BRITISH STANDARD

BS EN
12373-5:1999

Aluminium and aluminium alloys — Anodizing —

Part 5: Assessment of quality of sealed anodic oxidation coatings by measurement of admittance

The European Standard EN 12373-5:1998 has the status of a British Standard

ICS 25.220.20; 77.120.10

National foreword

This British Standard is the English language version of EN 12373-5:1998. It supersedes BS 6161-6:1984, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/32, Anodic oxidation coatings on aluminium, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 4, an inside back cover and a back cover.

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English version

Aluminium and aluminium alloys — Anodizing — Part 5: Assessment of quality of sealed anodic oxidation coatings by measurement of admittance

Aluminium et alliages d'aluminium — Anodisation — Partie 5: Evaluation de la qualité des couches anodiques colmatées par mesurage de l'admittance

Aluminium und Aluminiumlegierungen — Anodisieren — Teil 5: Prüfung der Qualität von verdichteten, anodisch erzeugten Oxidschichten durch Messung des Scheinleitwertes

This European Standard was approved by CEN on 5 November 1998.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 12373-5:1998 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 132, Aluminium and aluminium alloys, the Secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

It is based upon ISO 2931:1983.

EN 12373, *Aluminium and aluminium alloys — Anodizing*, comprises the following parts:

— *Part 1: Method for specifying decorative and protective anodic oxidation coatings on aluminium*;

— *Part 2: Determination of mass per unit area (surface density) of anodic oxidation coatings — Gravimetric method*;

— *Part 3: Determination of thickness of anodic oxidation coatings — Non-destructive measurement by split-beam microscope*;

— *Part 4: Estimation of loss of absorptive power of anodic oxidation coatings after sealing by dye spot test with prior acid treatment*;

— *Part 5: Assessment of quality of sealed anodic oxidation coatings by measurement of admittance*;

— *Part 6: Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in phosphoric acid/chromic acid solution without prior acid treatment*;

— *Part 7: Assessment of quality of sealed anodic oxidation coatings by measurement of the loss of mass after immersion in phosphoric acid/chromic acid solution with prior acid treatment*;

— *Part 8: Determination of the comparative fastness to ultra-violet light and heat of coloured anodic oxidation coatings*;

— *Part 9: Measurement of wear resistance and wear index of anodic oxidation coatings using an abrasive wheel wear test apparatus*;

— *Part 10: Measurement of mean specific abrasion resistance of anodic oxidation coatings using an abrasive jet test apparatus*;

— *Part 11: Measurement of specular reflectance and specular gloss of anodic oxidation coatings at angles of 20°, 45°, 60° or 85°*;

— *Part 12: Measurement of reflectance characteristics of aluminium surfaces using integrating-sphere instruments*;

— *Part 13: Measurement of reflectivity characteristics of aluminium surfaces using a goniophotometer or an abridged goniophotometer*;

— *Part 14: Visual determination of image clarity of anodic oxidation coatings — Chart scale method*;

— *Part 15: Assessment of resistance of anodic oxidation coatings to cracking by deformation*;

— *Part 16: Check for continuity of thin anodic oxidation coatings — Copper sulfate test*;

— *Part 17: Determination of electric breakdown potential*;

— *Part 18: Rating system for the evaluation of pitting corrosion — Chart method*;

— *Part 19: Rating system for the evaluation of pitting corrosion — Grid method.*

Contents

Introduction

The test described in this 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 should be checked from time to time by one of the reference acid-dissolution methods specified in EN 12373-6[1)] or EN 12373-7[1)].

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

1 Scope

This part of this European 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 purchaser.

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

2 Symbols and abbreviations

Admittance, Y, is the inverse of the complex apparent resistance, Z (impedance), which, in an alternating current circuit, is represented by the vectorial sum of the actual resistance, R, and the reactance, X_c:

$$Y = \frac{1}{Z} \quad (1)$$

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

In equation (2):

R is the resistance, in ohms;

$X_c = \frac{1}{2\pi f C}$ is the reactance, where:

f is the frequency of the alternating current;

C is the capacitance.

3 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 impregnation);

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.

4 Apparatus

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

The instrument shall measure at a frequency of 1 kHz ± 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 a pencil-like probe.

4.2 *Cell*, containing the electrolyte, formed conveniently by a rubber ring of 13 mm internal diameter and approximately 5 mm thickness, the surface of which is self-adhesive. This type of cell has an internal area of 133 mm^2.

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

5 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.

6 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 may 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.

[1)] See foreword.

Screw one electrode into the test piece so that it makes good electrical contact with the basis metal. Carefully fix the cell (**4.2**) 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 (**4.3**). 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 of 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 oxidation coating at the point of measurement.

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

7 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 the following formulae:

$$Y_1 = \frac{133\ Y_m}{A} \quad (3)$$

$$Y_2 = Y_1 f_1 \quad (4)$$

$$Y_3 = \frac{Y_2\ e}{20} \quad (5)$$

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.

8 Test report

The test report shall include at least the following information:

a) the type and identification of the product tested;

b) a reference to this European Standard;

c) the result of the test (see clause **7**);

d) the measuring area (if not 133 mm^2);

e) the temperature at which the test was carried out (if not 25 °C);

f) any deviation from the procedure described in this European Standard;

g) the date of the test.

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

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