INTERNATIONAL
STANDARD

ISO
7668

Second edition
2010-11-01

Anodizing of aluminium and its alloys — Measurement of specular reflectance and specular gloss of anodic oxidation coatings at angles of 20°, 45°, 60° or 85°

Anodisation de l'aluminium et de ses alliages — Mesurage des caractéristiques de réflectivité et de brillant spéculaires des couches anodiques à angle fixe de 20°, 45°, 60° ou 85°

Reference number
ISO 7668:2010(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 7668:2010
https://standards.iteh.ai/catalog/standards/sist/9ee6ab01-93d8-4174-82ed-4f5829d5589d/iso-7668-2010

COPYRIGHT PROTECTED DOCUMENT

© ISO 2010

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Terms and definitions 1
3 Principle 1
4 Apparatus and geometric conditions 2
5 Optical standards 7
5.1 Reference standards 7
5.2 Working standards 7
6 Preparation and calibration of apparatus 7
7 Measurement of specular reflectance and specular gloss 8
7.1 General 8
7.2 Measurement of specular reflectance 8
7.3 Measurement of specular gloss 8
8 Expression of results 11
8.1 General 11
8.2 Specular reflectance 11
8.3 Specular gloss 11
9 Test report 11
Annex A (normative) Specular reflectance and specular gloss of black glass 12
Bibliography 13

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 7668 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 7668:1986), which has been technically revised.

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.

Anodizing of aluminium and its alloys — Measurement of specular reflectance and specular gloss of anodic oxidation coatings at angles of 20°, 45°, 60° or 85°

1 Scope

This International 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 document, 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° and 85°.

4 Apparatus and geometric conditions

Usual laboratory apparatus and in particular the following.

4.1 General. Approximate comparisons between surfaces of the same colour can be made, but an accurate measurement requires 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 illuminants C (see CIE 38:1977[1]) or D65.

NOTE Since specular reflection is in general spectrally non-selective, the spectral characteristics of the light source (4.2) and the detector (4.4) need not be critically controlled for the measurement of normal uncoloured anodized surfaces.

4.2 Polychromatic light source and housing, with a lens that directs a parallel, or very slightly converging, beam of light onto the surface under test.

4.3 Means for locating the specimen surface, in the correct position for measurement.

4.4 Receptor housing containing a lens, a receptor aperture and a photoelectric cell, to receive the cone of reflected light.

4.5 Sensitivity control, for setting the photocell current to any desired value on the instrument scale or digital indicator.

4.6 Receptor meter, 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).

4.7 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°.

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

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 be for all methods such that:

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

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 illustrated 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 these 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.

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	0,75($\delta_{1\alpha}$)	0,65	2,5($\delta_{2\alpha}$)[b]	2,18[b]
	Tolerance	±0,25	±0,22	±0,5	±0,44
A	20° Receptor aperture	1,80($\delta_{1\beta}$)	1,57	3,6($\delta_{2\beta}$)	3,14
	Tolerance	±0,05	±0,04	±0,1	±0,09
B	45° Receptor aperture	4,4($\delta_{1\beta}$)	3,84	11,7($\delta_{2\beta}$)	10,25
	Tolerance	±0,1	±0,09	±0,2	±0,17
C	60° Receptor aperture	4,4($\delta_{1\beta}$)	3,84	11,7($\delta_{2\beta}$)	10,25
	Tolerance	±0,1	±0,09	±0,2	±0,17
D	85° Receptor aperture	4,0($\delta_{1\beta}$)	3,49	6,0($\delta_{2\beta}$)	5,24
	Tolerance	±0,3	±0,26	±0,3	±0,26

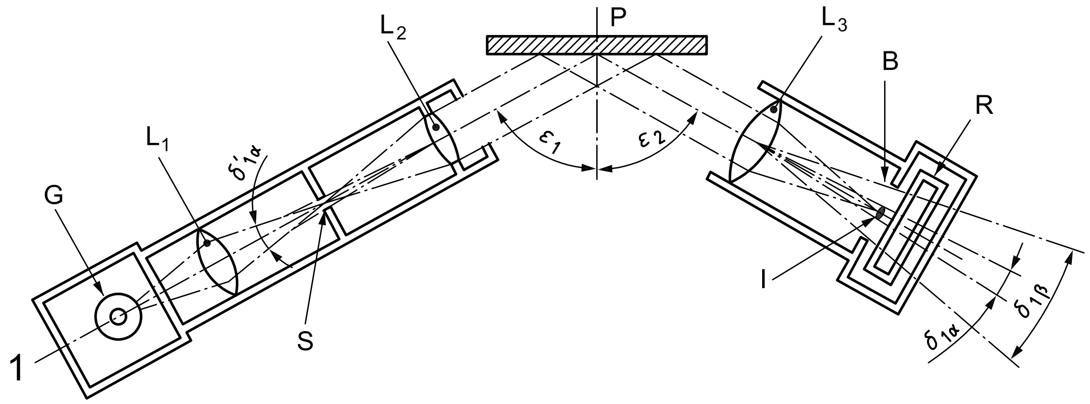
[a] Calculated for a focal length of 50 mm. For any other focal length, *f*, these dimensions shall be multiplied by *f*/50.

