INTERNATIONAL STANDARD

ISO
2931

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 2931 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

This third edition cancels and replaces the second edition (ISO 2931:1983), which has been technically revised.

Introduction

The test described in this International Standard 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 sealing tests may be affected by the presence of sealing additives, or contaminants such as silicate or phosphate. For this reason, sealing quality is checked from time to time by one of the reference acid-dissolution methods specified in ISO 3210.

The pretreatment, 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 International Standard 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.

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

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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.

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
admittance
Y
inverse of the complex apparent resistance, Z

$$Y = 1/Z$$

NOTE   In an alternating current circuit, Z (impedance) is represented by the vectorial sum of actual resistance, R, and the reactance, X_c using Equation (1).

$$Z = \sqrt{X_c^2 + R^2} \tag{1}$$

where

    R is the resistance, in ohms;

    $X_c = \dfrac{1}{2\pi f C}$ 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 capacitative resistances mounted in series and/or parallel in an alternating-current circuit. The numerical value of these resistances depends upon the following variables:

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);

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.

5   Apparatus and materials

5.1   Device for measuring admittance, covering a range of 3 µS to 300 µS.

The instrument shall measure at a frequency of 1 000 Hz ± 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 sample, 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 mm^2.

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

6   Test pieces

Anodized products of any shape or dimension, provided that it is possible 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.

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 piece using a suitable organic solvent.

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

8   Expression of results

To allow comparison of results, the result recorded shall include three corrections to the measured value:

a)   a correction to relate the measured admittance value to a measuring area of 133 mm^2 (in the case where it is not possible to use this exact area, and if the actual measuring area is between 100 mm^2 and 200 mm^2);

b)   a correction to relate the measured admittance value to that measured at an ambient temperature of 25 °C;

c)   a correction to relate the measured admittance value to a conventional layer thickness of 20 μm.

Perform these corrections using Equations (2), (3) and (4):

$$Y_1 = \frac{133 Y_m}{A} \tag{2}$$

$$Y_2 = Y_1 f_1 \tag{3}$$

$$Y_3 = \frac{Y_2 e}{20} \tag{4}$$

where

Y_m is the measured admittance value, in microsiemens;

A is the measuring area, in square millimetres;

Y_3 is the corrected admittance value, in microsiemens;

e is the thickness of the anodic oxidation coating, in micrometres;

f_1 is a coefficient given as a function of the temperature, t, in degrees Celsius, in Table 1.

Table 1 — Coefficient f_1 as a function of the temperature t

t, °C	10	12,5	15	17,5	20	22,5	25	27,5	30	32,5	35
f_1	1,30	1,25	1,20	1,15	1,10	1,05	1,00	0,95	0,90	0,85	0,80