INTERNATIONAL STANDARD

**ISO 9662**

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# Aircraft equipment — Environmental and operating conditions for airborne equipment — Humidity, temperature and pressure tests

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*Équipements aéronautiques — Conditions d'environnement et de fonctionnement pour les équipements embarqués — Essais d'humidité, de température et de pression*

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## Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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## Introduction

This International Standard is intended to apply primarily to equipment in regions of civil and transport aircraft where induced changes in atmospheric conditions result in frosting, external and internal condensation and moisture ingress.

Equipment will experience these conditions as the aircraft descends from low temperature at high altitude into a warmer atmosphere. This is particularly relevant to equipment which is not totally sealed and where the accompanying change in pressure can aggravate the effect causing ingress of moisture.

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# Aircraft equipment — Environmental and operating conditions for airborne equipment — Humidity, temperature and pressure tests

## 1 Scope

This International Standard, which is applicable primarily to civil and transport aircraft, specifies the test requirements for aerospace equipment which could be subjected to moisture ingress, frosting and condensation, resulting from the passage through atmospheric conditions of high humidity, in combination with or induced by changing temperature and pressure.

It specifies various test procedures which can be invoked when required by an equipment design and requirement specification.

This International Standard permits the selection of specific test conditions and methods that define acceptance requirements for aerospace equipment which may be subject to induced condensation and humidity.

The conditions are more likely to occur in an unconditioned bay but may also occur in a conditioned bay when the equipment has a short thermal transmission path to an external airframe structure. The incidence of this form of condensation is also influenced by the duty cycle of the equipment and its thermal characteristics.

This test is not intended to reveal the defects ensuing from prolonged exposure to high humidity such as may occur on the ground in tropical climates, a suitable test for this environment is given in ISO 7137.

Also this test is not intended to simulate the hazards of local ice formation, in which case reference should be made to the icing tests defined in ISO 7137, test procedure 1.4.

## 2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7137:1992, *Aircraft — Environmental conditions and test procedures for airborne equipment (Endorsement of EUROCAE/ED-14C and RTCA/DO-160C).*

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## 3 Conventions

In this International Standard, altitudes and pressures are expressed in conformity with the practice of ICAO.

## 4 Test applications

Three different tests are specified in this International Standard and the appropriate equipment specification should state which of the following is to be applied.

Test No. 2 shall be invoked in instances when the appropriate test method is not obvious.

### 4.1 Test No. 1

This test appies to items whose performance could be immediately and adversely affected by moisture condensation. The method is particularly applicable to equipment of an enclosed or partially sealed construction, where the pressure change due to altitude arising from one flight descent phase could induce the ingress of moisture.

### 4.2 Test No. 2

This test applies to equipment, or equipment containing items of enclosed or partially sealed construction where the cumulative effects of condensation over a number of flight descents would be needed to adversely affect the performance of the equipment.

### 4.3 Test No. 3

This test applies to items of open construction whose performance could immediately and adversely be affected by moisture condensation, but where the pressure changes due to altitude would have no influence.

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## 5 Test procedures

See figure 1.

### 5.1 Test No. 1

#### 5.1.1 Step 1

Place the test item inside the test chamber at laboratory ambient conditions and make any connections necessary through the chamber wall to apply power and to monitor test item performance.

Conduct a functional performance test in accordance with the equipment specification.

#### 5.1.2 Step 2

Reduce the temperature inside the chamber at a rate not exceeding 3 °C/min to − 20 °C ± 2 °C, or to the temperature specified by the equipment specification (see ISO 7137, test procedure 1.1).

Allow the test item to stabilize at the specified temperature, or condition for a period defined in the equipment specification.

#### 5.1.3 Step 3

Reduce the ambient pressure inside the chamber to represent the specified equivalent altitude over a period of 15 min.

#### 5.1.4 Step 4

Maintain the conditions obtained in steps 2 and 3 for a minimum period of 30 min.

#### 5.1.5 Step 5

a) With the prevailing pressure maintained, increase the temperature inside the chamber to + 30 °C ± 2 °C at an approximately uniform rate over a period of 1 h to 2 h and introduce moisture to produce relative humidity of not less than 95 %.

   Ensure that frosting or condensation occurs on the surface(s) of the test item.

b) Maintain this condition for a sufficient period of time to melt all frost and ice, or until the surface temperature of the equipment reaches 0 °C to + 5 °C, then begin restoring the pressure inside the chamber to that corresponding to ground level over a period of 15 min to 30 min.

NOTE 1 The point of introduction of moisture during the temperature increase is arbitrary. However, it is important to generate an atmosphere close to saturation and in which frosting or condensation occurs on the test item, before starting to restore the ambient pressure to corresponding ground level.

#### 5.1.6 Step 6

Maintain the damp heat conditions of + 30 °C and 95 % RH to 100 % RH for a minimum period of 1 h, or for a period sufficient to carry out a functional performance test, whichever is the longer (see 5.1.8).

