INTERNATIONAL STANDARD 2653

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Environmental tests for aircraft equipment — Part 2.3 : Ice formation

Essais en environnement pour les équipements aéronautiques — Partie 2.3 : Formation de glace

First edition — 1975-11-01

UDC 629.7

Ref. No. ISO 2653-1975 (E)

Descriptors : aircraft equipment, tests, environmental tests, ice formation.

Price based on 3 pages

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 2653 was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and circulated to the Member Bodies in May 1974.

It has been approved by the Member Bodies of the following countries :

Australia	Italy	Thailand
Austria	Japan	Turkey
Belgium	Netherlands	United Kingdom
Canada	Poland	U.S.S.R.
Czechoslovakia	Romania	Yugoslavia
France	South Africa, Rep. of	
Germany	Spain	

The Member Body of the following country expressed disapproval of the document on technical grounds :

U.S.A.

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

Printed in Switzerland

Environmental tests for aircraft equipment — Part 2.3 : Ice formation

0 INTRODUCTION

Icing tests are specified to simulate the effect that occurs when an aircraft flying in a cold atmosphere encounters free water or descends through cloud or into a moist atmosphere near the ground. Ice may build up on the equipment immediately, or frosting or condensation may occur and freeze to ice, of a thickness dependent upon the quantity of moisture in the air, the temperature and the thermal capacity of the equipment. Such tests also simulate the converse effect when water, which may have been trapped or has condensed inside an equipment, or may have collected in pockets on the outside either through wet conditions on the ground or through accumulation of moisture by frosting and subsequent melting of the frost, freezes as the aircraft ascends.

The accretion of ice, from whatever cause, may interfere with the necessary movement of parts. Films of ice may form on normally open electric contacts and maintain an open circuit even when the contacts are operated.

Three different tests are specified in this International Standard, each of which has a specific field of application. The relevant equipment specification will prescribe which test is to be used and also the appropriate functional checks.

Details of a further test for ice accretion may be found in ISO/TR 2654. This test is applicable to equipment installed in a forward facing location external to the aircraft or in an intake duct and where under conditions of near or sub-zero temperatures ice may be formed under the impact of super-cooled water droplets or ice crystals.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of test for evaluating the effect of various icing conditions on the performance of components or equipment in aircraft, namely :

1) the performance of equipment with ice or frost adhering to it;

2) the effects of refrozen water from molten ice or from condensation;

3) the performance of the equipment's anti-icing or de-icing system.

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)]

ISO/TR 2654, Environmental tests for aircraft equipment — *Part 2.4 : Ice accretion.*[2)]

3 GENERAL TEST PROCEDURES

3.1 General

The equipment to be tested shall, in all cases, be in a condition as initially installed. Unrepresentative coatings and contaminants, such as oil, grease and dirt, which could affect the adhesion between the ice and the surfaces of the equipment, shall be removed before commencing the test.

The icing test selected from the following three tests, and specified in the relevant equipment specification, shall be conducted in accordance with the procedures specified in the following clauses.

3.2 Test requirements

For the purposes of this International Standard, the appropriate requirements stated in ISO 2650 shall apply.

1) At present at the stage of draft.

2) In preparation.

3.3 Initial measurements

The equipment shall be visually examined and electrically and/or mechanically checked, as required by the relevant equipment specification.

3.4 Operational checks

The operation of the equipment shall be checked at the most adverse phase of the test, which for most applications would be a switch-on or start-up under icing conditions. Excessive operation of equipment which generates heat shall be avoided since this could mitigate the effects of this test.

For tests demonstrating survival of the equipment only, the equipment shall be operated and performance evaluation made when the temperature and humidity have returned to standard laboratory conditions.

4 TEST A

4.1 Field of application

This test is applicable to equipment in which there is movement of parts, for example electrical contacts, contained within a non-sealed enclosure[1] and where the equipment is so located and its duty cycle is such that the temperature of the equipment could vary during flight and on the ground within limits that would produce conditions of both condensation and freezing.

The relevant equipment specification shall specify whether it is permissible during the functioning tests for more than one attempt to be made to obtain satisfactory operation.

