SAE Aerospace
An SAE International Group

AEROSPACE RECOMMENDED PRACTICE

SAE ARP1974A

Issued 1986-03
Reaffirmed 2007-08
Cancelled 2008-12

Superseded by AS1974

Clamps, Support, Comparative Fatigue Strengths, Test Method

RATIONALE

Document superseded by Aerospace Standard AS1974.

CANCELLATION NOTICE

This document has been declared "Cancelled" as of December 2008 and has been superseded by AS1974. By this action, this document will remain listed in the Numerical Section of the Aerospace Standards Index noting that it is superseded by AS1974.

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1. SCOPE:

1.1 Scope:

This recommended practice establishes vibration and transmissibility test procedures which compare the relative strengths of various loop and saddle type support clamps.

This procedure is intended for conducting fatigue testing which is standard throughout the aerospace industry thereby establishing a clamp strength comparison which can be used in an evaluation process.

The testing required by this recommended practice ensures that clamps will meet adequate fatigue requirements only. It does not infer qualification of the clamp installation techniques or its ability to meet in-service environments or operating conditions. Separate qualification testing should be performed to ensure satisfactory service of the installed clamp.

2. APPLICABLE DOCUMENTS:

2.1 Specifications and Standards:

The following documents of the issue in effect on date of the start of testing form a part of this document to the extent specified herein.

2.2 Military Specifications:

MIL-C-85052	Clamp, Loop, Cushion, General Specification For
MIL-C-85052/1	Clamp, Loop, Tube, 17-7PH CRES, 275°F, Fuel and Petroleum Based Hydraulic Fluid Resistant
MIL-C-85052/2	Clamp, Loop, Tube 17-7PH CRES, 275°F, General Purpose
MIL-C-85052/3	Clamp, Loop, Tube 17-7PH CRES, 500°F, General Purpose
MIL-C-85449	Clamp Assembly, Saddle Type, Cushion, General Specification For
MIL-C-85449/1	Clamp Assembly, Saddle Type, Cushioned, NBR Rubber, 321 CRES, 275°F, Fuel Resistant, General Purpose
MIL-C-85449/2	Clamp Assembly, Saddle Type, Cushioned, EPR Rubber, 321 CRES, 275°F, General Purpose
MIL-C-85449/3	Clamp Assembly, Saddle Type, Cushioned, Silicone Fabric, Reinforced 321 CRES, 500°F, General Purpose
MIL-C-85449/4	Clamp Assembly, Saddle-Type, Cushioned Teflon, 321 CRES, -320°F to 450°F, General Purpose

2.3 Military Standards:

MS21106	Clamp, Loop, Cushioned, 1200°F CRES
MS21122	Clamp, Loop, Cushioned, Wedge, Polytetrafluoroethylene Type V, Class A and B
MS21919	Clamp, Loop Type, Cushioned, Support

2.4 Federal Standards:

QQ-T-580	Tool Steel, Carbon and Carbon - Vanadium

2.5 Aerospace Industries Association of America Standards:

AN742	Clamp, Plain Support, Loop-Type Aircraft
NAS1713	Clamp, Loop-Cushioned, Center Mount
NAS1715	Clamp, Loop-Cushioned
NAS1716	Clamp Assembly, Cushioned, Saddle

3. REQUIREMENTS:

3.1 Fatigue Test Device:

The test device should be capable of testing a wide variety of loop and saddle support clamps both cushioned and non-cushioned, metallic and non-metallic. The fatigue cycling shall be induced by means of vibration applied by a shaker in a test set-up similar to those shown in Figure 1. The test device shall be capable of testing clamps up to a maximum of 5 inches in diameter. Multiple set-ups are permissible if the shaker has the required force range and the test fixture has the stiffness required to achieve the specified vibration spectrum for all of the clamps tested.

The vibration device should be capable of automatic cycling and level control while maintaining sinusoidal loadings at constant acceleration of ± 2 g peak ± 10% through a frequency range of 20-500Hz. The input forces shall be controlled through an accelerometer mounted on top of vibration fixture coupled directly to the shaker armature, while acceleration forces generated on the clamps shall be measured at a point adjacent to the clamp (see Figure 1). A recording method is required to plot forces (g) generated vs frequency (Hz).

