SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE STANDARD

AS4157

Issued 5-11-88

Submitted for recognition as an American National Standard

COUPLING ASSEMBLIES, HYDRAULIC, SELF-SEALING, QUICK DISCONNECT 5000 and 8000 POUNDS PER SQUARE INCH, GAGE

1. SCOPE:

This specification covers the requirements for Aircraft Hydraulic, Self-Sealing, Quick Disconnect Couplings for use in 5000 and 8000 lbf/in^2 (gage) lightweight hydraulic systems.

1.1 Classification: Hydraulic self-sealing, quick disconnect couplings shall be of the following classes and types:

Class 5000 - 5000 lbf/in^2 (gage) Operating Pressure (psi)

Class 8000 - 8000 lbf/in^2 (gage) Operating Pressure

2. APPLICABLE DOCUMENTS:

2.1 Issues of Documents: The following documents, which are the issues in effect on the date of invitation for bids or request for proposals, form a part of this specification as specified herein.

2.1.1 Military Specifications:

MIL-F-85720 - Fittings, Tube, Fluid Systems, Separable, High Pressure Dynamic Beam Seal, General Specification for
MIL-G-5514 - Gland Design, Packings, Hydraulic, General Requirements for
MIL-H-83282 - Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base, Aircraft
MIL-H-85800 - Hose Assemblies, Polytetrafluoroethylene, Fiber Reinforced, 5000 and 8000 lbf/in^2 General Specification For
MIL-H-8775 - Hydraulic System Components, Aircraft & Missile, General Specification For

REAFFIRMED
April 1993

2.1.2 Military Standards:

MIL-STD-129 - Marking for Shipment and Storage
MIL-STD-130 - Identification Markings of US Military Property
MIL-STD-810 - Environmental Test Methods

2.2 Other Publications:

SAE:

AIR1047 - A Guide for the Selection of Quick Disconnect Couplings for Aerospace Fluid Systems
ARP24 - Hydraulic Pressure Drop, Determination of
ARP603 - Impulse Testing of Hydraulic Hose Assemblies, Tubing, and Fittings
ARP868 - Pressure Drop Test for Fuel System Components
ARP578 - Detail Requirements for 4000 and 5000 PSI Aircraft Hydraulic Systems

3. REQUIREMENTS:

3.1 Qualification: The couplings furnished under this specification shall be products which have been tested, and have passed the qualification tests specified herein, and have been approved by the Procuring Agency or prime contractor.

3.2 General Specification: The specification established by the Procuring Agency shall be in addition to the requirements specified herein.

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

3.4 Design and Construction: The configuration, dimensions, and other details of design of the couplings shall conform to applicable Specification Control Drawing, Table V, or as specified by the Procuring Agency. The design objective shall be to obtain the smallest size and lighest weight commensurate with meeting performance requirements herein. When coupled, the coupling shall be such that it shall 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.

Quick disconnect shall have both a visual and touch indication that they are connected and open to flow. The overall dimensions shall not exceed that shown in Table V. Unless otherwise specified by the Procuring Agency, the end fitting size configuration shall be per MIL-F-85720.

If a secondary sealing function for the disconnected half is required, a pressure cap or plug shall be provided as an optional design feature. The requirement shall oe specified by the Procuring Agency.

3.4.1 Temperature Range: Couplings shall be designed to operate throughout the temperature range listed in 4.6.3.

3.4.2 Sealing and Fluid Loss: The couplings shall, when uncoupled, seal the ends of the disconnected lines at the point of disconnection and shall not permit external leakage during any phase of coupling or uncoupling. 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).

3.4.3 Seals: The selection of packing and retainer materials shall be compatible with MIL-H-83282 fluid. For other fluids, packing and retainer material shall be specified by the Procuring Agency, and the material compatibility tests shall be conducted by the supplier to demonstrate the satisfactory performance of the coupling.

3.4.3.1 Glands: Glands shall be per MIL-G-5514, except that the radial clearance shall be reduced as required to prevent extrusion.