The testing of equipment in which the progressive accumulation of free water is experienced shall be conducted in accordance with test B (clause 5).

4.2 Procedure

The test shall be conducted in accordance with the requirements of the "temperature/pressure/humidity test sequence test" (method 2), specified in ISO 2651, and may for convenience form part of that test.

When the temperature of the equipment has risen to $-5 \pm 3\ ^{\circ}C$ and before the restoration of the chamber pressure to ground level, a functional test shall be conducted to check for satisfactory operation.

If, in the case of vented equipment, there is a possibility of the vent hole(s) being closed by the presence of ice, the test procedure shall be amended so that pressure is restored before the ice has melted.

4.3 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 stated, as far as they are applicable :

	Relevant clause
1) Object of test	1
2) Initial measurements	3.3
3) Operational checks	3.4
4) Permissible number of attempts to operate	4.1

5 TEST B

5.1 Field of application

This test is applicable to all equipment in which there is movement of parts and where such movement could be prevented or impeded by ice forming as the result of progressive accumulation of water inside non-sealed enclosures where positive drainage is not provided.

5.2 Procedure

The equipment shall be conditioned to a temperature not higher than $-20\ ^{\circ}C$ until temperature stabilization has been achieved. The chamber pressure shall then be reduced to that used in the "low temperature/low pressure" test specified in ISO 2651 but not lower than an altitude of 15 200 m (50 000 ft).

After a period of not less than 10 min, the temperature of the chamber shall be raised at a rate not exceeding $3\ ^{\circ}C$/min and the chamber humidified so that its humidity is held at or close to saturation. The chamber temperature shall not at any time exceed $+30\ ^{\circ}C$.

When the equipment temperature has reached a temperature above $0\ ^{\circ}C$ and after a period which would allow all frost or ice to melt, the pressure shall be increased to that corresponding to ground level at a uniform rate in a period of 15 to 30 min. At the completion of the repressurization, the next cycle shall be commenced.

A total of twenty-five such cycles shall be made consecutively.

If it becomes necessary to interrupt this sequence, the interruption shall take place whilst the equipment is held in the low temperature conditions.

A functional check, or checks, shall be made in the final cycle, as required by the relevant equipment specification, at the lowest temperature in the cycle (i.e. $-20\ ^{\circ}C$ or below).

1) A non-sealed enclosure is one into which moist air may penetrate during the test.

5.3 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 stated, as far as they are applicable.

		Relevant clause
1)	Object of test	1
2)	Initial measurements	3.3
3)	Operational checks	3.4 and 5.2

6 TEST C

6.1 Field of application

This test is applicable to items mounted externally or in non-temperature-controlled bays where there is a real risk of accretion of free water which could subsequently freeze on the cold surfaces of the items. The test is intended to examine the effects of a representative thickness of ice on the performance of the item, or to determine the maximum thickness that can be permitted before de-icing action is necessary.

The relevant equipment specification shall state the thickness and distribution of ice or whether a progressive build-up of ice is required.

6.2 Procedure

The equipment shall be conditioned in a low-temperature chamber until its temperature has stabilized at a level, determined by previous experiments, that will permit hard, clear ice to form on the item when water is sprayed upon it. The optimum temperature is likely to be between − 1 and − 10 °C depending upon the thermal mass of the item.

A homogeneous layer of hard clear ice (not white or air pocketed) shall be produced on the relevant surfaces of the item, to the required thickness and distribution, by hand spraying with a fine mist of water the temperature of which is close to freezing.

When the ice accretion has reached the level specified in the relevant equipment specification, spraying shall be stopped and the test temperature restabilized, unless otherwise stated, at the relevant "low temperature/low pressure" test low temperature given in table 1 in ISO 2651 before making the performance checks required by the relevant equipment specification.

For tests requiring a progressive increase in the thickness of ice, and when it is important that the ice be homogeneous (not layered), separate tests shall be made in which the ice is formed to the specified thickness in one continuous operation.

6.3 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 stated, as far as they are applicable.

		Relevant clause
1)	Object of test	1
2)	Initial measurements	3.3
3)	Required build up of ice	5.1
4)	Operational checks	3.4