INTERNATIONAL STANDARD

ISO 3210

Fourth edition
2017-10

Anodizing of aluminium and its alloys — Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in acid solution(s)

Anodisation de l'aluminium et de ses alliages — Évaluation de la qualité des couches anodiques colmatées par mesurage de la perte de masse après immersion en solution(s) acide(s)

Reference number
ISO 3210:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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 3210:2010), which has been technically revised.

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

— the option of using a test solution that does not contain hexavalent chromium ions (test solution B) has been added;

— a new subclause pertaining to the use of test solution B has been included in the procedure.

Anodizing of aluminium and its alloys — Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in acid solution(s)

1 Scope

This document specifies methods of assessing the quality of sealed anodic oxidation coatings on aluminium and its alloys by measurement of the loss of mass after immersion in acid solution(s).

It consists of the following two methods.

— Method 1: Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in a phosphoric acid based solution without prior acid treatment.

— Method 2: Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in a phosphoric acid based solution with prior acid treatment.

Method 1 is applicable to anodic oxidation coatings intended for decorative or protective purposes or where resistance to staining is important.

Method 2 is applicable to anodic oxidation coatings intended for outdoor architectural purposes. For less severe applications, Method 1 can be more suitable.

The methods are not applicable to the following:

— hard-type anodic oxidation coatings which normally are not sealed;

— anodic oxidation coatings that have been sealed only in dichromate solutions;

— anodic oxidation coatings produced in chromic acid solutions;

— anodic oxidation coatings that have undergone treatment to render them hydrophobic.

NOTE 1 The methods assess the quality of hydrothermal sealing applied to anodized aluminium. They can be appropriate for other sealing methods.

NOTE 2 The methods are destructive and can serve as reference methods in case of doubt or dispute regarding the results of the test for loss of absorptive power (see ISO 2143) or the measurement of admittance (see ISO 2931).

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 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

An unsealed anodic oxidation coating on aluminium is dissolved rapidly by acid media, whereas a well-sealed coating will withstand long immersion without appreciable attack.

The methods are surface specific. They test the resistance of the surface of a sealed anodic oxidation coating to attack by certain acid solutions. They do not test the quality through the whole thickness of the coating.

5 Reagents

5.1 General

Use only reagents of recognized analytical grade and distilled water or deionized water.

5.2 Predip solution, used only for Method 2

Aqueous solution containing (470 ± 15) g/l nitric acid.

NOTE This solution can be obtained, for example, by diluting a 65 % nitric acid solution (ρ_{20} = 1,40 g/ml) with an equal volume of water.

5.3 Test solution

5.3.1 Test solution A

Aqueous solution containing per litre, 35 ml of phosphoric acid (ρ_{20} = 1,7 g/ml) and 20 g of chromium(VI) oxide.

WARNING — Chromium(VI) is toxic and shall be handled properly. Chromium(VI) solutions are hazardous to the environment and severely hazardous to waters.

5.3.2 Test solution B

Aqueous solution containing per litre, 35 ml of phosphoric acid (ρ_{20} = 1,7 g/ml).

6 Apparatus

Usual laboratory apparatus and glassware together with a laboratory balance with a readability of 0,1 mg.

7 Preparation of test specimen

Cut a piece from the material to be tested, avoiding contact areas, such that there is an area of approximately 1 dm^2, but not less than 0,5 dm^2, of significant surface area. Normally, the mass of the test specimen should not exceed 200 g.

For hollow extrusions, take the test specimen from the end of the sections where the total (external plus internal) surface area has an anodic oxidation coating (due to the throwing power of the anodizing electrolyte).

In special cases, such as certain types of jigging, small hollow sections, etc., it is necessary to remove the anodic oxidation coating from the inside surface and to carry out the test on the coating on the outer surface of the extrusion. If test solution A is used, the anodic oxidation coating may be removed from the inside by mechanical abrasion or by chemical dissolution. Otherwise, the inside surface may be masked.

If by agreement between the anodizer and the customer, special test specimens are prepared, they shall be of the same alloy as the production components and processed through the anodizing line at the same time as the production components.

8 Procedure

8.1 Test solutions

Test solution A does not attack bare metal and it is not necessary to take uncoated surfaces into account.

Test solution B attacks bare metal to a limited extent. However, it is not necessary to take uncoated surfaces into account if conditions a) and b) are both satisfied.

a) Dissolution of an uncoated specimen of the metal does not exceed 10 mg/dm^2 over the operations 8.2.4 to 8.2.6 or 8.3.4 to 8.3.8 inclusive depending on the method being used.

b) The uncoated surface area does not exceed 20 % of the total surface area if the uncoated surface was created by cutting or mechanical abrasion to remove the anodic oxidation coating or by chemical dissolution of the anodic oxidation coating.