#### 5.1.7 Step 7

On completion of step 6, allow the conditions inside the chamber to return to standard ambient conditions and allow the test item to stabilize.

Carry out a visual inspection for ingress of water if specified in the relevant equipment specification.

#### 5.1.8 Operation of test item for test No. 1

Operate the test item during exposure to the climatic cycle as required by the relevant equipment specification.

Equipment required to operate throughout the flight, including takeoff, landing and taxiing (steps 1 to 6 inclusive), or which only has power applied during the descent phase (steps 5 and 6), shall be operated on a representative duty cycle during exposure to the climatic environment.

Unless required by the relevant equipment specification, equipment normally idle during the descent phase shall not be operated until the temperature and humidity inside the chamber (step 6) have stabilized at + 30 °C and 95 % RH.

Unless specified otherwise in either case, the conditions in step 6 shall be maintained and operation of the test item shall continue for a period of 1 h, or for a period sufficient to carry out a performance test, whichever is the longer. Power to the test item shall then be switched off.

When the test item has stabilized at laboratory ambient conditions, in accordance with step 7, conduct a functional performance test in accordance with the relevant equipment specification.

## 5.2 Test No. 2

### 5.2.1 Step 1

Subject the test item to the procedure defined in 5.1.1 to 5.1.6 to constitute the first cycle.

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### 5.2.2 Step 2

Repeat the procedure of 5.1.2 to 5.1.6 three times to produce a total of four cycles.

If specified in the relevant equipment specification, either:

a) allow the test item to stabilize between cycles in accordance with 5.1.7 to constitute a 24 h cycle; or

b) immediately start the next cycle following 5.1.6 by returning directly to the specified low temperature.

If option a) is selected, no "artificial" drying out procedure shall be carried out between cycles.

### 5.2.3 Step 3

On completion of step 6 of the fourth cycle, allow the conditions inside the chamber to return to standard ambient conditions and allow the test item to stabilize.

Carry out a visual inspection for ingress of water if specified in the relevant equipment specification.

### 5.2.4 Operation of the test item for test No. 2

Operation of the test item should be generally in accordance with the requirements of 5.1.8.

If required by the relevant equipment specification, additional functional performance tests may be carried out, e.g. if option a) of step 2 is selected, conduct a functional performance test towards the end of the stabilization period between climatic cycles.

## 5.3 Test No. 3

Two alternative procedures are permitted in accordance with 5.3.1 and 5.3.2. Procedure B is recommended where operation of the equipment is specified during exposure.

### 5.3.1 Procedure A: Two chamber method

a) Place the test item in a low temperature test chamber at standard ambient conditions and lower the temperature to − 20 °C ± 2 °C or as specified in the relevant equipment specification at a rate not exceeding 3 °C/min. Allow the test item to stabilize at the specified temperature, or condition for a period defined in the equipment specification.

b) Transfer the test item to a humidity chamber in which the working volume has been previously conditioned at + 30 °C ± 2 °C and humidity of not less than 95 % RH.

Make the transfer as quickly as possible, but in any case in a time not exceeding 15 min, this latter period applying only to complex equipment involving handling problems.

Make any connections necessary through the chamber wall to apply power and to monitor test item performance.

NOTE 2 The arrangement for the transfer of the test item between chambers requires appropriate planning in order to minimize the time that the doors and cable access ports are open and the time necessary to restore the applied environment.

c) When the temperature and humidity inside the test chamber have stabilized at + 30 °C and 95 % RH to 100 % RH, condition the test item for a minimum period of 1 h, or for a period sufficient to carry out a functional test, whichever is the longer.

d) On completion of c), allow the conditions inside the humidity chamber to return to standard ambient conditions and allow the test item to stabilize.

Carry out a visual inspection for ingress of water if specified in the relevant equipment specification.

### 5.3.2 Procedure B: One chamber method

a) Place the test item in the climatic chamber and begin the test procedure in accordance with 5.3.1 a).

b) Introduce heat and moisture such that the temperature inside the chamber is raised from the specified low temperature to + 30 °C ± 2 °C in 1 h to 2 h. Do not allow the rate of temperature change to exceed 3 °C/min at any time.

During this transitional period, hold the humidity close to saturation (nominally not less than 95 % RH).

c) Condition the test item in accordance with 5.3.1 c).

d) Allow the conditions inside the climatic chamber to return to standard ambient conditions and allow the test item to stabilize.

Carry out a visual inspection for ingress of water if specified in the relevant equipment specification.

### 5.3.3 Operation of the test item for test No. 3

Operation of the test item shall be in accordance with the requirements of the relevant equipment specification.

For procedure A, it is anticipated that operation of the test item will only be required when the temperature and humidity conditions inside the chamber have stabilized. Unless otherwise specified, apply power and operate the test item for 1 h, or for a sufficient period to conduct a specified functional performance test, whichever is the longer.

For procedure B, operation of the test item shall be generally in accordance with the operating requirements for test No. 1 (see 5.1.8).

