

International Standard



2671

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ANSI International Standard

Environmental tests for aircraft equipment — Part 3.4 : Acoustic vibration

Essais en environnement pour les équipements aéronautiques — Partie 3.4 : Vibrations acoustiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2671 was developed by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and was circulated to the member bodies in March 1979.

It has been approved by the member bodies of the following countries :

Austria	Italy	Spain
Belgium	Korea, Rep. of	United Kingdom
Canada	Libyan Arab Jamahiriya	USA
Czechoslovakia	Poland	USSR
France	Romania	
India	South Africa, Rep. of	

No member body expressed disapproval of the document.

This International Standard is part of a composite standard, specifying environmental tests for aircraft equipment, details of which are given in ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*.

Environmental tests for aircraft equipment —

Part 3.4 : Acoustic vibration

1 Scope and field of application

1.1 This International Standard specifies laboratory conditions for testing the ability of equipment for subsonic and supersonic civil aircraft to withstand the effects of acoustic vibration. Two types of tests are specified : tests for the functioning of the equipment, and tests for its acoustic endurance. The tests for the functioning of the equipment are carried out both during equipment development and for certification. The tests for acoustic endurance are usually carried out in order to find structural defects during equipment development.

1.1.1 The tests for the functioning of the equipment may be carried out in accordance with one of the two alternative methods.

- wide band noise test
- harmonic sound test.

The tests for acoustic endurance are carried out using the wide band noise method.

1.1.2 The selection of the test severity grade is made by the user in accordance with one of the following two procedures :

- a) If measurements of sound pressure levels at the location where the equipment is to be installed are available for in-flight conditions or can be calculated, they can be used to determine test sound pressure levels by a method proposed in this International Standard. This is referred to as procedure "A" (see 4.4.1, 5.2.1, and the annex).
- b) If such measurements are not available or the user does not wish to use method A, the test levels may be obtained from this International Standard on the basis of the type of aircraft in which the equipment is to be installed and the location of the equipment in the aircraft with respect to the noise sources. In this method, which will be referred to as procedure "B", the test sound pressure level can be determined by means of the tables and formulae given in this International Standard (see 4.4.2; 5.2.2, and the annex).

1.2 The tests are intended to be applied to equipment sensitive to acoustic vibration. The necessity for functioning and endurance tests, the use of the wide band noise method or harmonic sound method, and the applicable test sound pressure level shall be specified in the relevant equipment specifications.

1.2.1 The equipment located in aircraft, regions where overall sound pressure levels are less than 125 dB will not normally require testing in acoustic vibration environments.

2 Definitions

For the purposes of this International Standard, the following definitions apply :

2.1 control points : Locations of microphones in the test chamber.

2.2 maximum non-uniformity of sound pressure field : The maximum difference between overall sound pressure levels at any two control points when testing in accordance with the wide band noise method.

2.3 mean value of sound pressure levels at the control points : The value determined from the formula :

$$L_m = \left(10 \lg \sum_{j=1}^k 10^{L_j/10} \right) - \left[10 \lg k \right], \text{ dB}$$

where

L_j is an overall sound pressure level at the j -th control point relative to 20 μPa , in decibels;

k is the number of control points;

or, when the sound pressure level difference does not exceed 5 dB, from the following formula :

$$L_m = \frac{1}{k} \sum_{j=1}^k L_j, \text{ dB}$$

2.4 maximum overall sound pressure level at the equipment location in the aircraft, L_{max} : The maximum r.m.s. level of sound pressure in areas of the equipment location in the aircraft during typical flight.

2.5 nominal sound pressure level : The constant overall sound pressure level specified in a frequency range of 250 to 2 000 Hz for each severity grade, when testing in accordance with the harmonic sound method.

2.6 equivalent sound pressure level, L_{eqv} : The sound pressure level which, if applied constantly for a duration equal to that of an aircraft's typical flight, would result in overall damage of the aircraft's equipment equal to the damage in the aircraft during a typical flight. The formula for evaluation of the equivalent sound pressure level is given in the annex.

2.7 accelerated sound pressure level: The sound pressure level for accelerated acoustic endurance tests, in decibels.

It is determined from the formula :

$$L_{acc\ t} = L_{eqv} + \frac{20}{\gamma} \lg \frac{T_{s.l.}}{T_{acc.t}}, \text{ dB}^{1)}$$

where

$T_{s.l.}$ is the required service life of the aircraft equipment, in hours;

$T_{acc\ t}$ is the acoustic endurance test duration, in hours;

γ is the index of the rate of fatigue damage accumulation law for the equipment.

3 Test facility requirements

3.1 The acoustic vibration test facility shall consist of the following :

- test chamber;
- equipment to produce a sound field in the test chamber;
- instrumentation for monitoring the sound field parameters.

3.2 The test chamber, the equipment to produce the sound field in the test chamber and the instrumentation for monitoring the sound field parameters shall satisfy the requirements for sound pressure levels, non-uniformity of the sound pressure field, the sound pressure spectrum shape and the test duration (see 3.2.1 to 3.2.3, 3.3 to 3.7, 4.1.1 to 4.1.5, 4.2.1 to 4.2.4, 4.3, 5.2.1, 5.2.2 and the annex).

3.2.1 The test chamber shall be of such shape and construction to produce as closely as possible a diffuse sound field.

3.2.2 For the wide band noise tests, the sound pressure applied to the test chamber is preferred to be of a random nature

approximating to a normal (Gaussian) distribution, with amplitudes up to a peak value not less than three times the root mean square (r.m.s.) value.

3.2.3 The chamber shall be provided with a system for supporting the test equipment, the first resonance frequency shall not exceed 25 Hz.

3.3 The monitoring instrumentation shall be capable of measuring overall sound pressure levels in the frequency range from 90 to 11 200 Hz and octave band levels at central frequencies from 125 to 8 000 Hz at each of the control points.

The monitoring instrumentation shall have a flat frequency response with the following tolerances :

Frequency range Hz	Tolerance dB
90 to 125	$\pm 3,0$
125 to 2 500	$\pm 2,0$
2 500 to 11 200	$\pm 3,0$

3.4 The monitoring instrumentation shall be capable of measuring sound pressure levels at least 10 dB higher than the specified test level.

3.5 The microphones shall be calibrated for random incidence measurement.

3.6 The intensive sound pressure used in the tests is dangerous and appropriate measures should be taken for the protection of personnel.

3.7 If the test is carried out in test chambers which do not satisfy the requirements of this International Standard the test conditions shall be discussed between the purchaser and the supplier of the equipment.

4 Functioning tests

4.1 Functioning test conditions; wide band noise method

4.1.1 The functioning test conditions in the test chamber, when using the wide band noise method, are specified by the mean value of the overall sound pressure levels at the control points, the maximum permissible non-uniformity of the sound pressure field, the sound pressure spectrum shape and the test duration.

1) This formula is derived from the equation :

$$\frac{T_{s.l.}}{T_{acc\ t}} = \left(\frac{P_{acc\ t}^2}{P_{eqv}^2} \right)^{1/2}$$

where

$P_{acc\ t}^2$ is the mean value of the square of the accelerated sound pressure, in pascals squared;

P_{eqv}^2 is the mean value of the square of the equivalent sound pressure, in pascals squared;