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Aerospace series — Lamps, incandescent — Test methods

ICS 49.060

National foreword

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Foreword

This document (EN 2756:2010) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

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1 Scope

This standard specifies the test methods for incandescent lamps used for aerospace applications.

It concerns lamps used for lighting and/or for interior or exterior signalling.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2240-001:2009, *Aerospace series — Lamps, incandescent — Part 001: Technical specification*

EN 2240-002, *Aerospace series — Lamps, incandescent – Part 002: Main characteristics*

ISO 2678, *Environmental tests for aircraft equipment — Insulation resistance and high voltage tests for electrical equipment*

ISO 7137, *Aircraft — Environmental conditions and test procedures for airborne equipment*

IEC 60061-3, *Lamp caps and holders together with gauges for the control of interchangeability and safety — Part 3: Gauges*

3 Tests

3.1 Test conditions

Unless otherwise specified, the tests shall be carried out under the following conditions:

— ambient temperature: 15 °C to 35 °C;

— atmospheric pressure: 84 kPa to 107 kPa;

— relative humidity < 85 %.

Prior to all tests, the lamps shall be placed in these conditions for 1 h. The atmosphere of the environment shall not undergo any significant variations during a series of tests. (See ISO 7137.)

NOTE Each lamp subjected to tests shall be the object of individual monitoring.

3.2 Visual examination

3.2.1 External appearance

The lamps shall not present any defect capable of having an adverse effect on their installation or correct functioning; they shall conform with the characteristics specified in the product standards.

The bulb shall have a regular shape and shall not exhibit any defect which may adversely affect utilization.

The form and position of the filament shall conform with the indications given in EN 2240-002.

3.2.2 Quality of marking

The marking of lamps shall be legible and remain so after all the tests. It shall contain the indications specified in EN 2240-001.

3.3 Mass and dimensions

The mass should not exceed the values defined in the product standards by more than 10 %. The dimensions shall conform with the indications given in the product standards.

The dimensional interchangeability of the lamps shall be checked in individual cases by means of the gauge defined by IEC 60061-3 or by means of the gauge defined in the product standard.

3.4 Electrical and photometric tests

3.4.1 General

Before the electrical and photometric tests, the lamps shall be stabilized by energizing them at nominal voltage.

For the qualification tests, this stabilization shall be effected by energizing them at nominal voltage for 10 h.

NOTE For the photometric tests, the ambient temperature to which the lamps is subjected shall not exceed the values specified at 3.1.

3.4.2 Homogeneity of filament

When the lamp is energized at 50 % of nominal voltage, the filament shall appear homogenous and exhibit a uniform brightness except in the vicinity of points of contact with the support(s) and at the leadwires, where account shall be taken of the cooling effect.

3.4.3 Luminous flux at nominal voltage

The lamp shall be placed in a correctly calibrated integrating photometer (e.g.: Ulbricht sphere) where it is supplied with direct current at stabilized nominal voltage; the tolerance under test voltage shall be fixed at:

— $\pm$ 0,1 % for a test voltage $>$ 6 V;

— $\pm$ 0,2 % for a test voltage $\leq$ 6 V.

When thermal equilibrium has been reached, the intensity of the electric current and the luminous flux are measured.

The power consumed shall be equal to the nominal value to within $\pm$ 10 %.

The luminous flux recorded shall be equal to the nominal values specified in the product standards, taking account of the tolerances ($\pm$ 25 %, $\pm$ 15 %, $\pm$ 10 %) appropriate to the category of lamp.

3.4.4 Luminous flux at reduced voltage

This test concerns the lamps for use at reduced voltage.

The lamp shall first be subjected to tests specified in 3.4.3.

The lamp shall then be energized with direct current at reduced stabilized voltage as specified in the product standard applying the same tolerance as under 3.4.3.

When thermal equilibrium is reached, the electric intensity and the luminous flux are measured.

The luminous flux measured shall be equal to the value imposed in the product standard to within ± 25 %.

3.4.5 Colour temperature of the filament

This test shall apply to clear glass lamps (colourless glass) under nominal conditions of use when the colour temperature is mentioned in the product standards.

The lamp to be measured shall be energized at nominal voltage for a period of time which is sufficient to allow thermal equilibrium to be reached. Then the colour temperature shall be measured, recording at the same time the intensity of the current passing through the lamp.

