Fitting, Tube, Fluid Systems, Separable, Dynamic Beam Seal, General Requirements For
MIL-F-85720	Fitting, Tube, Fluid Systems, Separable, High Pressure, Dynamic Beam Seal, General Requirements For
MIL-H-25579	Hose Assembly, Tetrafluoroethylene, High Temperature, Medium Pressure, General Requirements For
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-83282	Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-H-85800	Hose Assemblies, Polytetrafluoroethylene, Aramid Fiber Reinforced, 5000 and 8000 psi, General Specification For
MIL-H-8775	Hydraulic System Components, Aircraft and Missile, General Specifications For
MIL-P-83461	Packing, Preformed, Petroleum Hydraulic Fluid Resistant, Improved Performance at 275 °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
MS33656	Fitting End, Standard Dimensions for Flared Tube Connection and Gasket Seal
MS33514	Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal

3. TECHNICAL REQUIREMENTS:

3.1 Qualification:

The couplings furnished under this document 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.

- 3.1.1 General Specification: The requirements of MIL-H-8775 apply to this document except as specified herein.

3.2 Materials:

The coupling shall be constructed of materials that will not change the composition of or be adversely affected by hydraulic fluid conforming to MIL-H-5606 or MIL-H-83282. Other materials and fluids can be utilized for similar applications based on Procuring Agency requirements.

3.3 Design and Construction:

The configuration, dimensions, and other details of design of the couplings shall conform to applicable Specification Control Drawings. This shall include mating with MS33656, MS33514, MIL-F-85421, or MIL-H-85720 end fittings as may be specified. The design objective shall be to obtain the smallest size and lightest weight commensurate with meeting performance requirements herein.

3.3.1 Temperature Range: The couplings shall be designed to operate throughout the temperature range of -65 to +275 °F (see 4.4.3).

3.3.2 Sealing, Fluid Loss, and Air Inclusion: The couplings shall, when uncoupled, seal the end of the disconnected line at the point of disconnection. Fluid loss (spillage) as specified in Table 1 and as determined by 4.4.11 is not considered to be external leakage. The coupling containing the valving shall seal under both low and high pressures (see 4.4.4).

TABLE 1 - Air Inclusion and Fluid Loss (see 4.4.11)

Dash No.	Equivalent Tube Size in	Air Inclusion ¹ cm ³	Air Inclusion ¹ in ³	Fluid Loss cm ³	Fluid Loss in ³
-04	0.250	1.64	.10	1.64	.10
-06	0.375	2.46	.15	2.46	.15
-08	0.500	4.10	.25	4.10	.25
-10	0.625	4.92	.30	4.92	.30
-12	0.750	11.47	.70	11.47	.70
-16	1.000	16.39	1.00	16.39	1.00
-20	1.250	36.88	2.25	36.88	2.25
-24	1.500	49.17	3.00	49.17	3.00
-32	2.000	98.34	6.00	98.34	6.00

¹ This value may be exceeded when the dynamic beam seal, separable fittings are used.

3.3.3 Seals: Only MIL-P-83461 packing material and MIL-R-8791 retainer material shall be used with MIL-H-5606 hydraulic fluid. Packing and retainer material for other fluids shall be specified by the Procuring Agency.

3.3.4 Operation: The coupling shall be so designed that it can be uncoupled without special tools (but using standard wrenches), while the fitting is held in a fixed mounting. It shall be possible to couple and uncouple with a static pressure, as shown in Table 2, applied to the coupling assembly. The installation torque, shall not exceed the values shown in Table 2, when completely coupled.

3.3.5 Interchangeability: Couplings of the same part number shall be interchangeable. It shall be impossible to interconnect different tube size fitting ends.