TABLE I - Rated Flow and Pressure Drop Classes 5000 & 8000

Dash No. Class 5000	Dash No. Class 8000	Equivalent Tube Size in Inches Class 5000	Equivalent Tube Size in Inches Class 8000	Rated Flow gal/min	Maximum Pressure Drop lbf/in² Rated Flow	Surge Flow gal/min
-04	-03	1/4	3/16	2.5	25	12.5
-06	-05	3/8	5/16	5.7	25	28.5
-08	-07	1/2	7/16	10.0	25	50.0
-10	-09	5/8	9/16	16.3	25	81.5
-12	-11	3/4	11/16	26.0	25	130.0
-16	-15	1	15/16	47.0	25	234.0

TABLE II - Air Inclusion and Fluid Loss

Dash No. Class 5000	Dash No. Class 8000	Equivalent OD Tube Size in Inches Class 5000	Equivalent OD Tube Size in Inches Class 8000	Air Inclusion Standard Cubic Centimeters Maximum	Average Fluid Loss (Spillage)/Operating Cycle, Cubic Centimeter Maximum
-04	-03	1/4	3/16	0.10	0.05
-06	-05	3/8	5/16	0.20	0.10
-08	-07	1/2	7/16	0.40	0.20
-10	-09	5/8	9/16	0.60	0.30
-12-	-11	3/4	11/16	1.00	0.50
-16	-15	1	15/16	1.75	1.00

3.4.4 Functional Operation: The coupling design shall be such that, even when wearing an arctic glove, the coupling's connect and disconnect operation can be performed with one hand. A static pressure shall be applied to both halves and each one-half of the coupling respectively (that is, when one-half of the coupling is pressurized and the other half is unpressurized). (See 4.6.10.1.) The static pressure applied shall be per Table III herein to permit one-hand operation (see 4.6.10).

TABLE III - Coupling Forces with the Indicated Static Pressure Applied to Both Halves

Dash No. Class 5000	Dash No. Class 8000	Static Pressure lbf/in^2 (gage)	Push-Pull Axial lb	Torque Rotation in lb
-04	-03	100	50	15
-06	-05	100	50	20
-08	-07	100	50	25
-10	-09	100	50	30
-12	-11	100	50	40
-16	-15	100	50	50

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.

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

3.6.3 Extreme Temperature Functioning: The connected coupling and each coupling half shall show no malfunction during or after being subjected to extreme temperature testing using the values stated in 4.6.3.

3.6.4 Leakage: Coupling halves shall meet specified leakage requirements of 4.6.4 at 30 in static head of hydraulic fluid and at the operating pressure specified in 1.1.

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: The connected and disconnected coupling shall meet leakage, operational and pressure drop requirements after being subjected to the surge flow tests, as defined in Table I.

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

3.6.8 Impulse: The connected coupling and disconnected coupling halves with pressure cap and plug, if required, 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 VI and Fig. 3 (see 4.6.8).

3.6.9 Endurance: Each coupling half shall be capable of withstanding 1000 endurance cycles of coupling/uncoupling without any evidence of malfunction or degradation, with the pressures specified in Table III applied to both halves (see 4.6.9).

3.6.10 Manual Operation: The coupling shall be capable of being tested in accordance with specified requirements of 4.6.10 with no evidence of coupling forces, leakage or spillage beyond the specified limits.

The coupling force/torque and applied pressures shall be per Table 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 couplings shall be within specified limits per Table II and at 30 in of fluid pressure (see 4.6.11).

3.6.12 Impact: Unless otherwise specified by the Procuring Agency, 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 4.6.12).

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 setup shall be as shown in Fig. 4 (see 4.6.13).

3.6.14 Burst Test: The connected and disconnected coupling shall be capable of withstanding 250% of operating pressure and 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, Purchase Assigned) part number, manufacturer's part number and the manufacturer's name or code identification number. Class number and operating pressure shall be part of product identification. Where space is not available, only the manufacturer's trade mark and part number is required.

3.8 Workmanship: Workmanship shall be of the quality necessary to produce couplings free from all defects which 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 herein. 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 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 supplies and services conform to prescribed requirements.

4.2 Classification of Tests: 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)	Manual Operation	(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. The detail test parameters and extent of the production testing shall be established by the Procuring Agency.

(a)	Examination	(4.7.1)
(b)	Proof Pressure	(4.7.2)
(c)	Manual Operation	(4.7.3)
(d)	Leakage	(4.7.4)

4.5 Test Conditions:

4.5.1 Test Fluid: Unless otherwise specified, the fluid used shall be per MIL-H-83282 for all qualification testing. Other fluids may be specified by the Procuring Agency, if required, for system compatibility.

