SLOVENSKI STANDARD
SIST EN 12373-11:2002

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Aluminij in aluminijeve zlitine - Anodizacija - 11. del: Merjenje odbojnosti in sijaja anodizirane plasti pod koti 20°, 45°, 60° ali 85°

Aluminium and aluminium alloys - Anodizing - Part 11: Measurement of specular reflectance and specular gloss of anodic oxidation coatings at angles of 20°, 45°, 60° or 85°

Aluminium und Aluminiumlegierungen - Anodisieren - Teil 11: Messung des gerichteten Reflexionsgrades und des Spiegelglanzes von anodisch erzeugten Oxidschichten bei Winkeln von 20°, 45°, 60° oder 85°

Aluminium et alliages d'aluminium - Anodisation - Partie 11: Mesurage des caractéristiques de réflectance et de brillant spéculaires des couches anodiques a angles fixes de 20°, 45°,
60° ou 85°

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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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of an identical text or by endorsement, at the latest by February 2001, and conflicting national standards shall be withdrawn at the latest by February 2001.

It is based upon ISO 7668:1986.

In this standard, annex A is normative.

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 in 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 in 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 coadugs 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

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.

Introduction

Specular reflectance and specular gloss are not unique physical properties of a surface. They vary with the angle of measurement, and with the aperture dimensions that define the incident and the reflected beams, such that measurements of these properties are not independent of the apparatus being used.

The specular reflectance of most surfaces increases with the angle of measurement and accounts for the use of reflectometers with various angles as, for example, for painted surfaces. The specular reflectance characteristics of anodized aluminium, however, do not always behave in the normal manner and, because of its property of double reflection, reflected light comes partly from the film surface and partly from the underlying metal. It is advisable to measure the specular reflectance characteristics at 20°, 45°, 60° and 85° to obtain a complete understanding of the specular reflectance properties of the anodized surface, and careful thought should be given to which method or methods are most relevant in any particular situation. The specular reflectance of bright-anodized aluminium with a mirror finish is best measured using 45° or 20° geometry.

1 Scope

This Part of this European Standard specifies methods for the measurement of specular reflectance and specular gloss of flat samples of anodized aluminium using geometries of 20° (method A), 45° (method B), 60° (method C) and 85° (method D), and of specular reflectance by an additional 45° method (method E) employing a narrow acceptance angle.

The methods described are intended mainly for use with clear anodized surfaces. They can be used with colour-anodized aluminium, but only with similar colours.

2 Terms and definitions

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

2.1
specular reflectance
ratio of the luminous flux, reflected in the specular direction for a specified source and receptor angle, to the luminous flux of the incident light, normally expressed as a percentage

2.2
specular gloss
ratio of the luminous flux, reflected from an object in the specular direction for a specified source and receptor angle, to the luminous flux reflected from glass with a refractive index of 1,567 in the specular direction

NOTE To set the specular gloss scale, polished black glass with a refractive index of 1,567 is assigned the value of 100 for geometries of 20°, 45°, 60° and 85° (see Table 5). The phenomenon of light reflectance by anodized aluminium is very different to that of black glass and the choice of a black glass standard is arbitrary and made to allow comparison of different qualities of anodized aluminium.

3 Principle

The specular reflectance and specular gloss of anodized aluminium surfaces are measured under defined conditions using, as required, geometries of 20°, 45°, 60° or 85°.

4 Apparatus

4.1 Components

The apparatus consists of

a) a polychromatic light source and housing with a lens that directs a parallel, or very slightly converging, beam of light onto the surface under test;
b) means for locating the specimen surface in the correct position for measurement;
c) a receptor housing containing a lens, a receptor aperture and a photoelectric cell to receive the cone of reflected light;
d) a sensitivity control for setting the photocell current to any desired value on the instrument scale or digital indicator.

NOTE Since specular reflection is in general spectrally non-selective, the spectral characteristics of the light source and the detector need not be critically controlled for the measurement of normal uncoloured anodized surfaces.

Approximate comparisons between surfaces of the same colour can be made, but an accurate measurement will require the combination of light source, photoelectric cell and associated colour filters to give a spectral sensitivity, approximating to the CIE photopic luminous efficiency function, weighted for CIE standard illuminant C (see CIE 38:1977).