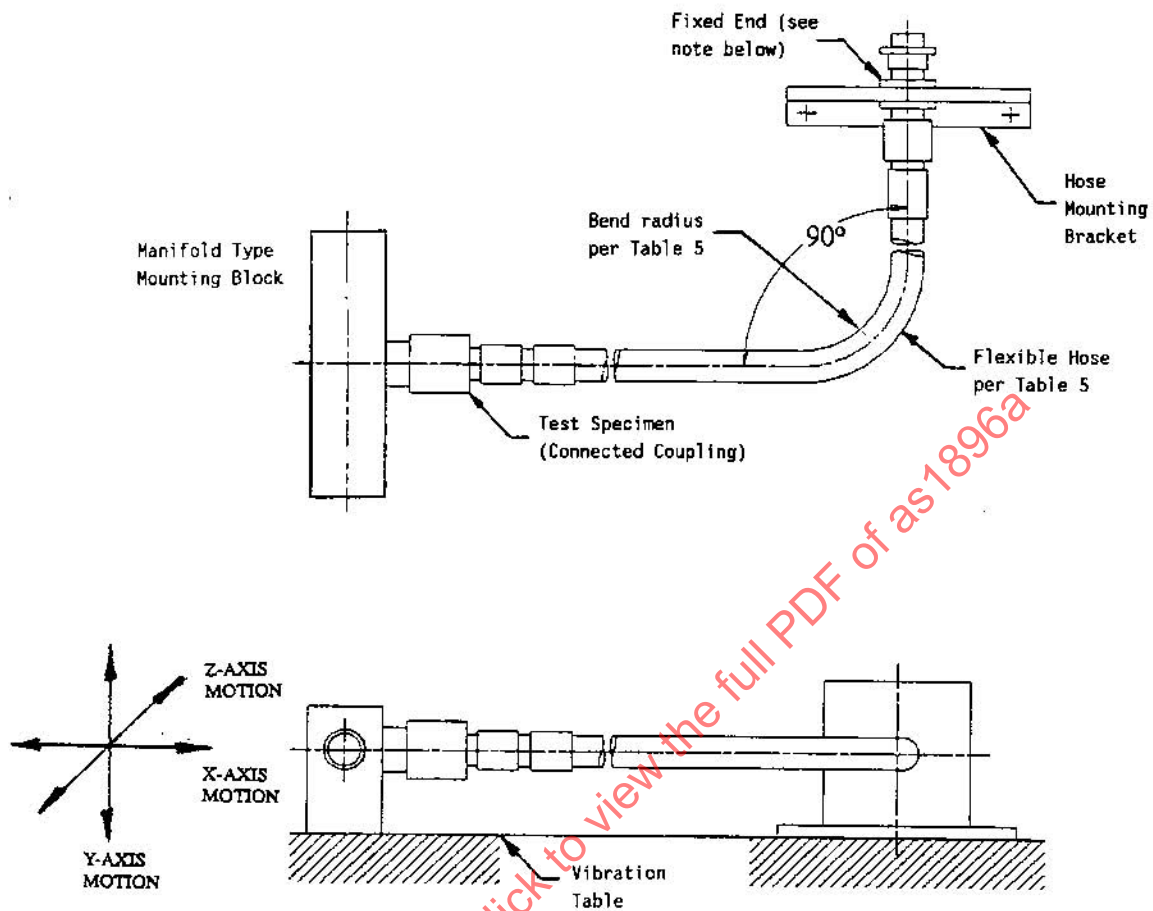
TABLE 2 - Coupling Torque with the Indicated Pressure and Fitting Ends Shown

Dash No.	With Human Engineering Factor		With Human Engineering Factor		MS33356 or MS33514		MS33356 or MS33514		MIL-F-58421 or MIL-F-85720		MIL-F-58421 or MIL-F-85720	
	All Specified Fitting Ends	Static Pressure	All Specified Fitting Ends	Hand Tightening	Maximum Installation Torque in lbf-in	Fitting End	Maximum Installation Torque in lbf-in	Fitting End	Maximum Installation Torque in lbf-in	Fitting End	Maximum Installation Torque in lbf-in	Fitting End
		lb/in ² (gage)		Torque lb-in (Approximate)	per ARP908 CRES Material	Aluminum	per ARP908 CRES Material	Aluminum	per ARP908 CRES Material	Aluminum	per ARP908 CRES Material	Aluminum
-04	100		15	145	65		145	65	168		168	
-06	100		20	245	130		245	130	300		300	
-08	100		25	470	260		470	260	480		480	
-10	100		30	680	360		680	360	660		660	
-12	100		40	945	500		945	500	840		840	
-16	100		50	1280	700		1280	700	1128		1128	
-20	60		60	1680	900		1680	900	1680		1680	
-24	60		70	2100	900		2100	900	1980		1980	
-32	30		80	2940	2000		2940	2000	--		--	

