INTERNATIONAL STANDARD ISO 2669

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Environmental tests for aircraft equipment — Part 3.2 : Steady state acceleration

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FOREWORD

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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 2669 was developed by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and was circulated to the member bodies in July 1976.

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

Australia	Germany	South Africa, Rep. of
Austria	India	Spain
Belgium	Italy	Sweden
Brazil	Japan	Turkey
Canada	Korea, Rep. of	United Kingdom
Chile	Mexico	U.S.A.
Czechoslovakia	Poland	U.S.S.R.
France	Romania	Yugoslavia

No member body expressed disapproval of the document.

This International Standard is part of a composite standard, specifying environmental tests for equipment in aircraft, which will be published as a number of separate parts, details of which are given in ISO 2650, Part 1 : *Scope and applicability*.

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Environmental tests for aircraft equipment — Part 3.2 : Steady state acceleration

1 SCOPE AND FIELD OF APPLICATION

This International Standard describes two types of steady state acceleration test and specifies three severity grades of acceleration forces used to simulate an environment representative of that which aircraft equipment may encounter in operational use, excluding emergency landings.

This International Standard is in close agreement with IEC Publication 68-2-7.

2 REFERENCES

ISO/R 224, *Standard form of declaration of performance of aircraft electrical equipment.*

ISO 2650, *Environmental tests for aircraft equipment — Part 1 : Scope and applicability.*

ISO 2651, *Environmental tests for aircraft equipment — Part 2.1 : Temperature, pressure and humidity.*[1)]

IEC Publication 68, *Basic environmental testing procedures* — Part 2 : *Tests.*
68-2-7, *Test Ga : Acceleration, steady state.*

3 DEFINITIONS

For the purposes of this International Standard the definitions given in ISO 2651 shall apply.

4 OBJECT OF TESTS

The objects of the tests described in this International Standard are to determine the performance and to confirm the structural integrity of an equipment when it is subjected to steady state acceleration forces generated by an aircraft manœuvre such as turn, pull-out, etc, excluding emergency landings. For example, the tests would be expected to indicate :

a) any variations in performance;

b) any decrease in the free travel and change in the suspension characteristics of the anti-vibration mountings;

c) any breakage or any weaknesses of the fastenings, mounting devices or structure of the equipment that could cause hazard to the aircraft or its occupants.

5 TEST APPARATUS

5.1 General characteristics

5.1.1 A centrifuge shall be the preferred apparatus for producing the required acceleration forces.

5.1.2 In special cases, if stated by the relevant equipment specification, a linear accelerator may be used instead of a centrifuge. (See 5.2.2.)

5.1.3 The apparatus shall be capable of producing the specified acceleration forces within the limits of ± 10 % at all points within the equipment.

5.1.4 When the apparatus is to be used for functioning tests (see 8.2.1), it shall be fitted with devices that permit all necessary electrical, hydraulic and/or pneumatic connections to be made between the equipment and/or the measuring circuits. (See clause 6.)

5.2 Special cases

5.2.1 If, owing to the excessive size of the equipment, it is not possible to maintain the tolerances specified in 5.1.3 at all points in the equipment, the relevant equipment specification may permit relaxations on those parts not considered to be sensitive to the specified acceleration forces.

5.2.2 When it is required to test equipment which is sensitive to rotary motion, i.e. containing rotating parts which have an appreciable polar moment of inertia (for example rate-gyros), care shall be taken in interpreting the test results. The relevant equipment specification shall state whether the equipment may be tested under these conditions, or whether it is necessary to use a linear accelerator. (See 5.1.2.)

1) At present at the stage of draft.

6 MOUNTING OF EQUIPMENT

6.1 Orientation

The equipment to be tested shall be mounted on the apparatus in such a way that it can be successively orientated in six directions defined by a reference system employing three mutually perpendicular axes. The relevant equipment specification shall define the reference system.

6.2 Method of mounting

The orientation may be achieved with the aid of an adjustable table which is integral with the apparatus or with a special fixture attached to the apparatus.

The equipment shall be attached to the adjustable table or fixture by its fastenings or mounting devices, as defined in the installation manual for the equipment.

6.3 Supply connections

The connections to the equipment of the electrical, hydraulic and pneumatic supplies shall simulate as closely as possible those called for in the installation manual for the equipment.

7 INITIAL FUNCTIONING TEST

If required by the relevant equipment specification, or if it has previously been exposed to another environmental test, the equipment shall be put into operation and its performance checked prior to subjecting it to the test.

8 CLASSIFICATION OF TESTS

8.1 Severity

The equipment shall be classified in accordance with the appropriate severity grade selected from table 1. The severity grade shall be stated in the relevant equipment specification.

TABLE 1 — **Equipment severity grades**

Equipment severity grade	Intended for installation in
1	Light aircraft Transport aircraft
2	
3	High performance aircraft Aerobatic aircraft

8.2 Types of test

Two types of steady state acceleration test shall be conducted, namely :

8.2.1 *Functioning test*

The basic aim of this test is to check the functioning of the equipment under the imposed acceleration forces. The test apparatus shall, therefore, enable the equipment to be operated during the steady state acceleration phase of the test.

8.2.2 *Structural integrity test*

The basic aim of this test is to check that the equipment will not cause hazard to the aircraft or its occupants. This test is applicable to the three categories of equipment listed in table 2. The appropriate equipment structural integrity category shall be stated in the relevant equipment specification.