4.2 Geometric conditions

The incident angle ε_1, which is the angle between the axis of the incident beam and the perpendicular to the surface under test, shall have the following values and tolerances:

—for method A: 20° ± 0,1°;

—for method B: 45° ± 0,1°;

—for method C: 60° ± 0,1°;

—for method D: 85° ± 0,1°;

—for method E: 45° ± 0,1 °.

The axis of the receptor shall, as far as possible, coincide with the mirror image of the axis of the incident beam; the receptor angle ε_2, which is the angle between the axis of the receptor and the perpendicular to the surface under test, shall for all methods be such that:

$$|\varepsilon_1 - \varepsilon_2| \leq 0{,}1°$$

With a flat piece of polished glass or other front-surface mirror in the test panel position, an image of the source shall be formed at the centre of the receptor aperture. The width of the illuminated area of the test panel shall be not less than 10 mm.

The angular dimensions of the receptor apertures shall be measured from the receptor lenses. The dimensions and tolerances of the sources and receptors shall be as indicated in Tables 1 and 2. Figures 1, 2 and 3 give generalized illustrations of the dimensions. Table 1 gives both angles and corresponding dimensions calculated for lenses of a focal length of 50 mm for methods A, B, C and D. Table 2 gives the angles and aperture dimensions for method E. The angles are mandatory and the aperture sizes have been calculated from the corresponding angle δ as $2f(\tan \delta/2)$, where f is the focal length of the receptor lens.

4.3 Vignetting

There shall be no vignetting of rays that lie within the angles specified in 4.2.

4.4 Receptor meter

The receptor measuring device shall be capable of giving an indication proportional to the light flux passing the receptor aperture within 1 % of the full-scale reading. Spectral corrections are not usually required (see note to 4.1).

Table 1 — Angles and dimensions of source image and receptor apertures for methods A, B, C and D

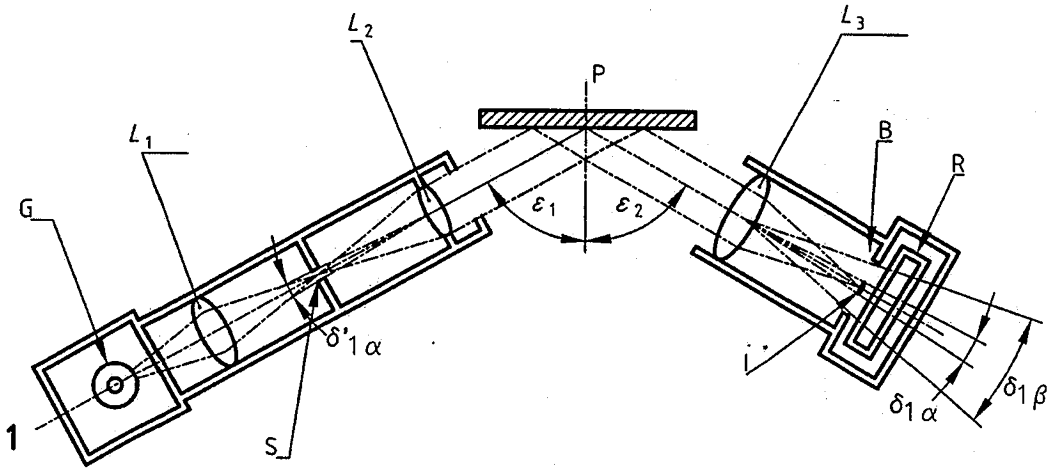
Method(s)	Instrument characteristics	In plane of measurement		Perpendicular to plane of measurement	
		Angle δ_1 (degrees)	Dimension[a] mm	Angle δ_2 (degrees)	Dimension[a] mm
A, B, C and D	Source image size Tolerance	0,75 ($\delta_{1\alpha}$) ± 0,25	0,65 ± 0,22	2,5 ($\delta_{2\alpha}$) [b] ± 0,5	2,18 [b] ± 0,44
A	20° Receptor aperture Tolerance	1,80 ($\delta_{1\beta}$) ± 0,05	1,57 ± 0,04	3,6 ($\delta_{2\beta}$) ± 0,1	3,14 ± 0,09
B	45° Receptor aperture Tolerance	4,4 ($\delta_{1\beta}$) ± 0,1	3,84 ± 0,09	11,7 ($\delta_{2\beta}$) ± 0,2	10,25 ± 0,17
C	60° Receptor aperture Tolerance	4,4 ($\delta_{1\beta}$) ± 0,1	3,84 ± 0,09	11,7 ($\delta_{2\beta}$) ± 0,2	10,25 ± 0,17
D	85° Receptor aperture Tolerance	4,0 ($\delta_{1\beta}$) ± 0,3	3,49 ± 0,26	6,0 ($\delta_{2\beta}$) ± 0,3	5,24 ± 0,26