3.4 Performance:

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

- 3.4.1 Envelope, Weight, Materials: Each coupling half shall conform to the applicable purchaser and supplier envelope dimensions, weight control, materials, and finishes.
- 3.4.2 Proof Pressure: Each coupling half must meet operational and leakage requirements after being subjected to proof pressure of 150% operating pressure for a period of 1 min (see 4.4.2).
- 3.4.3 Extreme Temperature Functioning: Each coupling half shall show no malfunction during or after being subjected to extreme temperature testing from -65 to +275 °F (see 4.4.3).
- 3.4.4 Leakage: Coupling halves shall meet specified leakage requirements at 30 in static head of hydraulic fluid and at operating pressure (see 4.4.4).
- 3.4.5 Vacuum: The uncoupled coupling shall be subjected to a vacuum equivalent of 10 in of Hg internally. The vacuum line shall be closed for 5 min. The coupling assembly shall not exhibit a decrease in vacuum level exceeding 0.5 in Hg within a period of 5 min (see 4.4.5).
- 3.4.6 Surge Flow: Coupling shall meet leakage, operational, and pressure drop requirements after being subjected to five times (three times for -16, two times for -20, -24, and -32) the rated flow in each direction (see 4.4.6). The surge flow pattern shall be repeated 100 times.
- 3.4.7 Vibration: Each coupling shall be capable of withstanding the vibration environment specified without experiencing any malfunction or degradation. Couplings shall be pressurized with 15 lbf/in² (gage) pressure (see 4.4.7).
- 3.4.8 Impulse: Coupling halves shall be capable of withstanding the impulse testing specified per ARP603 without any indication of malfunction. Pressures, rate of rise, and impulse form shall be per Table 3 and Figure 3 (see 4.4.8).
- 3.4.9 Endurance: Coupling shall be capable of withstanding 200 endurance cycles without any evidence of malfunction or serious degradation with 15 lbf/in² (gage) pressure applied to the self-sealing half. Size -32 shall have 10 lbf/in² (gage) pressure (see 4.4.9).
- 3.4.10 Manual Operation: The couplings shall be coupled and uncoupled five times for this test. Couplings shall be installed in systems capable of accommodating some fluid displacement without pressure rise. The coupling force/torque and applied pressures shall be per Table 2 (see 4.4.10).
- 3.4.11 Air Inclusion/Fluid Loss: The air inclusion and fluid loss for the coupling shall be within specified limits per Table 1 (see 4.4.11).



NOTE: During impulse testing, this end shall be fixed to allow equivalent length and bend radius shown on Table 5 by clamping either the end fitting or the hose as required. During vibration, both ends are to be mounted to the shaker table.

FIGURE 1 - Setup for Impulse and Vibration Test

TABLE 3 - Impulse Test

	Class 1000	Class 3000	Class 4000	Class 5000
1. Operating Pressure	1 000	3 000	4 000	5 000
2. Peak Pressure $\pm 5\%$	1 500	4 500	6 000	7 500
3. Temperature	25% at 275 °F and 75% at 225 °F			
4. Cycle Rate (cpm)	70 $\pm$ 10			
5. Rate of Rise lbf/in ² (gage)/s	Min	10 000	45 000	60 000
	Max	100 000	300 000	300 000
6. Number of Cycles	100 000	200 000	200 000	200 000

3.4.12 Impact: Connected couplings and coupling halves (disconnected coupling halves with caps and plugs, if required) shall withstand a 20 G impact test without evidence of disconnection. Evidence of leakage or malfunction after the test is not permitted (see 4.4.12). This can be accomplished by 20 G acceleration during the vibration testing per 4.4.7.

3.4.13 Pressure Drop: Each coupling subjected to this test shall have a pressure drop not to exceed those limits specified in Table 4. The fluid temperature shall be 100 °F $\pm$ 10 and test setup shall be as shown in Figure 4 (see 4.4.13).

