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Anodizing of aluminium and its alloys — Accelerated test of light fastness of coloured anodic oxidation coatings using artificial light

Anodisation de l'aluminium et de ses alliages — Essai accéléré de solidité à la lumière artificielle des couches d'oxydation anodique colorées

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

This fourth edition cancels and replaces the third edition (ISO 2135:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the information on the test specimen has been added;

— the black panel temperature has been added;

— the instrumental assessment for colour change and gloss retention has been added;

— the specification of various light sources has been added as a new Annex A.

Anodizing of aluminium and its alloys — Accelerated test of light fastness of coloured anodic oxidation coatings using artificial light

1 Scope

This document specifies an accelerated test method for assessing the fastness, using artificial light, of coloured anodic oxidation coatings on aluminium and its alloys.

For evaluating light fastness on exterior exposure, only outdoor exposure under conditions comparable with actual service is completely satisfactory.

Accelerated testing is suitable as a quality-control test of coloured anodic oxidation coatings whose light fastness number has already been established by means of outdoor exposure testing.

The method is applicable to coloured anodic oxidation coatings on aluminium and its alloys produced by any means and for any purpose.

However, the method is not suitable for the measurement of coloured coatings with a light fastness number already established by means of outdoor exposure testing and of less than 6.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to glass-filtered solar radiation, natural weathering or laboratory radiation sources*

ISO 7583, *Anodizing of aluminium and its alloys — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7583 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Principle

Exposure of coloured anodic oxidation coatings to artificial light, regular observations of any colour change by comparison with the grey scale in accordance with ISO 105-A02 and instrumental assessment.

The apparatus and light source are first calibrated by exposing parts of coloured cloth samples having a light fastness number of 6 on the European blue scale (in accordance with 8.2.1, NOTE, 8.2.2 and ISO 105-B01). The time of exposure is determined for these samples to show a colour change corresponding to grade 3 of the grey scale (about 25 % loss of colour). This length of time is defined as the exposure cycle for the apparatus (see 8.2.2, NOTE).

Coloured anodized test specimens of unknown light fastness are then exposed under the same conditions as the standard cloth samples until they also show a colour change corresponding to grade 3 of the grey scale. The number of exposure cycles required to produce this colour deterioration is used to assign the light fastness numbers of the specimens tested (see 8.2).

5 Apparatus

For tests in artificial light, several types of apparatus fulfil the conditions stipulated in this document (see also 7.2).

Suitable light sources shall be provided by a xenon-arc lamp, open-frame carbon-arc lamp or enclosed carbon-arc lamp (the specifications of which shall be in accordance with Annex A).

6 Test specimen

6.1 Sampling

The test specimen shall be taken from a significant flat surface of the product and shall not be taken from part of the edge because of possible distortion and/or non-uniformity.

Where it is impossible to test the product itself, a test specimen may be used. However, in this case, the test specimen used shall be one which is representative of the product and it shall be made from the same material and prepared under the same conditions of finishing as those used for the preparation of the product.

The aluminium alloy, the manufacturing conditions (kind and temper of the material) and the surface condition before treatment shall be the same as those of the product.

Pretreatment, anodizing, colouring and sealing shall be performed in the same baths and under the same conditions as the treatment of the product.

6.2 Size

The standard size of the test specimen should be about 150 mm × 70 mm. Other sizes may be used based on agreement between the interested parties.

6.3 Treatment before testing

The test specimen shall be clean, free from dirt, stains and other foreign matter. Any deposits or stains shall be removed with a clean, soft cloth or similar material which is wetted by water or an appropriate organic solvent such as ethanol. Organic solvent which can corrode the test specimens or generate protective films on the test specimens shall not be used.

7 Procedure

7.1 Preparation of test specimen

In order to detect colour changes, partly cover the exposed surface of the test specimen by means of an opaque mask.

7.2 Exposure conditions

Expose the test specimens in such a way that they are equidistant from the light source, around which they revolve slowly in order to ensure an identical distribution of light on each test specimen. If a flat bed type apparatus is used, this can be done by relocating test specimens.

Throughout the test, ensure that the temperature of the black panel is (63 ± 3) °C. A temperature of (50 ± 3) °C or another for the black panel may be used based on agreement between the interested parties.

NOTE The ± tolerances given are the allowable operational fluctuations, which are defined as the positive and negative deviations from the setting of the sensor at the operational control set point during equilibrium conditions. This does not mean that the set value varies by plus/minus the amount indicated from the given value.

Ensure that the procedure conforms to any instructions given by the manufacturer of the apparatus.