[a] Calculated for a focal length of 50 mm. For any other focal length f these dimensions should be multiplied by $f/50$.
[b] 0,75° ± 0,25°corresponding to dimensions of 0,65 mm ± 0,22 mm, i.e. the same as those in the plane of measurement, is also recommended

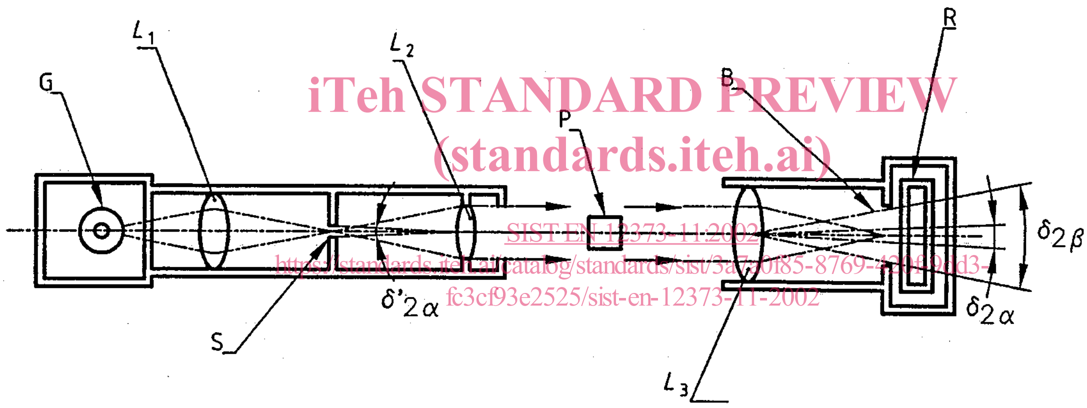
Table 2 — Angles and dimensions of circular source image and circular receptor aperture for 45° reflectometer of method E

Instrument characteristics	Angle δ (degrees)	Dimensions[a] mm
Source image size Tolerance	3,44 ± 0,23	1,5 ± 0,1
45° Receptor aperture Tolerance	3,44 ± 0,23	1,5 ± 0,1

[a] Calculated for a focal length of 25,4 mm. For any other focal length, f, the aperture diameter = $2f(\tan \delta/2)$.



a) In plane of measurement



b) Perpendicular to plane of measurement

Key

1 axis

G filament lamp

L_1 condenser lens

L_2 collimator lens

L_3 receptor lens

S effective light source (pin hole)

P test surface

B receptor field aperture

I source image

R photoelectric cell

$\delta_{1\alpha}$ source image angles (in plane of measurement)

$\delta_{1\beta}$ receptor aperture angles (in plane of measurement)