4.5.2 Temperatures: 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 - 125°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: All couplings shall be immersed continuously in hydraulic fluid for a period of 72 h at a maximum fluid temperature of 275°F prior to conducting the qualification tests (see 4.3) 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 temperatures until such test.

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 (see Table V), mounting requirements, interface dimensions and applicable dimensional tolerances. Record dry weight. Visually check finish and material usage.

4.6.2 Proof Pressure: The coupled coupling and the uncoupled halves shall be subjected to a proof pressure of 150% of the rated pressure for a period of 5 min at 275°F. There shall be no leakage greater than that specified in 4.6.4, 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 test required herein have been accomplished but just prior to the burst pressure test (see 4.6.14). The repeat test shall be conducted at the maximum temperature of 275°F for a duration of 5 minutes.

4.6.3 High Temperature: After immersion (see 4.5.3) but before being uncoupled, the coupling shall be connected to a 30 in static head of hydraulic fluid and subjected to the high temperature of 275°F 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 coupling shall be connected to a 30 in static head of hydraulic fluid, and subjected to the low temperature of -65°F for a period of 4 h after stabilization. There shall be no measurable leakage from the connected coupling during this 4 h 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 shall be satisfactory for the temperature to rise to -30°F during this process.

4.6.3.3 Rapid Warm-up: The coupled coupling, while connected to a 30 in static head of hydraulic fluid, shall be allowed to warm-up rapidly from the low temperature specified in 4.6.3.2 to + 40°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 surfaces. 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 subjected to an internal pressure equal to a head of 30 in of hydraulic 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 hydraulic static pressure equal to the applicable operating pressure, per 1.1, 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.

4.6.5 Vacuum: A vacuum shall be applied to the connected and disconnected coupling equivalent to 10 in Hg. When the correct vacuum pressure has been attained, the lines shall be closed for a period of 5 min, during which time there shall be no change in vacuum pressure.

4.6.6 Surge Flow: The couplings shall be subjected to surge flows shown in Table I 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 disconnected halves shall pass the leakage tests (see 4.6.4) at the completion of the surge flow sequence.

4.6.7 Vibration - Sinusoidal: Unless otherwise specified by the Procuring Agency, the couplings shall withstand the following vibration tests without evidence of failure or leakage. During the vibration test, 15 lbf/in^2 (gage) pressure shall be applied. The vibration testing is required per MIL-STD-810D. The parameters shall be established in conjunction with the Procuring Agency.