3.2 Vibration Test Specimens:

The specimen to be tested using this procedure is classified as any type of loop or saddle support clamp that has the strength capability to ensure a reasonable probability of successfully completing the vibration tests. Clamps representative of those to be tested are shown in Figure 3 and as listed below:

AN742
MS21106
MS21122
MS21919
MIL-C-85052/1
MIL-C-85052/2
MIL-C-85052/3
MIL-C-85449/1
MIL-C-85449/2
MIL-C-85449/3
MIL-C-85449/4
NAS1713
NAS1715
NAS1716

3.3 Test Mandrels and Test Weights:

Test mandrels shall be tool steel drill rod in accordance with QQ-T-580 or equivalent and shall be as shown in Figure 2. All dimensions shall be as shown in Table 1 with surface finishes of 125 microinches maximum unless otherwise specified.

3.4 Vibration Test Fixture:

The vibration test fixture shall be similar to that described by Figure 1 with mandrels and weights as specified in Table 1 and Figure 2.

4. PROCEDURE:

4.1 Preparation for Test:

4.1.1 Instrumentation, Accelerometers: A control accelerometer (input) should be mounted to the top of the vibration fixture as close to a clamp mounting bolt of the fixture as possible. A monitoring accelerometer (output) should be mounted as shown in Figure 1. The output accelerometer should be monitored and recorded as frequency vs g force generated.

4.1.2 Failure Criteria: When tested in accordance with this ARP no clamp shall exhibit any evidence of cushion separation or their deterioration (when applicable). There shall be no cracking or separation of metal components. The Transmissibility Ratio (TR) shall be recorded at the start of testing and at the time of failure.

$$TR = \frac{\text{CLAMP OUTPUT (RESPONSE) ACCELERATION}}{\text{TEST INPUT (CONTROL) ACCELERATION}}$$

4.1.3 Environment: Unless otherwise specified all testing shall be done at room temperature (60 °F - 90 °F).

4.2 Vibration Fatigue Testing:

The clamps to be tested shall be mounted as shown in Figure 1 using mandrels as specified in Figure 2 and Table 1. The clamps shall be installed flat on a mounting block using 10-32UNF-3A bolts (160 KSI or higher strength) with a rounded or chamfered edge washer against the clamp foot to avoid chaffing of the clamp. The bolt size may be changed where a clamp requires a size other than specified. This test assembly shall then be mounted to a shaker table.

A resonance search shall be performed at a constant sine wave vibration of ± 2 g peak ± 10% acceleration (in the vibration axis, see Figure 1) from 50 to 500 CPS using a logarithmic sweep rate of approximately 5 minutes per cycle, where a cycle shall consist of a sweep from 50 Hz to 500 Hz to 50 Hz. One complete cycle shall be performed. Both Accelerometer signals shall be continuously recorded. Each resonant frequency peak shall be monitored and recorded and the transmissibility ratio (TR) shall be calculated for each resonance peak, and shall also be recorded.

The clamps shall then be dwelled at the most severe resonance peak for 30 minutes at a constant sine wave vibration of ± 10 g peak ± 10% acceleration.

4.2 (Continued):

Following the test, the clamp shall be inspected for evidence of failure as defined in 4.1.2. If no evidence of failure is found continue testing at the most severe resonant peak at a constant sine wave vibration of ± 10 g peak ± 10% acceleration until failure occurs. Record the total time to fail the clamp.

4.4 Test Report:

The testing agency shall furnish a certified test report, showing quantitative results which shall include but not be limited to plots of input and response acceleration (g) versus frequency (Hz) and photographs of the test set ups for the vibration and transmissibility tests. The report shall designate the part number of the clamp tested.

5. BACKGROUND AND PHILOSOPHY OF VIBRATION TESTING:

5.1 Background:

The requirements for vibration testing are based on MIL-C-85052 which requires vibration testing of a three clamp set-up with long mandrels and heavy test fixturing. This test method resulted in the need for larger more costly vibration equipment which in many cases were not readily available to the clamp manufacturers.

The test requirements herein are such that the test set-ups are more compact, lighter in weight and therefore reduce the size of the shaker which results in more readily obtainable vibration equipment.