The following measuring methods may be used:

— interpolation method based on the ratio of the red/blue luminous flux and by reference to the known colour temperature of three gauge lamps energized under specified conditions (the colour temperatures of these gauges lamps shall encompass the value specified for the lamps examined);

— Ulbricht sphere with a two-colour pyrometer;

— Ulbricht sphere with a coloured measuring head and measuring device;

— pyrometer with incandescent filament.

Requirement: the colour temperature should conform with the nominal value mentioned in the product standards. The measured value shall be only for information if not otherwise specified.

NOTE In the event of discrepancy between the results obtained by means of these different methods, the method of interpolation based on the ration of the red/blue luminous flux and by reference to the gauge lamps shall be taken as the reference method.

3.4.6 Voltage strength and insulation resistance

3.4.6.1 Measurements to be undertaken on lamps in which the filament shall be supplied by a free wire or on bi-pin lamps

After mechanical destruction of the filament, the following tests shall be carried out:

a) voltage strength test in accordance with ISO 2678.

An alternating voltage is applied between the two power leads under the following conditions:

1) alternating current 500 V r.m.s, 50 Hz to 60 Hz;

2) method of application: progressive;

3) duration of application: 1 min.

Requirements:

4) there shall be no breakdown;

5) the value of the leakage current shall not exceed 0,5 mA (r.m.s.);

b) insulation resistance in accordance with ISO 2678.

A test voltage of 50 V d.c. to 100 V d.c. is applied between the two power leads.

The resistance is measured after 1 min of application.

Requirement:

— insulation resistance ≥ 100 MΩ.

3.4.6.2 Measurements to be undertaken on lamps equipped with a single-contact cap

After mechanical destruction of the filament, the tests set out in 3.4.6.1, a) and b) shall be carried out, applying the test voltages between the contact and the outer casing of the cap.

3.4.6.3 Measurements to be undertaken on lamps the filament of which shall be supplied by two contacts insulated from the outer casing of the cap

3.4.6.4 Measurements to be undertaken between the outer casing of the cap and one of the contacts (or the two contacts joined together)

a) voltage strength test in accordance with ISO 2678.

An alternating voltage shall be applied between the two power leads under the following conditions:

1) alternating voltage 500 V r.m.s, 50 Hz to 60 Hz;

2) method of application: progressive;

3) duration of application: 1 min.

Requirements:

4) there shall be no breakdown, nor flashover;

5) the value of the leakage current shall not exceed 0,5 mA (r.m.s.);

b) insulation resistance in accordance with ISO 2678.

A test voltage of 50 V d.c. to 100 V d.c. shall be applied between the outer casing of the cap and one of the contacts.

The resistance is measured after 1 min of application.

Requirement:

— insulation resistance ≥ 100 MΩ.

3.4.6.5 Measurements to be undertaken between the two contacts

After mechanical destruction of the filament, the tests set out in 3.4.6.2, a) and b) shall be carried out, applying the test voltages between the two contacts.

3.4.7 Life

3.4.7.1 General

The life to be taken into account shall be the value specified in the product standard.

Two types of tests are applied to verify the life of the lamps.

The duration of static life (3.4.7.2) and the duration of dynamic life (3.4.7.3) are specified in the product standard.

Unless otherwise specified in the product standards, the tests are carried out on lamps which are so positioned that their axis is horizontal.

The power supplies used are such that the electric current is not limited when the lamps are energized.

3.4.7.2 Static tests

Half of the lamps are supplied with direct current, the other half with alternating current.

The duration of test is determined on the basis of the life indicated in the product standards (duration of static life):

a) for lamps with a life of less than or equal to 4 000 h, the test duration is equal to the life; during this test, the lamps are energized at nominal voltage;

b) for lamps with a life of more than 4 000 h, the duration of the test is equal to $\frac{\text{life}}{3,5}$; during the test, the lamps shall be energized at a voltage equal to 1,1 times the nominal voltage.

During the course of the test, the lamps are extinguished twice every 24 h for approximately 30 min each time.

The following measurements are taken:

c) during the course of the test, at the end of a period corresponding to half of tests [in practice, (50 ± 5) % of the total test duration], measurement of electric intensity and of luminous flux is in accordance with 3.4.2;

Requirements:

— the luminous flux and the electric intensity shall remain within the tolerances specified in 3.4.2;

a) at the end of the tests, measurement of electric intensity and luminous flux is in accordance with 3.4.2.