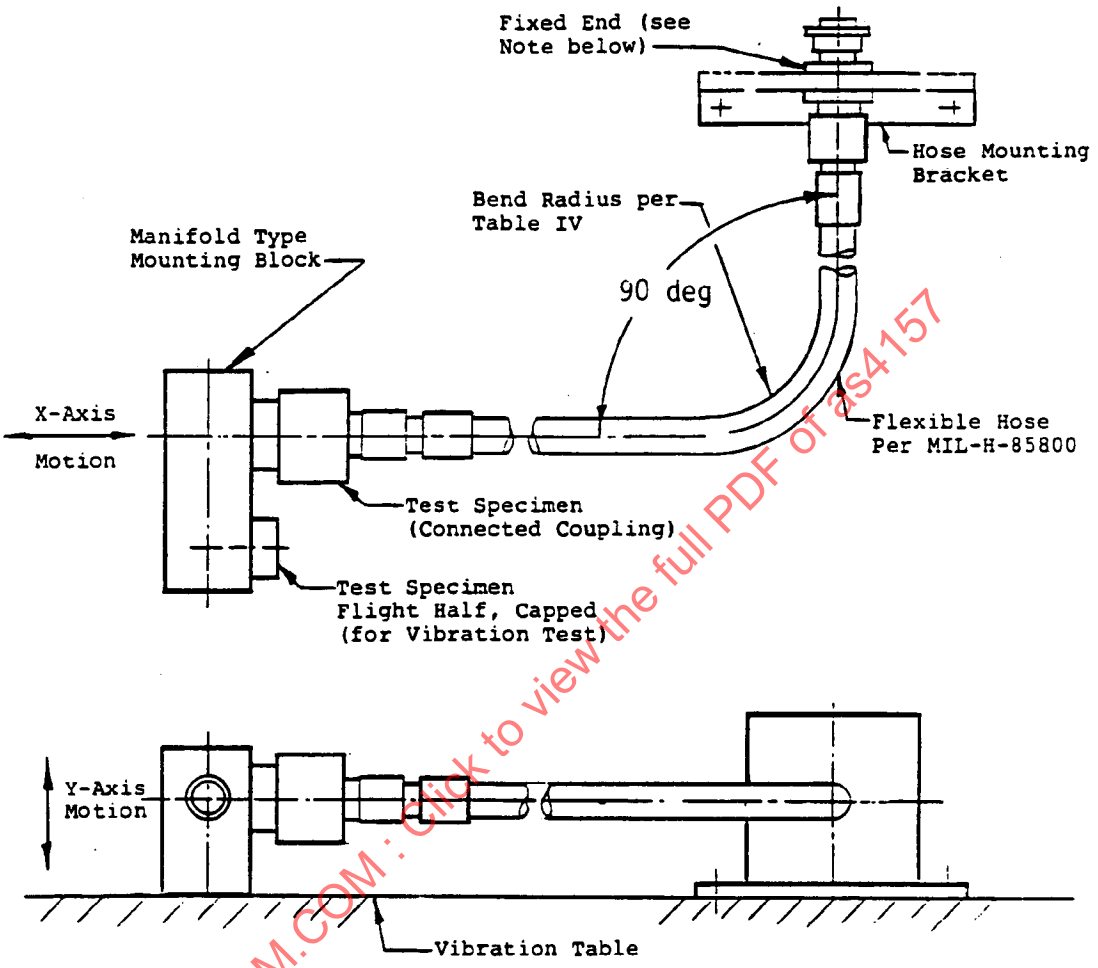
4.6.7.1 Resonance:

4.6.7.1.1 Resonance Search: The connected coupling and disconnected flight half, capped, shall be pressurized to 15 lbf/in^2 (gage) pressure and a resonance search conducted, in direction parallel and perpendicular to the axis of the coupling (two axes total). Resonant frequencies of the equipment shall be determined by varying the frequency of applied vibration slowly through the range of 5 - 2000 Hz at reduced test levels but with sufficient amplitude to excite the item.

4.6.7.1.2 Resonance Dwell: The test item shall be vibrated along each of the two axes, at the most severe resonant frequencies determined in 4.6.7.1.1. The test levels and frequency range shall be in accordance with Fig. 2. The dwell time for each resonance shall be 30 minutes. 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.

4.6.7.2 Cycling: The test article shall be vibrated for a total duration of 3 h in each of the two axes. The resonance dwell time per axis shall be subtracted from the 3 h of required cycling time. These levels shall be per Fig. 2 and the sweep time shall be 20 min for 5 - 2000 - 5 Hz.

4.6.8 Impulse: The mated coupling (and disconnected coupling halves with pressure cap, if required) shall be subjected to impulse testing in accordance with the general requirements of ARP603. Test conditions shall be per Table VI in a setup per Fig. 1. The impulse test machine shall produce dynamic pressure impulses, in the coupling, of the magnitude indicated by the trace shown in Fig. 3. The form of the electronics trace shall be included in the test report.



NOTE: THE END SHALL BE FIXED TO ALLOW EQUIVALENT LENGTH AND BEND RADIUS SHOWN ON TABLE IV BY CLAMPING EITHER THE END FITTING OR THE HOSE AS REQUIRED.

