
**Anodizing of aluminium and its
alloys — Assessment of quality of
sealed anodic oxidation coatings by
measurement of admittance**

*Anodisation de l'aluminium et de ses alliages — Évaluation de
la qualité des couches anodiques colmatées par mesurage de
l'admittance*

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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 2931:2010), which has been technically revised.

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

- the content of [Clause 6](#), now entitled “Test specimen”, has been revised.

Introduction

The test described in this document is intended to give a quick, non-destructive assessment of the quality of sealed anodic oxidation coatings and is very suitable for routine production control. It is carried out following sealing and before any other supplementary process is undertaken, for example, oiling, waxing or lacquering.

The correlation of the results obtained with those of other tests that can assess sealing quality such as that of ISO 2143 can be affected by the presence of sealing additives or contaminants such as silicate or phosphate. For this reason, the quality is checked from time to time by one of the reference acid-dissolution methods specified in ISO 3210.

The pre-treatment, the anodizing process, the colouring process used and the alloy can all have an effect on admittance readings.

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Anodizing of aluminium and its alloys — Assessment of quality of sealed anodic oxidation coatings by measurement of admittance

1 Scope

This document specifies a method for assessing the quality of sealed anodic oxidation coatings on aluminium and its alloys by measurement of the admittance.

The method is applicable to anodic oxidation coatings sealed in an aqueous medium.

NOTE 1 Results obtained from anodic oxidation coatings sealed by different methods, e.g. hydrothermal sealing and cold sealing, are not necessarily comparable.

NOTE 2 Results obtained from anodic oxidation coatings on alloys containing more than 2 % silicon or 5 % manganese or 3 % magnesium are not comparable with results obtained from anodic oxidation coatings on more dilute alloys.

The method is suitable for use as a production-control test and as an acceptance test where there is agreement between the anodizer and the customer.

Any type of anodized component can be tested by the method described, provided that there is a sufficient area (a circle of diameter about 20 mm) and that the film thickness is greater than 3 µm.

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 2360, *Non-conductive coatings on non-magnetic electrically conductive base metals — Measurement of coating thickness — Amplitude-sensitive eddy-current method*

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 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 admittance

Y

inverse of the complex apparent resistance, Z

$$Y = 1/Z$$

Note 1 to entry: In an alternating current circuit, Z (impedance) is represented by the vectorial sum of actual resistance, R , and the reactance, X_c , using

$$Z = \sqrt{X_c^2 + R^2}$$

where

R is the resistance, in ohms;

$X_c = \frac{1}{2\pi fC}$ is the reactance;

where

f is the frequency of the alternating current;

C is the capacitance.

4 Principle

An anodic oxidation coating on aluminium is represented as an electrical diagram made up of a number of ohmic and capacitive resistances mounted in series and/or parallel in an alternating-current circuit. The numerical value of these resistances depends upon a number of variables including the following:

- a) basis metal (for example, composition, size and distribution of intermetallic compounds, and surface condition);
- b) type of sealing process (for example, steam, hot water, nickel or cobalt salts or cold sealing) and the conditions used;
- c) thickness and density of the anodic oxidation layer (depending upon electrolyte, type of current, current density, electrolyte temperature, etc.);
- d) dyeing or pigmentation processes used to colour the anodic oxidation coating;
- e) time and conditions of storage between sealing and measurement.

Thus, the test method differs from those of ISO 3210 and ISO 2143, which are only sensitive to sealing at the surface of the anodic oxidation coating.

5 Apparatus and materials

5.1 Device for measuring admittance, covering a range of at least 3 μ S to 200 μ S.

The instrument shall measure at a frequency of 1 000 Hz \pm 10 Hz and be equipped with two electrodes, one with a contact screw by means of which a connection shall be made with the basis metal of the test specimen, and the other with a pencil-like probe.

5.2 Cell, containing the electrolyte, formed conveniently by a rubber ring of internal diameter 13 mm and thickness approximately 5 mm, the surface of which is self-adhesive. This type of cell has an internal area of 133 mm². The internal area of the cell shall be between 100 mm² and 200 mm².

5.3 Electrolyte, aqueous solution of potassium sulfate, 35 g/l.

6 Test specimen

6.1 Sampling

Wherever practicable, test specimens shall be production components or cut from production components. The test shall be carried out on a significant surface and shall not be near an edge because of possible non-uniformity. The area of the test specimen shall be sufficient to determine the thickness of the coating at the point of measurement, to apply the electrolyte-filled cell and, if necessary, to determine the surface area tested.

Where it is impossible to test the production component itself, a test specimen which is representative of the production component may be used. In this case, the test specimen used 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.

The pretreatment, anodizing, colouring, and sealing shall be performed in the same bath and under the same conditions as the treatment of the product. Where the substrate of the test specimen is composed of extruded aluminium or rolled aluminium, the orientation of the extruded or rolling direction to the bending direction (i.e. orthogonal or parallel to the bending direction) shall be reported in the test report.

6.2 Treatment before testing

The test area shall be clean, free from dirt, stains and other foreign matters. 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 solvents which can corrode the test specimen or generate protective films on the test specimen shall not be used.

7 Procedure

Carry out the test preferably within 1 h to 4 h after sealing and cooling to room temperature, and, in any case, within 48 h.

Degrease the test area of the test specimen using a suitable organic solvent.

NOTE 1 If a silicone or wax preservative has been applied after sealing, degreasing might not be adequate. In such cases, satisfactory cleaning can sometimes be achieved by first using an organic solvent, followed by rubbing with a paste of magnesium oxide or pumice powder and water until no water break occurs.

Screw one electrode into the test specimen so that it makes good electrical contact with the basis metal.

Carefully fix the cell (5.2) on the test area. If the area of the cell is modified by the geometric shape of the test specimen, determine the new dimensions. Fill the cell with the electrolyte (5.3). At each point of measurement, use a new cell and fresh electrolyte. If the test is carried out on an oblique or vertical surface, introduce into the cell a cotton-wool plug soaked in the electrolyte, or use a cell of special design.

Immerse the other electrode in the solution and measure the admittance.

Carry out the measurement at a temperature between 10 °C and 35 °C. Take the reading at least 2 min after the introduction of the electrode into the cell, and record the temperature.

After the admittance has been measured, determine the thickness of the anodic coating at the point of measurement using the method described in ISO 2360.

NOTE 2 Cells which are not perfectly attached, and therefore not watertight, can give an inaccurate reading.