TABLE 4 - Rated Flow and Pressure Drop

Dash No.	Equivalent Tube Size in	Rated Flow GPM	Surge Flow GPM	Pressure Drop lbf/in ² (gage) (Max)
-04	0.250	1.2	6.0	8
-06	0.375	3.5	17.5	8
-08	0.500	6.0	30.0	8
-10	0.625	10.5	51.5	8
-12	0.750	16.0	80.0	8
-16	1.000	29.0	87.0	8
-20	1.250	45.0	90.0	4
-24	1.500	60.0	120.0	4
-32	2.000	100.0	200.0	4

3.4.14 Burst Test: Coupling shall be capable of withstanding 250% of operating pressure without fluid loss or rupture (see 4.4.14). The connected couplings shall be tested at 275 °F and disconnected couplings shall be tested at the room ambient condition only.

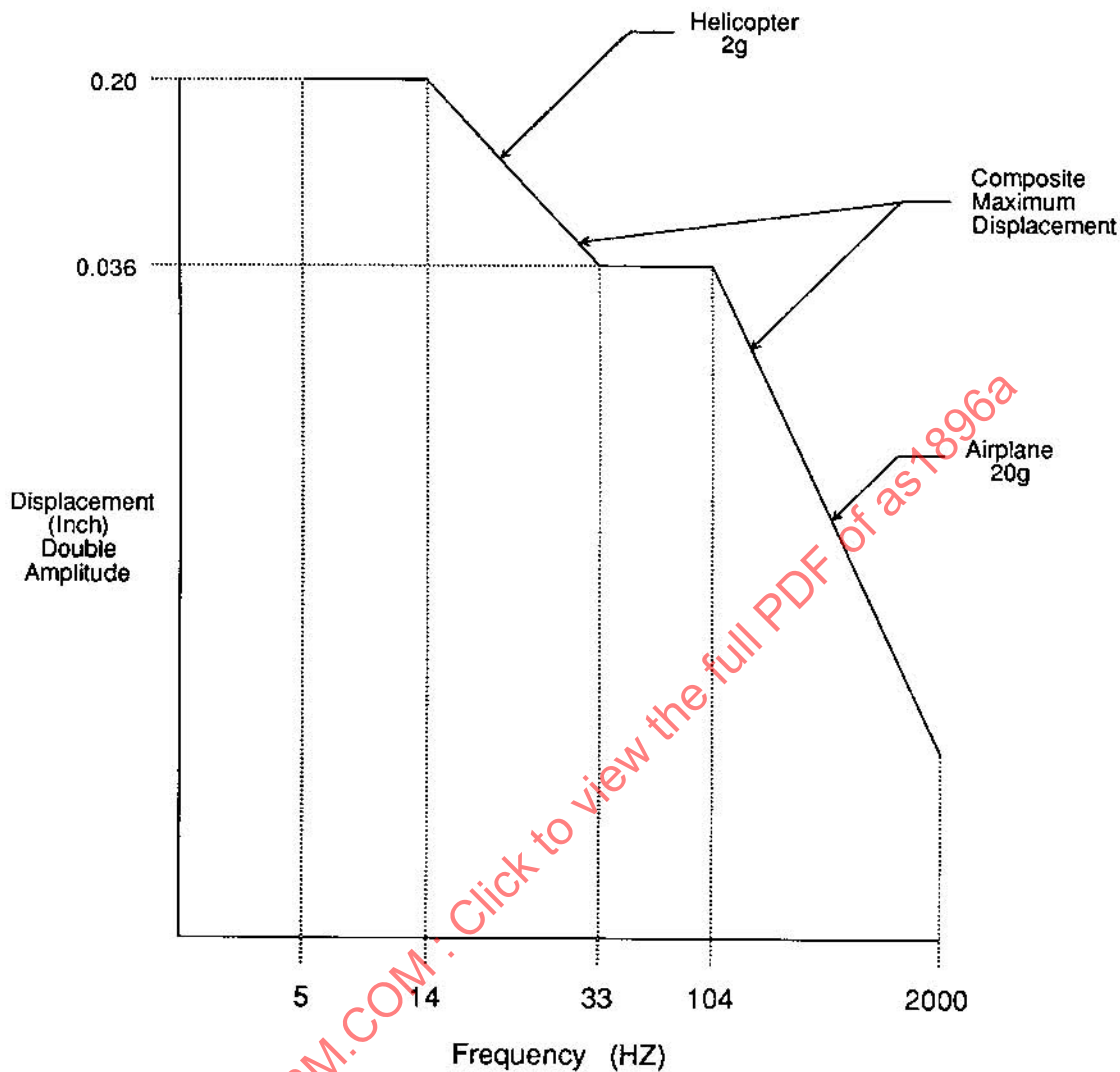


FIGURE 2 - Composite Vibration Test Curve for Equipment Mounted on Helicopters or Airplane Engines

3.5 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. Class number (or operating pressure) shall be part of product identification. When available surface area precludes complete identification, a tag may be attached.

3.6 Workmanship:

Workmanship shall be of the quality necessary to produce couplings free from all defects, which would affect proper functioning in service and be equal to or better than qualification test units.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Inspection Responsibility:

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

4.2 Classification of Tests:

The tests shall consist of qualification tests and acceptance tests.

4.2.1 Qualification Tests: The qualification tests shall consist of the following tests and shall be conducted in the following order. All tests are described under 4.4. 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: 4.4.1
- b. Immersion: 4.4.1.1
- c. Proof pressure: 4.4.2
- d. Extreme temperature functioning: 4.4.3
- e. Leakage: 4.4.4
- f. Vacuum: 4.4.5
- g. Surge flow: 4.4.6
- h. Vibration: 4.4.7
- i. Impulse: 4.4.8
- j. Endurance: 4.4.9
- k. Manual operation: 4.4.10
- l. Air inclusion and fluid loss: 4.4.11
- m. Impact: 4.4.12
- n. Pressure drop: 4.4.13
- o. Burst pressure: 4.4.14

4.2.2 Acceptance Tests: The acceptance tests shall consist of the following tests. All tests are described under 4.4.

- a. Examination of product: 4.4.1
- b. Proof pressure: 4.4.2
- c. Leakage: 4.4.4
- d. Manual operation: 4.4.10

4.3 Test Conditions:

