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Anodizing of aluminium and its alloys — Determination of thickness of anodic oxidation coatings — Non-destructive measurement by split-beam microscope

Anodisation de l'aluminium et de ses alliages — Détermination de l'épaisseur des couches anodiques — Méthode non destructive par microscope à coupe optique

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Foreword

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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 2128 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

This second edition cancels and replaces the first edition (ISO 2128:1976), which has been technically revised.

Anodizing of aluminium and its alloys — Determination of thickness of anodic oxidation coatings — Non-destructive measurement by split-beam microscope

1 Scope

This International Standard specifies a non-destructive method for 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 specified 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 arise as a result of the roughness of the surface.

2 Terms and definitions

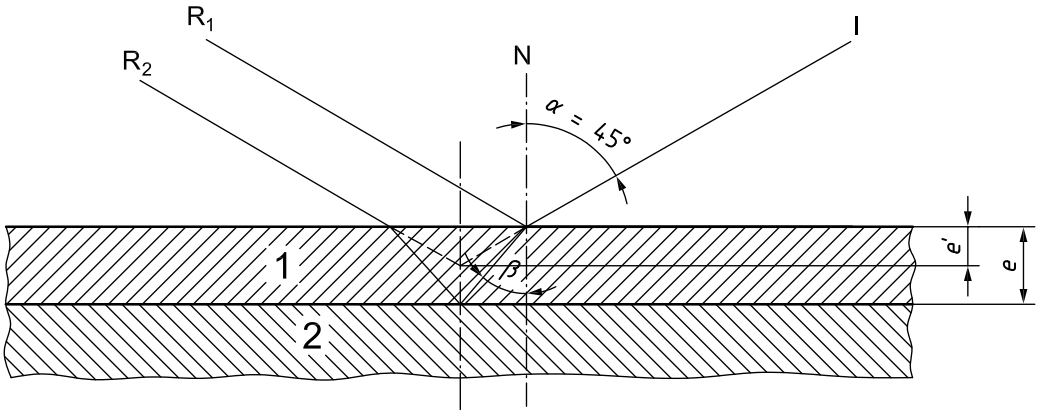
For the purposes of this document, the following terms and definitions apply.

2.1
thickness of an 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

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°, onto the anodized surface (see Figure 1).



Key

1 oxidation coating

2 metal

Figure 1 — Diagram of optical path

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 oxidation 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 Formula (1):

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

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'.

4 Apparatus

4.1 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.

The inspection area should be agreed between the supplier and the customer.

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 calibration any anomalous values deviating by more than ±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 Formula (2):

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

7 Test report

The test report shall include at least the following information:

a) a reference to this International Standard;

b) the type and identification of the product tested;

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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