FIGURE 1 - Set-up for Impulse & Vibration Test

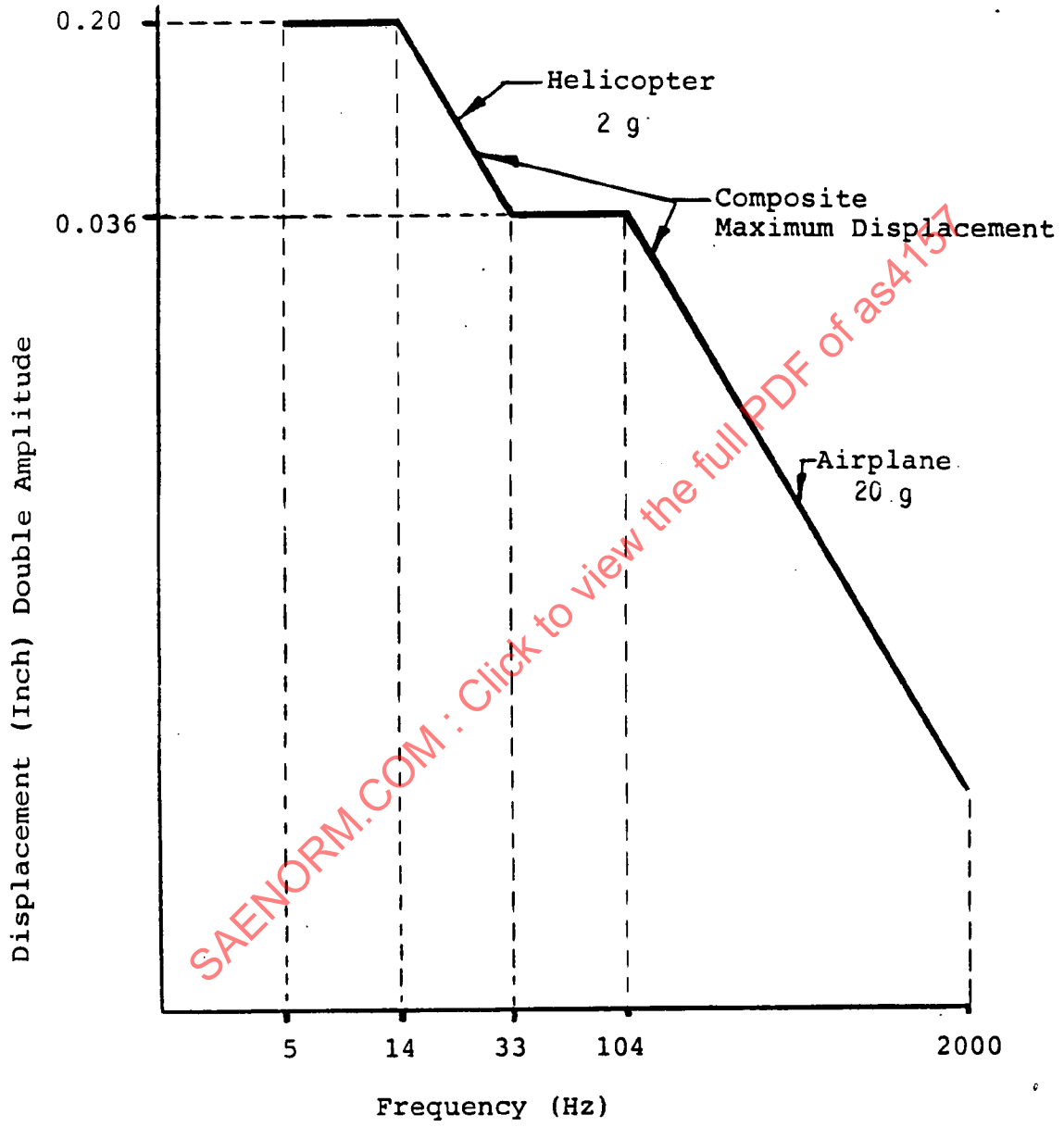


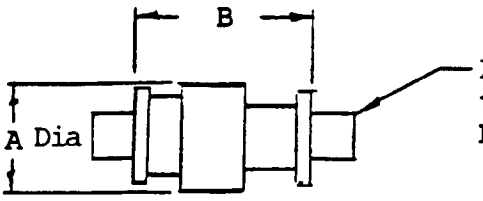
FIGURE 2 - Composite
Vibration Test Curve for Equipment
Mounted on Helicopters or Airplane Engines

TABLE IV - Hose Length and Bend Radii

Dash No.		Equivalent OD Tube Size		Hose Length (in) Flexible Section		Bend Radii in	
Class		Class		Class		Class	
5000	8000	5000	8000	5000	8000	5000	8000
-04	-03	1/4	3/16	12	16	1.5	3.00
-06	-05	3/8	5/16	15	21	2.5	5.00
-08	-07	1/2	7/16	18	24	2.9	5.75
-10	-09	5/8	9/16	21	30	3.3	6.50
-12	-11	3/4	11/16	25	33	4.0	7.75
-16	-15	1	15/16	31	41	5.0	9.65