7.3 Period of exposure

After calibrating the apparatus (see Clause 4), test the test specimens for several exposure cycles until they show a colour change corresponding to grade 3 of the grey scale (about 25 % loss of colour). Record the number of exposure cycles required to produce this colour change.

The exposure cycle time for any given apparatus remains constant if

— the emission of light is constant (i.e. constant intensity of radiation),

— the temperature is constant,

— the distance between the light source and the test specimens is constant, and

— the ambient conditions (humidity, etc.) are constant.

In general, these conditions will not hold over a long period of time and it is necessary to redetermine the exposure cycle period from time to time.

8 Expression of results

8.1 General

Results should be expressed by visual assessment (see 8.2) or instrumental assessment (see 8.3).

8.2 Visual assessment

8.2.1 The light fastness number is a function of the number of exposure cycles required to produce the appropriate colour change corresponding to grade 3 of the grey scale and is indicated in Table 1.

Table 1 — Light fastness number as a function of number of exposure cycles

Number of exposure cycles to fade anodized test specimen to grade 3 of the grey scale	Light fastness number
1	6
2 to 3	7
4 to 7	8
8 to 15	9
16	10
over 16	greater than 10

NOTE The standard 7 cloth samples of the European blue scale are not suitable for use in this test because their rate of fading is not proportional to the time of exposure.

8.2.2 In order to avoid differences in the performance of the standard 6 cloth samples from different manufacturers, the standards used should always come from the same manufacturer, if possible.

NOTE Typical exposure cycle times of the standard number 6 cloth sample with apparatus designed for this test are about 300 h with a xenon-arc lamp (see ISO 105-B02) and 150 h with a carbon-arc lamp.

8.3 Instrumental assessment

The number of exposure cycles determined by the agreement between interested parties is exposed. After exposure, take out the test specimen and remove the opaque mask. The colour difference between exposed and masked parts shall be determined by the colour meter in ISO 4582, expressed by ΔE^*. If required, the gloss retention in ISO 7668 is determined. In case the opaque mask is not used, the colour difference and the gloss retention shall be determined before and after the exposure of the test specimen.

9 Test report

The test report shall contain at least the following information:

a) a reference to this document, i.e. ISO 2135:2017;

b) the type, application and identification of the product tested;

c) the specification of the material used;

d) the type of finishing treatment used;

e) the type of light source used (xenon-arc lamp or carbon-arc lamp, either open-frame or enclosed);

f) the results of the test (see Clause 8);

g) any deviation, by agreement or otherwise, from the procedure specified;

h) the date of the test.

Annex A
(normative)

Various light sources

A.1 General

This annex gives the specification of various light sources — xenon-arc lamps, open-frame carbon-arc lamps and enclosed carbon-arc lamps — for artificial light exposure tests.

A.2 Xenon-arc light apparatus

Xenon-arc lamps with daylight filters specified in ISO 4892-2 and ISO 16474-2 or extended UV filters in ASTM G155 are used. The specifications are shown in Table A.1.

In order to prevent unrealistic heating of the test specimens caused by infrared radiation, filters to remove infrared radiation may be used.

Table A.1 — Specifications of xenon-arc lamps

Filter	Irradiance W/m^2
Daylight or extended UV	60 ± 2 or 180 ± 5 (300 nm to 400 nm)

A.3 Open-frame carbon-arc light apparatus

Open-frame carbon-arc lamps with daylight filters (type 1) or extended UV filters (type 3) in ISO 4892-4 and ISO 16474-4 are used. The specifications are shown in Table A.2.

Table A.2 — Specifications of open-frame carbon-arc lamps

Filter	Irradiance W/m^2
Daylight (Type 1)	240 ± 24 (300 nm to 700 nm)
Extended UV (Type 3)	255 ± 25 (300 nm to 700 nm)

A.4 Enclosed carbon-arc light apparatus

Enclosed carbon-arc lamps with extended UV in ASTM G153 are used. The specifications are shown in Table A.3.

Table A.3 — Specifications of enclosed carbon-arc lamps

Filter	Irradiance W/m^2
Extended UV	500 ± 100 (300 nm to 700 nm)

Bibliography

[1] ISO 105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

[2] ISO 105-B01, *Textiles — Tests for colour fastness — Part B01: Colour fastness to light: Daylight*

[3] ISO 105-B02, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon arc fading lamp test*

[4] ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

[5] ISO 4892-4, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

[6] ISO 7668, *Anodizing of aluminium and its alloys — Measurement of specular reflectance and specular gloss of anodic oxidation coatings at angles of 20°, 45°, 60° or 85°*

[7] ISO 16474-2, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

[8] ISO 16474-4, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

[9] ASTM G153, *Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*

[10] ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

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