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1972

Specification for

# General requirements for equipment in aircraft —

## Part 2: All equipment —

## Section 3: Environmental conditions —

## Subsection 3.9: Ice formation

Confirmed
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# Foreword

This British Standard is part of a composite standard in the Aerospace Series of British Standards specifying general requirements for equipment in aircraft. An introduction to the complete British Standard is given in British Standard 3G. 100-0.

This subsection of this standard supersedes the icing requirements stated in the current revision of 2G. 100-2 (Clauses **210** and **211**). It details three types of test to evaluate the effects of the formation of ice on aircraft equipment.

A further British Standard in the Aerospace Series relating to the accretion of ice by external equipment exposed to supercooled water droplets or ice crystals is in the course of preparation.

This subsection makes reference to the following British Standards:

3G. 100-2-3.0, *Standard test requirements.*

3G. 100-2-3.2, *Temperature-pressure requirements.*

NOTE The figures in metric units are to be regarded as the standard. The conversions to imperial units are approximate. Accurate conversions should be based upon BS 350, "Conversion factors and tables". Information concerning metric (SI) units is given in BS 3763, "The International System of units (SI)".

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**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 3 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.


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## 1 Scope

This British Standard defines tests to evaluate the effect of various icing conditions on the performance of components or equipment in aircraft. It should be read in conjunction with
British Standard 3G. 100-0.

Three different tests are given, 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.

## 2 General

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 and the temperature and the thermal capacity of the equipment. The tests also simulate the converse effect when water, which may have been trapped or has condensed inside 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.

The tests specified in the following clauses are intended to evaluate:

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 equipments' anti-icing or de-icing system.

The objective of the test shall be clearly stated in the relevant equipment specification.

## 3 General Test Procedures

**3.1 Test conditions.** The item to be tested shall, in all cases, be in a condition representative of operational use. Un-representative 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 this test.

**3.2 Test details.** The selected icing test specified in the relevant equipment specification shall be conducted in accordance with the procedures described in the following clauses.

**3.3 Test requirements.** For the purposes of this standard the appropriate requirements stated in British Standard 3G. 100-2-3.0, shall apply.

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

**3.5 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 should be avoided since this could mitigate the effects of the test.

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

## 4 Test A

**4.1 Field of application.** This test applies to equipment in which there is movement of parts, e.g. 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 permissable during the functioning tests for more than one attempt to be made to obtain satisfactory operation.

**4.2 Test procedure.** The test shall be conducted in accordance with the requirements of Test D, Method 2, Specified in
British Standard 3G. 100-2-3.2, and may for convenience form part of that test.

When the temperature of the equipment has risen to – 5 ± 3 °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.

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

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**4.3 Information to be stated in the relevant specification.** When this test is a requirement in the relevant equipment specification the following information shall be stated, as far as is applicable:

| | | Relevant clause |
|---|---|---|
| 1) | Object of test | **2** |
| 2) | Initial measurements | **3.4** |
| 3) | Operational checks required | **3.5** |
| 4) | Permissible number of attempts to operate | **4.1** |

## 5 Test B

**5.1 Field of application.** This test applies 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 Test procedure.** The equipment shall be conditioned to a temperature of – 20 °C until temperature stabilization has been achieved. The chamber pressure shall then be reduced to that used in Test C specified in
British Standard 3G. 100-2-3.2, but not lower than at 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 °C per minute and humidified so that the chamber humidity is held at or close to saturation. The chamber temperature shall not at any time exceed + 30 °C.

When the equipment has reached a temperature above 0 °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 min 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 condition.

**5.2.1** A functional check, or checks, shall be made, as required by the relevant equipment specification, at the lowest temperature in the cycle.

**5.3 Information to be stated in the relevant specification.** When this test is a requirement in the relevant equipment specification the following information shall be stated, as far as is applicable:

| | | Relevant clause |
|---|---|---|
| 1) | Object of test | **2** |
| 2) | Initial measurements | **3.4** |
| 3) | Operational checks | **3.5** and **5.2.1** |

## 6 Test C

**6.1 Field of application.** This test applies 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.

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

**6.2 Test 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 °C 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 formation has reached the level specified in the relevant equipment specification, spraying shall be stopped and the test temperature restablized, unless otherwise stated, at the relevant Test C low temperature given in Table 1 and Table 2 of Part 2:Section 3:Subsection 3.2 of
British Standard 3G. 100, before making the performance checks required by the relevant equipment specification.

**6.2.1** 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.


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**6.3 Information to be stated in the relevant specification.** When this test is a requirement in the relevant equipment specification the following information shall be stated, as far as is applicable:

| | | Relevant clause |
|---|---|---|
| 1) | Object of test | **2** |
| 2) | Initial meaurements | **3.4** |
| 3) | Required build-up of ice | **6.1.1** |
| 4) | Operational checks | **3.5** |

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