Where either condition is not satisfied, the uncoated surface may be masked using an adherent material that neither gains nor loses mass in excess of 1,0 mg/dm^2 over the operations 8.2.4 to 8.2.6 or 8.3.4 to 8.3.8 inclusive depending on the method being used.

The dissolution of an uncoated specimen of the metal may be determined by using an uncoated specimen of the same alloy as that of the test specimen. Empirical data indicate that the dissolution of each of the alloys AA 1050A, 1080A, 5005, 5005A, 5657, 5754, 6060, 6063 and 6063A satisfies condition a).

8.2 Method 1

8.2.1 Remove any sealing smut from the test specimen by rubbing with a dry cloth.

8.2.2 Measure the total coated surface area of the test specimen (excluding cut edges and other uncoated surfaces).

8.2.3 Degrease the test specimen in an organic solvent, e.g. acetone or ethanol (96 %), at room temperature according to the method specified in A.1.

8.2.4 Dry the test specimen thoroughly in accordance with A.2 and weigh immediately to 0,1 mg (mass, m_1).

8.2.5 Immerse the test specimen completely, standing upright, in the test solution and leave it for exactly 15 min when using test solution A or 13 min when using test solution B. Maintain the test solution at 38 °C ± 1 °C for the duration of the test.

Uniformity of temperature within the test solution is very important; this can be achieved by using a water bath and stirring continuously.

Do not use the test solution after more than 4,5 g of anodic oxidation coating and aluminium have been dissolved per litre of solution.

Do not use the test solution which has been in contact with metals other than anodized aluminium or its alloys.

8.2.6 Take the test specimen from the test solution and rinse thoroughly, first, under running water and then in distilled water or deionized water. Dry the test specimen as specified in A.2 and weigh immediately to 0,1 mg (mass, m^2).

8.2.7 During the operations described in 8.2.3 to 8.2.6 inclusive, avoid touching the test specimen with bare hands.

Take extreme care that the two drying operations required in 8.2.4 and 8.2.6 are carried out in the same reproducible way and avoid heating to temperatures above 63 °C.

8.3 Method 2

8.3.1 Remove any sealing smut from the test specimen by rubbing with a dry cloth.

8.3.2 Measure the total coated surface area of the test specimen (excluding cut edges and other uncoated surfaces).

8.3.3 Degrease the test specimen in an organic solvent, e.g. acetone or ethanol (96 %), at room temperature according to the method specified in A.1.

8.3.4 Dry the test specimen thoroughly in accordance with A.2 and weigh it immediately to 0,1 mg (mass, m_1).

8.3.5 Immerse the test specimen completely, standing upright, in the predip solution (see 5.2) and leave for 10 min at a temperature of 19 °C ± 1 °C.

NOTE The predip solution does not attack bare metal.

8.3.6 Take the test specimen from the predip and rinse it thoroughly, first, under running water and then in distilled water or deionized water.

8.3.7 Immerse the test specimen completely, standing upright, in the test solution and leave it for exactly 15 min when using test solution A or 13 min when using test solution B. Maintain the test solution at 38 °C ± 1 °C for the duration of the test.

Uniformity of temperature within the test solution is very important; this can be achieved by using a water bath and stirring continuously.

Do not use the test solution after more than 4,5 g of anodic oxidation coating and aluminium have been dissolved per litre of solution.

Do not use the test solution which has been in contact with metals other than anodized aluminium or its alloys.

8.3.8 Take the test specimen from the test solution and rinse it thoroughly, first, under running water and then in distilled water or deionized water. Dry the test specimen as specified in A.2 and weigh immediately to 0,1 mg (mass, m_2).

8.3.9 During the operations described in 8.3.3 to 8.3.8, avoid touching the test specimen with bare hands.

Take extreme care that the two drying operations required in 8.3.4 and 8.3.8 are carried out in the same reproducible way and avoid heating to temperatures above 63 °C.

9 Expression of results

Calculate the loss in mass of surface, δ_A, in milligrams per square decimetre, using Formula (1):

$$\delta_A = \frac{m_1 - m_2}{A} \quad (1)$$

where

m_1 is the mass of the test specimen before immersion in the (predip and) test solution, in milligrams;

m_2 is the mass of the test specimen after immersion in the (predip and) test solution, in milligrams;

A is the coated surface area of the test specimen in contact with the (predip and) test solution, in square decimetres.

10 Test report

The test report shall include at least the following information:

a) a reference to this document, i.e. ISO 3210:2017;

b) the type and identification of the product tested;

c) whether Method 1 or Method 2 was used;

d) whether test solution A or B was used;

e) how the significant surface area has been determined;

f) whether the test solution has been stirred;

g) the result of the test (see Clause 9);

NOTE Acceptance levels will normally be specified in the relevant product specification.

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

i) the date of the test.