TABLE 2 — **Equipment structural integrity categories**

Equipment category	Operational requirements
A	Equipment required to function after, but not during, the acceleration phase
B	Equipment not required to function during and after the acceleration phase, but which must remain free from structural damage that would cause hazard to the aircraft or its occupants
C	Equipment required to function throughout and after the acceleration phase (for example, recorder, safety devices, etc.)

9 TEST PROCEDURES

The procedures to be adopted for the two types of test shall be as follows :

9.1 Functioning test procedure

The equipment shall be operating at its maximum rating for at least 5 min before subjection to the acceleration forces specified in table 3. During the period of steady state acceleration, the essential performance parameters shall be checked for compliance with the requirements of the relevant equipment specification.

After the test, the equipment shall be put into operation and its performance checked for compliance with the requirements of the relevant equipment specification.

If it is not possible to put the equipment into operation while it is being subjected to the acceleration forces, it may be tested in the idle state. Immediately following the test, it shall be put into operation and its performance checked for compliance with the requirements stated in the relevant equipment specification.

The procedures shall be repeated in each of the six attitudes.

9.2 Structural integrity

The equipment shall be tested in accordance with the test procedure described below, appropriate to the category of equipment.

9.2.1 *Category A equipment*

With the equipment in its idle state, it shall be subjected to the acceleration forces specified in table 4. During the test, the equipment and its mounting shall remain undamaged.

After the test, the equipment shall be visually checked for structural failure and then put into operation and its performance checked for compliance with the requirements of the relevant equipment specification.

This procedure shall be repeated in each of the six attitudes.

9.2.2 *Category B equipment*

With the equipment in its idle state, it shall be subjected to the acceleration forces specified in table 4. During the test, the equipment and its mounting shall remain undamaged.

After the test, the equipment shall be visually checked for structural failure only.

This procedure shall be repeated in each of the six attitudes.

9.2.3 *Category C equipment*

The equipment shall be operating at its maximum rating for at least 5 min before subjection to the acceleration forces specified in table 4. During the period of steady state acceleration, the essential performance parameters shall be checked for compliance with the requirements stated in the relevant equipment specification. The equipment and its mounting shall remain undamaged during the test.

After the test, the equipment shall be visually checked for structural failure and then put into operation and its performance checked for compliance with the requirements of the relevant equipment specification.

This procedure shall be repeated in each of the six attitudes.

TABLE 3 — **Functioning test accelerations**

Equipment severity grade	Acceleration		Duration	
	linear $m/s^2 \pm 10\ \%$	equivalent to $g \pm 10\ \%$	of rise to, and fall from, steady state acceleration s	of constant acceleration[1] s
1	29,5	3	> 15	60 minimum
2	49,0	5	> 15	60 minimum
3	98,0	10	> 15	60 minimum

1) The duration of the steady state acceleration phase shall be as long as is necessary to make measurements of the essential performance parameters, or a minimum of 60 s.

NOTE — Since the orientation of an equipment installation varies from aircraft to aircraft, table 3 does not specify different acceleration figures for each of the six mounting attitudes.

TABLE 4 — **Structural integrity test accelerations**

Equipment severity grade	Acceleration		Duration	
	linear $m/s^2 \pm 10\ \%$	equivalent to $g \pm 10\ \%$	of rise to, and fall form, steady state acceleration s	of constant acceleration[1] s
1	98	10	> 15	60 minimum
2	98	10	> 15	60 minimum
3	196	20	> 15	60 minimum

1) The duration of the steady state acceleration phase shall be as long as is necessary to make measurements of the essential performance parameters, or a minimum of 60 s.

NOTE — Since the orientation of an equipment installation varies from aircraft to aircraft, table 4 does not specify different acceleration figures for each of the six mounting attitudes.

10 SEQUENCE OF TESTS

10.1 General case

The functional and structural integrity tests shall be performed in the following order :

1) a functioning test with performance check in accordance with 9.1, once in each of the six attitudes, followed by

2) a structural integrity test with performance check, once in each of the six attitudes.

10.2 Special cases

10.2.1 To limit the number of operations involving the re-positioning of the equipment on the test apparatus, and if permitted by the relevant equipment specification, the structural integrity test may immediately follow the functioning test once in each of the six attitudes.

10.2.2 For category C equipment, the structural integrity test may be made directly, but using the functioning test procedure, if permitted by the relevant equipment specification.

11 INFORMATION TO BE STATED IN THE RELEVANT EQUIPMENT SPECIFICATION

When this test is a requirement in the relevant equipment specification, the following details shall be supplied, as far as they are applicable :

	Relevant sub-clause(s)
1) Appropriate test apparatus	5.1.1, 5.1.2 and 5.2.2
2) Relaxations of acceleration forces applied to specific parts of equipment	5.2.1
3) Special considerations to be observed when testing sensitive equipment	5.2.2
4) Orientation of the equipment	6.1
5) Equipment severity grade	8.1 and table 1
6) Equipment structural integrity category	8.2(2) and table 2
7) Essential performance parameters to be checked during functioning test or structural integrity test	9.1 or 9.2.3
8) Performance check to follow functioning test and/or structural integrity test	9.1, 9.2.1 and 9.2.3
9) Sequence of tests	10.2
10) Variations in number of test attitudes (if necessary)	–