5.2 Vibration Test Philosophy:

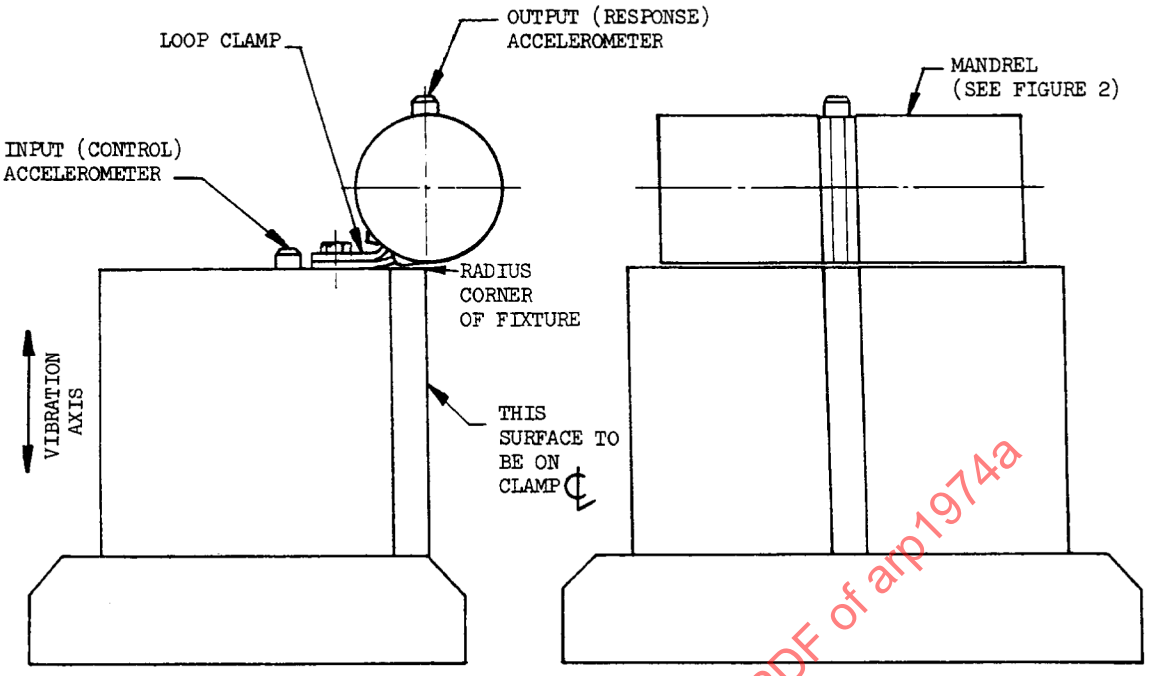
Vibration testing has been used successfully as a means of comparing the relative fatigue life of clamp installations. Previous test analysis has been compared with actual service data and has confirmed conclusions derived from test programs.

6. EQUIPMENT:

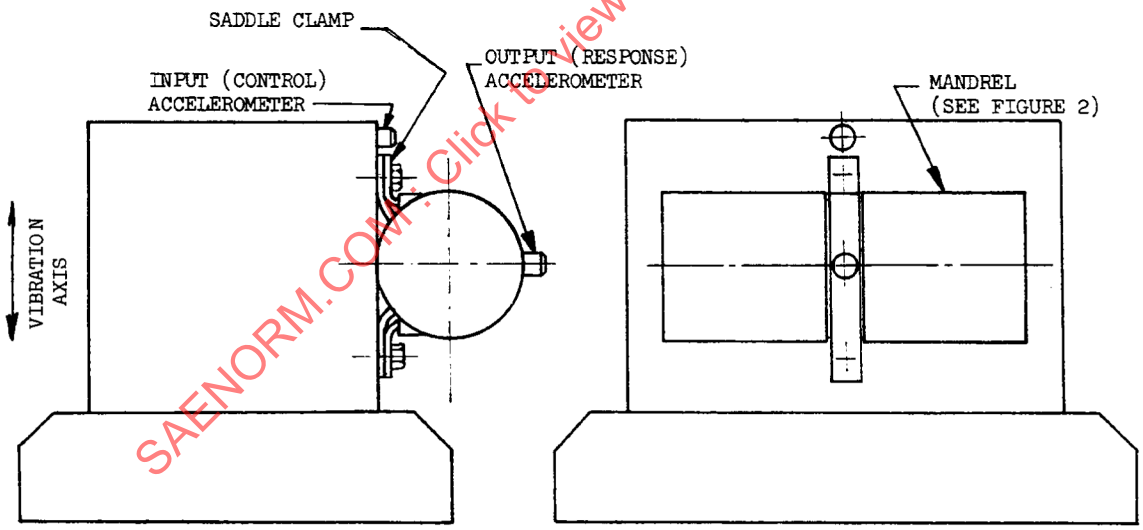
6.1 Vibration Equipment:

If vibration test equipment is not available at the clamp manufacturer's plant, the vibration testing can be subcontracted to an independent testing laboratory.

PREPARED BY
SAE SUBCOMMITTEE G3-E, AEROSPACE TUBING
INSTALLATION OF SAE COMMITTEE G-3, AEROSPACE COUPLINGS, FITTINGS,
HOSE AND TUBING ASSEMBLIES



CASE I - LOOP TYPE CLAMP, SINGLE BOLT



CASE II - SADDLE TYPE CLAMP, TWO BOLT

FIGURE 1 - Loading Schematic for Fatigue Testing Tube Clamps Single Clamp Method