Requirements:

the characteristics shall remain within the tolerances set out below:

1) electric intensity: nominal value ± 15 %;

2) luminous flux: nominal value ± 30 %.

3.4.7.3 Dynamic tests

The lamps are supplied with direct current.

These tests consist of several successive phases intended to evaluate the behaviour of the lamps in different environments. After each phase and before executing the measures, the lamps undergo an overhauling obtained by lighting them during 1 h at nominal voltage in the test conditions (3.1).

The tests are carried out in the order indicated below.

Phase A (see Figure 1)

Tests at ambient temperature: 15 °C to 35 °C.

Duration of test: $\frac{\sqrt{T}}{2}$ where T is the duration of dynamic life specified in the product standard.

The lamps are energized at nominal voltage under the conditions indicated as follows:

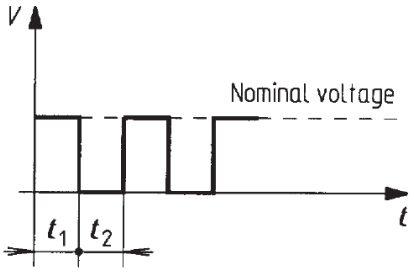

Figure 1

During this phase, the lamps are submitted to a succession of cycles ($t_1 + t_2$) specified as follows:

— $t_1 = (30 \pm 2)$ s, lamps energized at nominal voltage;

— $t_2 = (30 \pm 2)$ s, lamps shall not energized.

Then, measure the intensity of current and the luminous flux according to 3.4.3.

Requirements: as 3.4.3.

Phase B (see Figure 2)

Tests at low temperature: – 55 °C.

Duration of test: $\frac{\sqrt{T}}{2}$ where T is the duration of dynamic life specified in the product standard, in hours (h).

The lamps are energized at nominal voltage under the conditions indicated as follows:

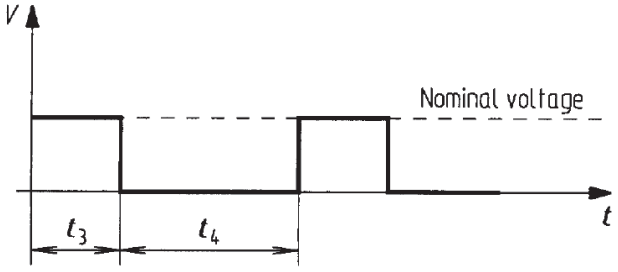

Figure 2

During this phase, the lamps are submitted to a sequence of cycles ($t_3 + t_4$) specified as follows:

— t_3 = (120 ± 10) s, lamps energized at nominal voltage;

— t_4 = (240 ± 10) s, lamps not energized.

Then measure the intensity of current and the luminous flux according to 3.4.3.

Requirement: as 3.4.3.

Phase C

Tests in dry heat: 85 °C.

Duration of test: 2 $\sqrt{T}$, where T is the duration of dynamic life specified in the product standard, in hours (h).

During this phase, the lamps are energized at nominal voltage.

Then, measure the intensity of current and the luminous flux according to 3.4.3.

Phase D

Tests at ambient temperature: 15 °C to 35 °C.

Duration of test: 3 $\sqrt{T}$, where T is the duration of dynamic life specified in the product standard, in hours (h).

During this phase, the lamps are energized at 1,1 times nominal voltage.

Then, measure the intensity of current and the luminous flux according to 3.4.3.

Requirements:

— power absorbed: initial value ± 5 %;

— luminous flux: initial value ± 10 %.

Phase E

Vibration tests: test in accordance with 3.5.2.

During this phase half of the lamps are energized (at nominal voltage), the other half are not.

Requirements:

— the lamps shall be lighted.

3.5 Mechanical tests

3.5.1 Test support

The support used shall exhibit the mechanical characteristics specified in ISO 7137.

3.5.2 Vibration resistance test

The test procedures are in conformity with ISO 7137 (sinusoidal vibrations), the excitation curve is defined as follows:

— From 5 Hz to 18 Hz, constant displacement = 1,5 mm;

— From 18 Hz to 33 Hz, constant acceleration = 20 m/s^2 (2 g_n);

— From 33 Hz to 52 Hz, constant displacement = 0,45 mm;

— From 52 Hz to 2 000 Hz, constant acceleration = 50 m/s^2 (5 g_n).

The lamps are submitted to the tests following three perpendicular axes. The duration is 3 h per axis.