$\delta_{2\alpha}$ source image angles (perpendicular to plane of measurement

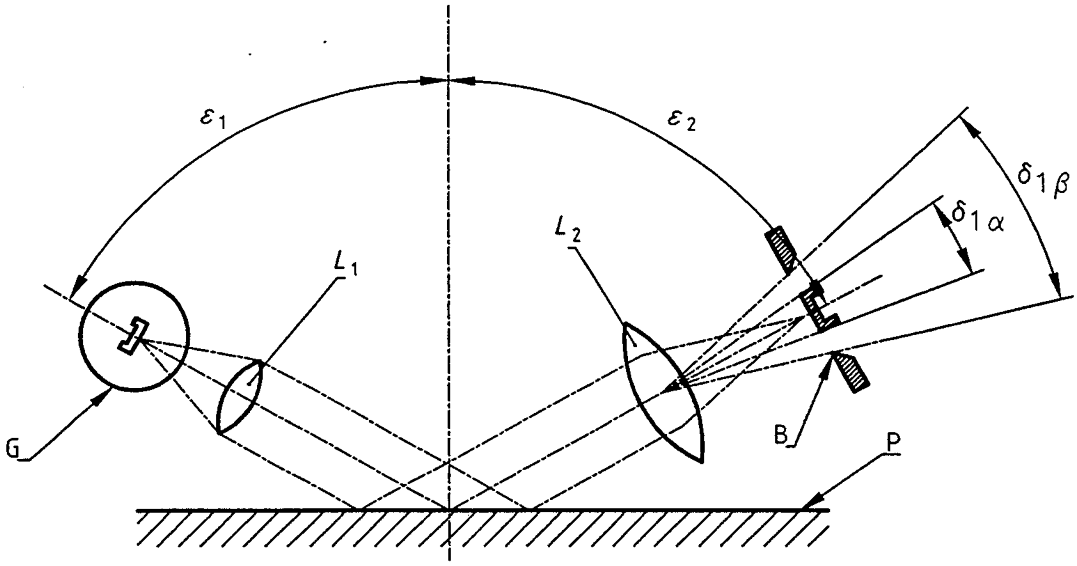
$\delta_{2\beta}$ receptor aperture angles (perpendicular to plane of measurement)

$\delta'_{1\alpha} = \delta_{1\alpha}$ and

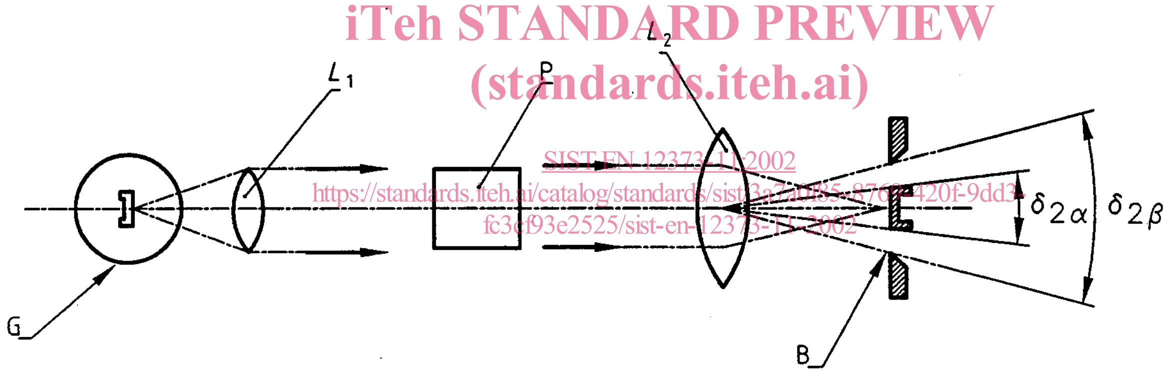
$\delta'_{2\alpha} = \delta_{2\alpha}$, if the focal lengths of L_2 and L_3 are the same

NOTE Angles and dimensions are given in Table 1.

Figure 1 — Schematic arrangement of apparatus showing apertures and source image formation for a collimated-beam type instrument for method A (20°), method B (45°), method C (60°) and method D (85°)



a) In plane of measurement



b) Perpendicular to plane of measurement

Key

G	filament lamp	$\delta_{1\alpha}$ and $\delta_{2\alpha}$	source image angles
L_1 and L_2	lenses		
P	test surface	$\delta_{1\beta}$ and $\delta_{2\beta}$	receptor aperture angles
B	receptor field aperture		
I	source image		

NOTE Angles and dimensions are given in Table 1.

Figure 2 — Schematic arrangement of apparatus showing apertures and source image formation for a non-collimated-beam type instrument for method A (20°), method B (45°), method C (60°) and method D (85°)