4.3.1 Test Fluid: Unless otherwise specified, MIL-H-5606 shall be used for all qualification testing. Other fluids may be specified by the Procuring Agency, if required, for systems compatibility.

4.3.2 Temperatures: Except where otherwise specified, the tests of this document shall be conducted at a room temperature of 70 to 90 °F and with a fluid temperature of 70 to 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.

4.4 Test Methods:

4.4.1 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.

4.4.1.1 Immersion: After examination of product (4.4.1) is complete, all couplings shall be immersed continuously in hydraulic fluid for a period of 72 h at a fluid temperature of $275\text{ }^{\circ}\text{F} \pm 5$, prior to conducting the qualification tests (see 4.2.1) specified herein. 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.

4.4.2 Proof Pressures: The couplings shall be subjected to a proof pressure of 150% of the rated pressure for a period of 1 min at room temperature in the coupled and in the uncoupled state. There shall be no leakage greater than specified herein, nor any permanent distortion or other malfunctioning of the coupling. The coupling shall couple and uncouple normally and seal hydraulic fluid as required after having been subjected to this test. This test shall be repeated after all other tests required herein have been accomplished, but just prior to the burst pressure test (see 4.4.14). This repeat test shall be conducted at $275\text{ }^{\circ}\text{F} \pm 5$ for a duration of 5 min for qualification test and at room temperature for a duration of 1 min for acceptance tests (4.2.1 and 4.2.2, respectively).

4.4.3 Extreme Temperature Functioning: The couplings shall withstand the following tests without malfunctioning or leakage in excess of the values specified herein (see 4.4.4).

4.4.3.1 High Temperature: After immersion (see 4.4.1.1), the coupling shall be connected to a 30 in static head of hydraulic fluid and subjected to a temperature of $275^{\circ}\text{F} \pm 5$ for a period of 6 h. 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 $140^{\circ}\text{F} \pm 5$ and shall be subjected to the leakage at low pressure test and then at high pressure test (see 4.4.4).