The sweeping 5 Hz - 2 000 Hz - 5 Hz is effected at the maximal logarithmic speed of 1 octave/min.

During the test the lamps are switched on then switched off in a 10 min/10 min cycle.

Requirement:

— after the test the lamps shall be switched on.

3.5.3 Impact resistance test

The impact resistance test shall be carried out in accordance with ISO 7137 (operational impacts), the lamps not being energized.

Requirement:

— after the test, the lamps shall be switched on.

3.5.4 Mechanical strength of caps test

3.5.4.1 Torque tests

It is applicable to the caps detailed in Table 1.

A torque value of which is specified in the Table 1 and axis of which coincides with that of the cap, is applied progressively between the bulb and the cap. This torque is maintained during (60 ± 5) s.

Table 1

Type of cap	BA7s	BA9s	BA15 BAY15	BA20d
Torque	0,2 Nm	0,3 Nm	0,5 Nm	1,5 Nm

Requirements:

— no modification of the lamp appearance, no deformation, no unsealement;

— the lamps shall be lighted.

3.5.4.2 Tensile tests

For bi-pin lamps, a tensile force of which the value is specified in Table 2 is applied progressively between the bulb and one of the pins, along the axis of this pin; the force is maintained for (60 ± 5) s. Then the same test is repeated under the same conditions on the other pin of the lamp.

For lamps fitted with a cap of type S, a tensile force of which the value is specified in Table 2, is applied progressively in accordance the longitudinal axis of the lamp, between the bulb and the cap. This force is maintained for (60 ± 5) s.

Table 2

Type of cap	Bi-pin All sizes	SX4s SY4s	SX6s S5,7s
Force	10 N	10 N	20 N

Requirements:

— no modification of the lamp appearance, no deformation, no unsealement;

— the lamps shall be lighted.

3.6 Climatic tests

3.6.1 Behaviour at extreme temperature test

3.6.1.1 General

Before applying the tests, the lamps shall undergo an overhauling obtained by lighting them during 1 h at nominal voltage in the test conditions (3.1).

3.6.1.2 Tests at minimal temperature conditions − 55 °C

Duration of test: $\sqrt{T}$, where T is the duration of dynamic life specified in the product standard, in hours (h).

The lamps are energized at nominal voltage under the conditions indicated as follows.

During this phase, the lamps are submitted to a sequence of cycles ($t_5 + t_6$) specified as follows:

— t_5 = (600 ± 20) s, lamps energized at nominal voltage;

— t_6 = (600 ± 20) s, lamps not energized.

Then, measure the intensity of current and the luminous flux according to 3.4.3.

Requirements:

— appearance as 3.2.1;

— marking as 3.2.2;

— intensity of current and luminous flux according to 3.4.3.

3.6.1.3 Tests at dry heat: 85 °C

The duration of test is determined from the duration of dynamic life, T, indicated in the product standard:

a) for the lamps with a life less or equal to 4 000 h, the duration of test is equal to 5 $\sqrt{T}$. During the test the lamps are energized at nominal voltage;

b) for the lamps with a life of more than 4 000 h, the duration of test is equal to $\frac{5\sqrt{T}}{3,5}$. During the test the lamps are energized at a voltage equal to 1,1 times the nominal voltage.

Requirements:

— appearance as 3.2.1;

— marking as 3.2.2;

— intensity of current and luminous flux according to 3.4.3.

3.6.2 Salt spray tests

The salt spray test shall be carried out in conformity with ISO 7137. The duration of test is limited to 48 h, the temperature being 35 °C and the saline solution at 5 %.

Requirement:

— after the test, the lamps shall not exhibit any defect which might adversely affect their correct functioning. The quality of the contacts shall in particular be verified.

3.7 Tests form

The tests form the subject of a report of synthesis centralizing the results stated on each of the lamps.

It comprises the following information:

— the date of tests;

— the list of test equipment and means of measurement;

— the designation of lamps submitted to the test (EN 2240-001:2009, 6.1);

— the applicable product standard (EN 2240-...);

— the No. of manufacture lot;

— the identification of each of the lamps submitted to the test;

— the tests carried out (referring to the subclauses of this standard);

— the results obtained for each of the identified lamps;

— the conclusion.

In the case of qualification tests, the tests are carried out according to the procedure defined in EN 2240-001:2009, 5.1. The test report shall be drawn up respecting the order mentioned in EN 2240-001:2009, 5.1.4.

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