## 6 Test facilities

The test chamber required to carry out these tests is more complex and, therefore, more expensive than those necessary to apply the individual environments.

However, the prime purpose of the tests is to demonstrate compatibility and/or vulnerability of the test item when exposed to the aggravated conditioning which occurs during the transition from flight to ground conditions. This would not be properly demonstrated by tests representing the individual environments. Frosting, melting/condensation and the induced ingress of moisture are the essential ingredients of this test.

Whilst it is important to maintain good environmental testing practice, control of some of the test parameters may be relaxed in comparison with those tests for the individual environments, thereby helping to reduce the complexity and cost of a suitable test chamber, e.g. the rates of change of pressure and temperature may be considered average values for the transition stages of test Nos. 1, 2 and 3, procedure B.

In those cases where a closer control of the test conditions are considered important and cost effective, the relevant equipment specification should detail any necessary amendments to the test parameters or test procedure.

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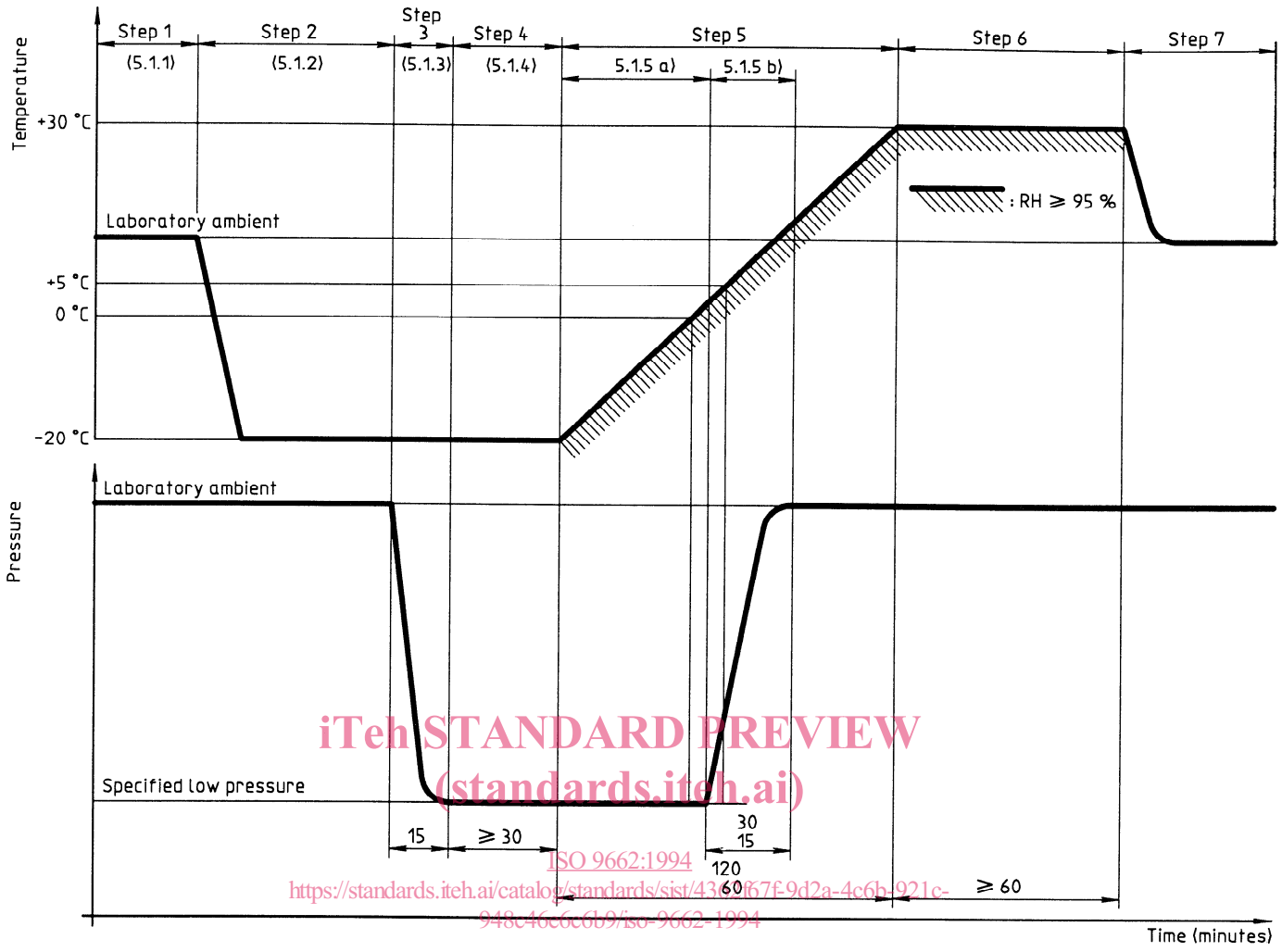


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NOTE — For test No. 2, the relevant equipment specification shall state whether option a) or option b) is required (see 5.2.2).

**Figure 1 — Humidity/temperature/pressure profile for test Nos. 1 and 2**