TABLE V - Envelope Dimensions

Dash No.		"A" Dimension In Maximum	"B" Dimension In Maximum
Class			
5000	8000		
-04	-03	1.25	1.75
-06	-05	1.50	2.00
-08	-07	1.80	2.20
-10	-09	1.90	2.53
-12	-11	2.10	2.75
-16	-15	2.44	3.02



End Fitting configuration to be specified by the Procuring Agency (Typical)

TABLE VI - Impulse Test

	Class 5000	Class 8000
1. Rated Pressure, Pr	5 000	8 000
2. Peak Pressure, + 5%	7 500	10 800
3. Temperature (both classes)	at 275°F for 25% of the cycles 225°F for 75% of the cycles	
4. Cycle Rate cycles/min	70 + 10	70 + 10
5. Rate of Rise lbf/in^2 per s Min	75 000	120 000
Rate of Rise lbf/in^2 per s Max	300 000	800 000
6. Number of Cycles	250 000	250 000

Trace of Pressure Impulse Cycle
(Per ARP603F Except as Shown in Table IV)

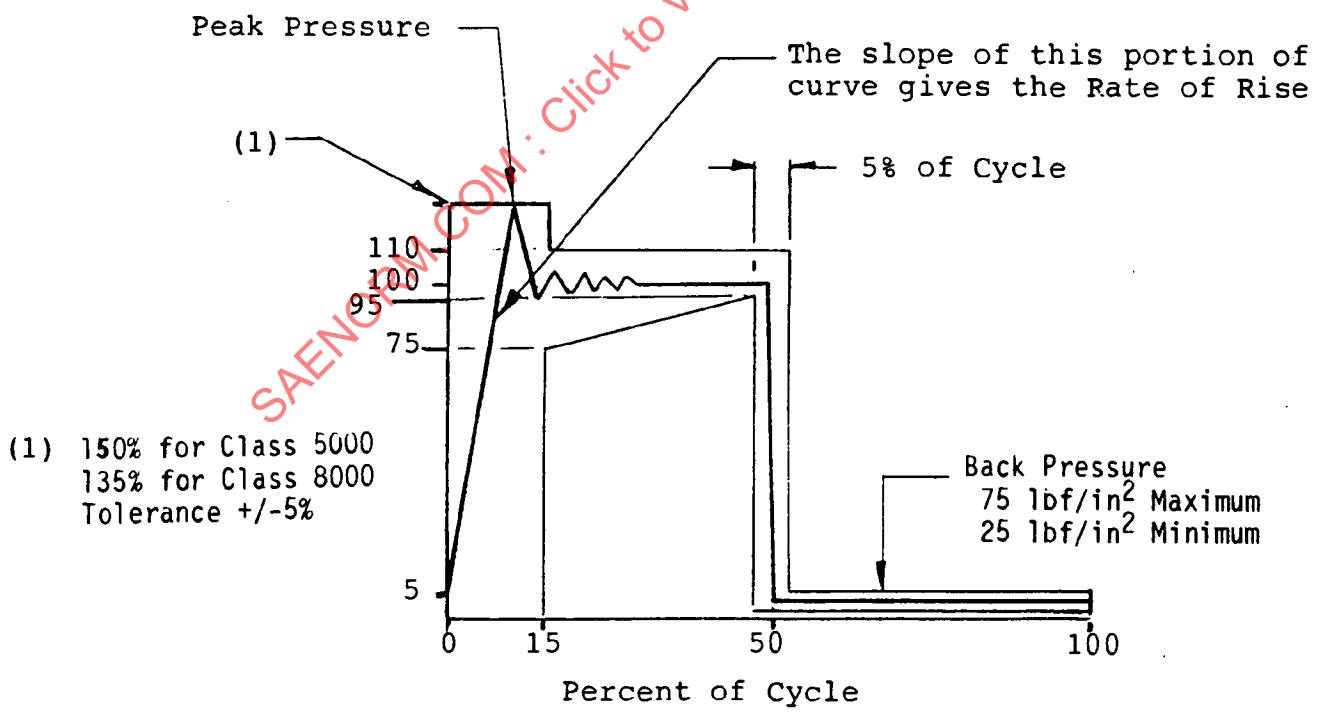


FIGURE 3 - Impulse Trace