4.4.3.2 Low Temperature: After completion of the high temperature tests (4.4.3.1), the couplings shall be connected to a 30 in static head of hydraulic fluid, and subjected to a temperature not warmer than -65°F for a period of 4 h after stabilization. There shall be no measurable leakage from the coupled 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 coupling or uncoupling. The uncoupled half shall be subjected to the leakage at low pressure test and then at high pressure test (see 4.4.4). It will be satisfactory for the temperature to rise to -40°F during this process.

4.4.3.3 Rapid Warming: The coupled coupling, while connected to a 30 in static head of hydraulic fluid, shall be allowed to warm up rapidly from -65 to $+40^{\circ}\text{F}$ within a 5 min period and shall be coupled and uncoupled 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.

4.4.4 Leakage:

4.4.4.1 Leakage at Low Pressure: The coupled coupling and the uncoupled half shall be subjected to an internal pressure equal to a head of 30 in of hydraulic fluid for 12 min. All external surfaces and cavities shall be blown dry with clean, filtered air at the beginning of this test. There shall be no evidence of any external leakage from the coupled coupling. A waiting period of 2 min shall be allowed for the leakage rate to become constant from the uncoupled half. Following this waiting period, leakage shall be measured for the next 10 min and shall not exceed one drop.

For acceptance tests, the coupled coupling and the uncoupled half shall be subjected to internal pressure equal to 30 in of hydraulic fluid for 2 min. All external surfaces and cavities shall be blown dry with clean, filtered air at the beginning of this test. There shall be no evidence of leakage from either the coupled coupling or the uncoupled half.

4.4.4.2 Leakage at High Pressure: Both the coupled coupling and the uncoupled half shall be subjected to a hydraulic static pressure equal to the applicable operating pressure for 15 min. All external surfaces shall be blown dry with clean, filtered air at the beginning of this test. There shall be no evidence of any external leakage from the coupled coupling. Leakage from the uncoupled half shall not exceed a trace (insufficient to form a drop in 10 min). Fluid loss (spillage), as specified in Table 1, is not considered to be external leakage.

- 4.4.5 Vacuum: A vacuum shall be applied to the coupled coupling equivalent to 10 in Hg. When the correct pressure has been attained, the lines shall be closed for a period of 5 min, during which time the change in vacuum pressure shall not exceed 0.5 in of Hg. The size and length of the vacuum line shall be minimized between the vacuum pump and the test specimen
- 4.4.6 Surge Flow: The coupling shall be subjected to flow of five times (three times for -16, and two times for -20, -24, and -32 sizes) the rated flow for 3 s minimum duration in each direction. This surge flow pattern shall be repeated 100 times. There shall be no evidence of flow blocking or internal damage, and the uncoupled half shall pass the leakage tests (4.4.4) at the completion of the surge flow sequence.
- 4.4.7 Vibration: The couplings shall withstand the following tests without evidence of failure or leakage. During the vibration test, 15 lbf/in (gage) pressure shall be applied. If the vibration test levels are other than those specified, the parameters shall be established in conjunction with the Procuring Agency.
- 4.4.7.1 Resonance:
- 4.4.7.1.1 Resonance Search: The connected coupling and disconnected coupling, if required, shall be pressurized to 15 lbf/in² (gage) pressure and a resonance search conducted, in a direction parallel and perpendicular to the axis of the coupling (three axes total). Resonant frequencies of the equipment shall be determined by varying the frequency of applied vibration slowly through the range of 5 to 2000 Hz at reduced test levels but with sufficient amplitude to excite the item.
- 4.4.7.1.2 Resonance Dwell: The test item shall be vibrated along each of the three axes, at the most severe resonant frequencies determined in 4.4.7.1.1. The test levels and frequency range shall be in accordance with Figure 2. The dwell time for each resonance shall be 30 min. If more than four significant resonant frequencies are found for any one axis, the four most severe resonant frequencies shall be chosen for the dwell test. If a change in the resonant frequency occurs during the test, its time of occurrence shall be recorded and immediately the frequency shall be adjusted to maintain the peak resonance condition. The final resonant frequency shall be recorded.
- 4.4.7.2 Cycling: The test article shall be vibrated for a total duration of 3 h in each of the three axes. The resonance dwell time per axis shall be subtracted from the 3 h of required cycling time. These levels shall be per Figure 2 and the sweep time shall be 20 min for 5 to 2000 to 5 Hz.

