# INTERNATIONAL STANDARD 2128

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION · МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ · ORGANISATION INTERNATIONALE DE NORMALISATION

# Anodizing of aluminium and its alloys — Determination of thickness of anodic oxide 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*



**First edition — 1976-11-01**



**UDC 669.71 : 621.794.61 : 620.1** **Ref. No. ISO 2128-1976 (E)**

**Descriptors** : metal finishing, anodizing, anodic coatings, aluminium, aluminium alloys, tests, optical tests, dimensional measurement, thickness, microscopic analysis.

Price based on 2 pages

## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.



International Standard ISO 2128 was drawn up by Technical Committee ISO/TC 79, *Light metals and their alloys.* It was submitted directly to the ISO Council, in accordance with clause 6.12.1 of the Directives for the technical work of ISO.



This International Standard cancels and replaces ISO Recommendation R 2128-1971, which had been approved by the Member Bodies of the following countries :

| | | |
|---|---|---|
| Austria | Italy | Sweden |
| Belgium | Japan | Switzerland |
| Canada | New Zealand | Thailand |
| Finland | Norway | Turkey |
| France | Poland | United Kindom |
| Germany | Portugal | U.S.A. |
| India | South Africa, Rep. of | U.S.S.R. |
| Israel | Spain | |

The Member Body of the following country had expressed disapproval of the document on technical grounds :

Netherlands



Printed in Switzerland

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

## 1 SCOPE

This International Standard specifies a non-destructive method of determining, by split-beam microscope, the thickness of anodic oxide coatings on aluminium and its alloys.

## 2 FIELD OF APPLICATION

The use of the method is limited by two factors :

— the opacity of the coating (measurement is impossible, for example, on coatings of dark colours);

— the roughness of the surface (measurement is impossible, for example, on deeply pitted surfaces);

and it is only possible if the two luminous lines described in clause 4 are visible and distinctly separated.

However, the measurement is possible in most industrial cases for coating thicknesses of aluminium oxide above 10 μm, or from 5 μm when the surface is smooth.

## 3 DEFINITIONS

For the purpose of this International Standard, the following definitions apply :

**3.1 thickness of anodic oxide coating :** The arithmetic mean of the thicknesses measured at at least ten points of an inspection area.

**3.2 inspection area :** The part of the surface (or of the line) on which, after agreement between the supplier and user, the specified properties are required.



## 4 PRINCIPLE

In the split-beam microscope, a parallel, lamellar beam of light (I) is directed obliquely, generally at an angle of incidence of 45°, onto the oxidized surface (see the figure).

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

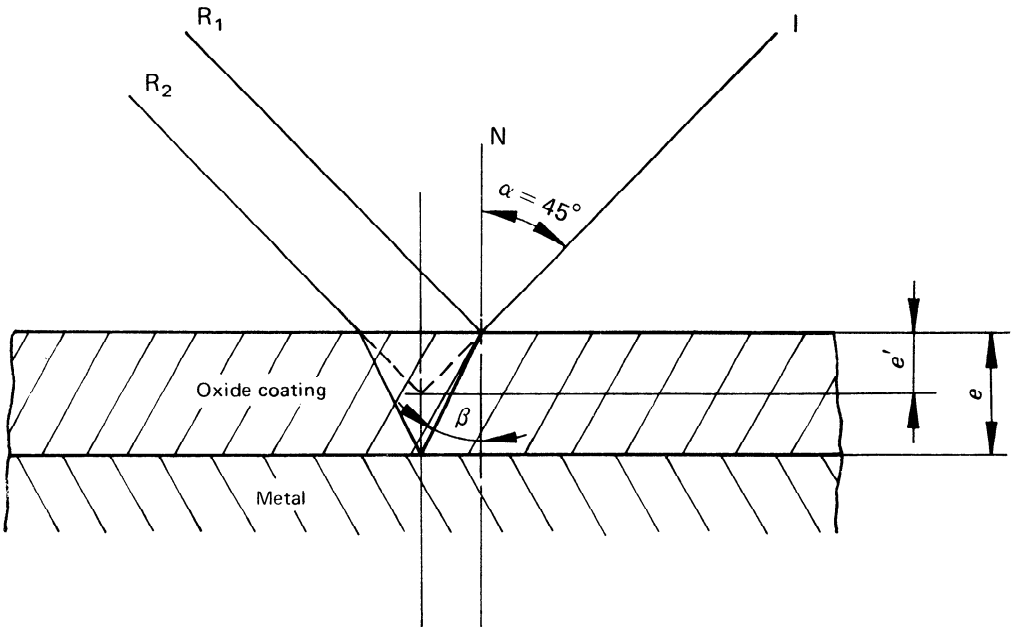


FIGURE — **Diagram of optical path**

Two parallel lines are, therefore, obtained at the ocular, the distance between them being proportional to the thickness of the oxide coating and to the magnification. This distance is also dependent on the refractive index of the oxide, $n$, 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

$$e = e' \sqrt{2\,n^2 - 1} = 2{,}04\,e'$$

where

$e$ is the true thickness;

$e'$ is the apparent measured thickness.

The use of $e = 2\,e'$ gives adequate precision.

## 5 APPARATUS

**Special split-beam microscope,** generally used to measure either the thickness of transparent coatings, or surface roughness.

## 6 PROCEDURE

Proceed in accordance with the instructions given by the manufacturer of the apparatus.

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

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

## 7 CALIBRATION

The microscope may be calibrated using an anodized aluminium sample, the oxide coating thickness of which has been determined by the micrographic section method.

## 8 EXPRESSION OF RESULTS

The conventional thickness of the anodic oxide coating is the arithmetic mean of the measurements carried out at at least ten points of the surface examined.

As regards the measured values, a deviation of ± 10 % from the arithmetic mean is permitted.

Any anomalous values, the number of which must not exceed 30 %, shall be excluded from the calculation and each replaced, once only, by values obtained from two further measurements.

If the anomalies are repeated, add to the expression of the mean value, $\bar{x}$, the indication of the mean deviation :

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