BRITISH STANDARD

BS EN
12373-3:1999

Aluminium and aluminium alloys — Anodizing —

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

The European Standard EN 12373-3:1998 has the status of a British Standard

ICS 25.220.20

National foreword

This British Standard is the English language version of EN 12373-3:1998. It supersedes BS 6161-2:1981, which is withdrawn.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.

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

Aluminium et alliages d'aluminium — Anodisation — Partie 3: Détermination de l'épaisseur des couches anodiques — Méthode non destructive au microscope à coupe optique

Aluminium und Aluminiumlegierungen — Anodisieren — Teil 3: Bestimmung der Dicke von anodisch erzeugten Oxidschichten — Zerstörungsfreie Messung mit Lichtschnittmikroskop

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CEN

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

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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of an identical text or by endorsement, at the latest by May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.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 2128:1976.

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

1 Scope

This part of this European Standard specifies a non-destructive method of determining the thickness of anodic oxidation coatings on aluminium and its alloys using a split-beam microscope.

The method is applicable, in most industrial cases, to anodic oxidation coatings above 10 μm, or above 5 μm when the surface is smooth.

The use of the method described is limited by the need for the two luminous lines described in clause **3** to be visible and distinctly separated, i.e. not in the case of opaque or dark-coloured coatings.

NOTE Problems can also arise as a result of the roughness of the surface.

2 Definitions

For the purposes of this standard, the following definitions apply.

2.1

thickness of anodic oxidation coating

arithmetic mean of the thicknesses measured at not less than 10 points of an inspection area

2.2

inspection area

part of the surface on which the specified properties are required to be measured

NOTE The inspection area should be agreed between the supplier and purchaser.

3 Principle

A parallel, lamellar beam of light (I) in a split-beam microscope is directed obliquely, generally at an angle of incidence of 45°, on to the anodized surface (see Figure 1).

A part of this beam, R_1, is reflected at the outer face of the coating; another part, R_2, penetrates the coating and emerges after reflection at the metal/coating interface and two resulting refractions.

Two parallel lines are obtained at the ocular, the distance between these being proportional to the thickness of the oxide coating and to the magnification. This distance is also dependent on the refractive index of the coating, n, which lies between 1,59 and 1,62, and on the geometry of the apparatus. When the angle of incidence and the optical axis of the objective lens of the measuring apparatus are both at 45°, the thickness is given by the formula:

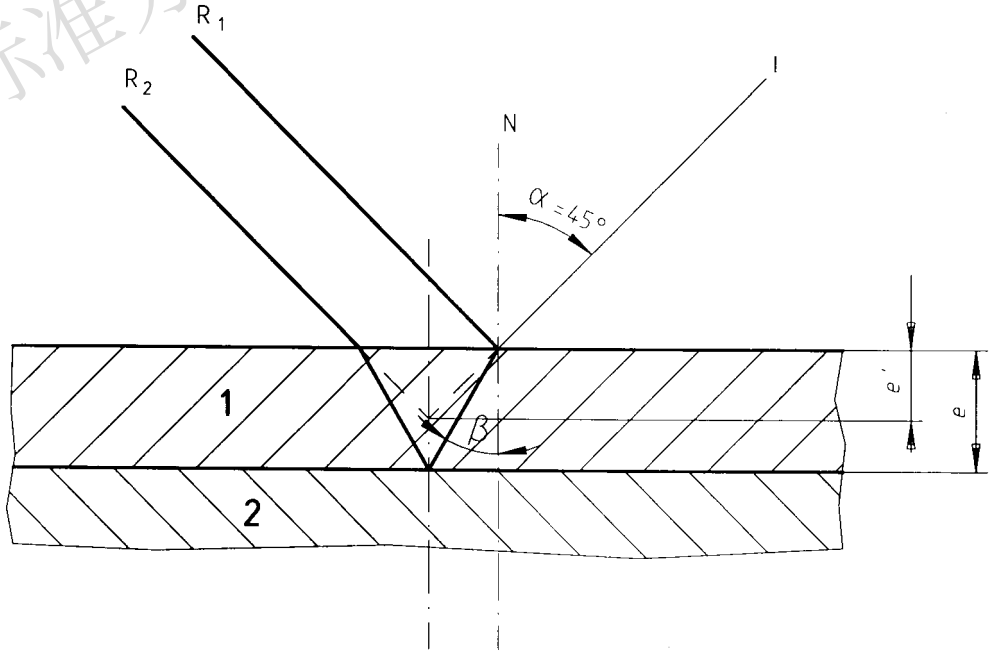
$$e = e' \sqrt{2n^2 - 1}, \text{ or } 2{,}04\, e', \text{ approximately} \qquad (1)$$

where

e is the true thickness;

e' is the measured apparent thickness.

NOTE The use of $e = 2e'$ provides adequate accuracy. Some instruments are calibrated in such a way that they give the actual thickness, e, rather than the apparent thickness, e'.



1 Oxide coating

2 Metal

Figure 1 — Diagram of optical path

4 Apparatus

Split-beam microscope, specially designed for measuring the thickness of transparent coatings or surface roughness.

The calibration of the microscope shall be checked using an anodized aluminium sample, the anodic oxidation coating thickness of which has been determined by the micrographic section method.

5 Procedure

Proceed in accordance with the instructions provided with the apparatus.

Measure the coating thickness by means of a graticule moved from one line to another by a vernier tube graduated in micrometres.

NOTE In certain types of apparatus, the magnification can be selected so that the reading on the tube corresponds to the true thickness of the coating.

6 Expression of results

Calculate the thickness of the coating as the arithmetic mean of measurements carried out on at least 10 points on the surface examined.

Exclude from the calculation any anomalous values deviating by more than $\pm$ 10 % from the arithmetic mean, and replace each anomalous value, once only, by the values obtained from two further measurements. Such anomalous values shall not exceed 30 % of the total number of measurements.

If the repeated measurements give anomalous values, add to the expression of the mean value, $\bar{x}$, the indication of the mean deviation, given by:

$$\frac{\sum_{1}^{n}(x - \bar{x})}{n} \qquad (2)$$

7 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 **6**);

d) where appropriate, the mean deviation for anomalous values;

e) anything unusual noticed during the determination;

f) the date of the test.

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