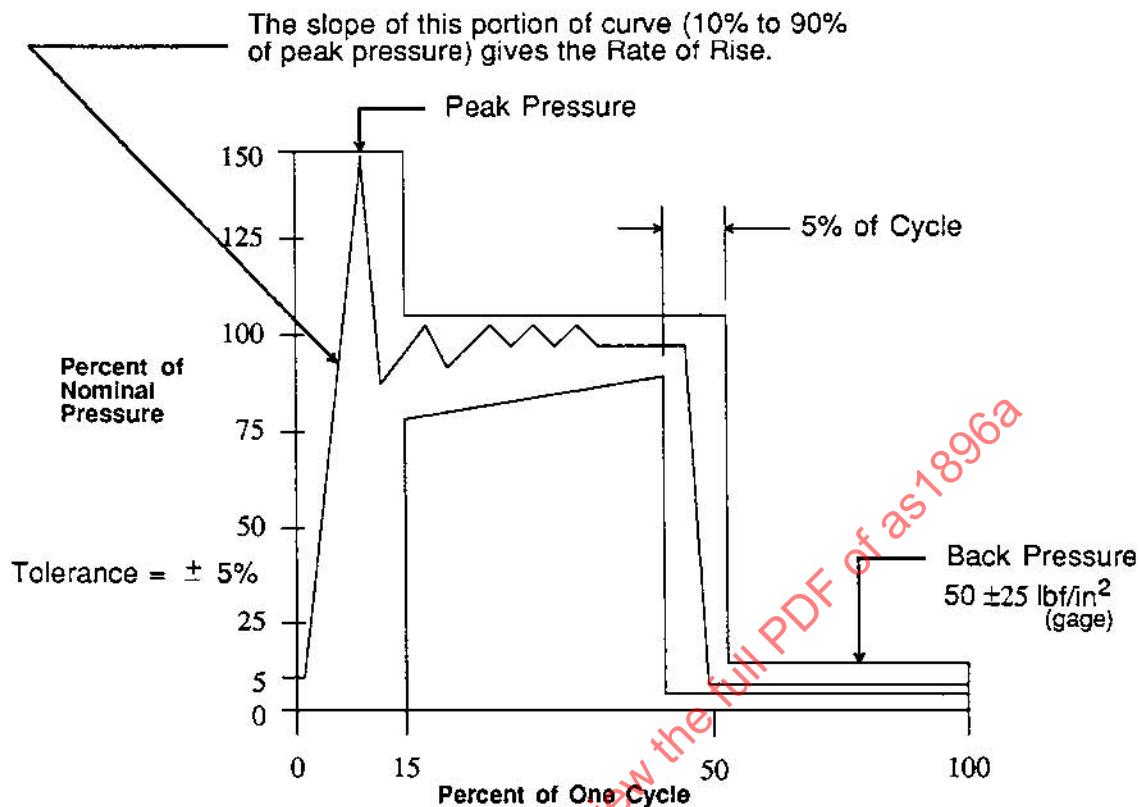


FIGURE 3 - Graph of Pressure Impulse Cycle (Per ARP603)

- 4.4.8 Impulse: The coupled coupling shall be subjected to impulse testing in accordance with the general requirements of ARP603. Test conditions shall be per Table 3 in a setup per Figure 1, and Table 5. The impulse test machine shall produce dynamic pressure impulses, in the coupling, of the magnitude indicated by the graph shown in Figure 3. An oscilloscope photograph of the nature of the impulse shall be included in the test report.
- 4.4.9 Endurance: The coupling shall be subjected to 200 coupling and uncoupling operations. During each operation 15 lbf/in^2 (gage) shall be applied to the self-sealing coupling (except for the -32 size, where 10 lbf/in^2 (gage) shall be applied). The coupling shall be observed for any indication of abnormal operation or leakage. The coupling shall withstand this test without degradation in performance. There shall be no indication of external leakage during or at the end of this test.