[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.

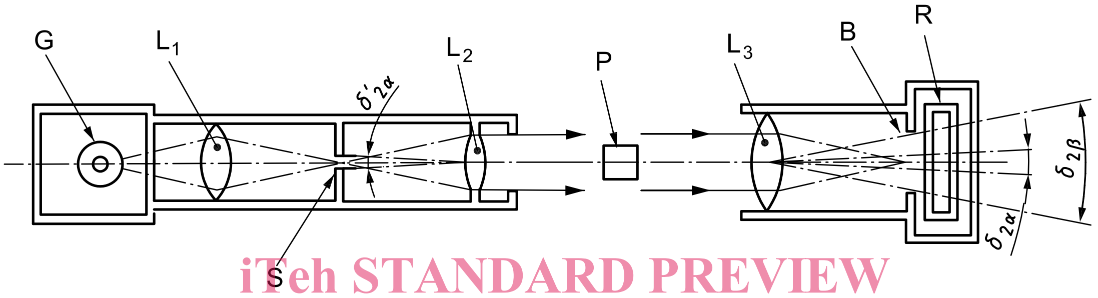
Table 2 — Angles and dimensions of circular source image and circular receptor aperture for 45° reflectometer of Method E

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

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



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 note)
P	test surface
B	receptor field aperture
I	source image
R	photoelectric cell

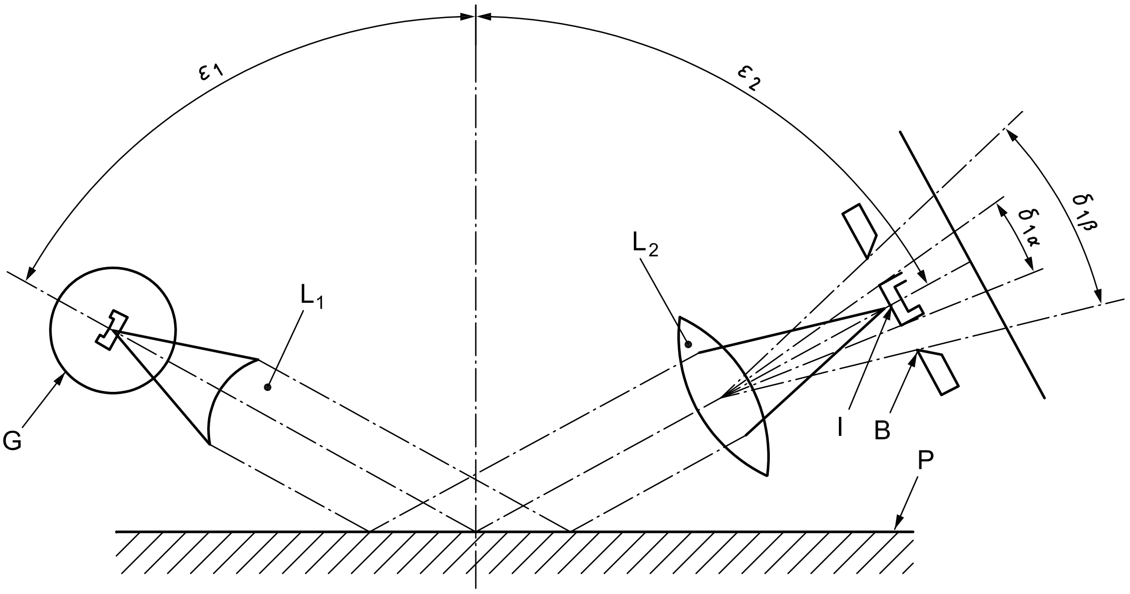
$\delta_{1\alpha}$	source image angles (in plane of measurement)
$\delta_{1\beta}$	receptor aperture angles (in plane of measurement)
$\delta_{2\alpha}$	source image angles (perpendicular to plane of measurement)
$\delta_{2\beta}$	receptor aperture angles (perpendicular to plane of measurement)

$\delta'_{1\alpha} = \delta_{1\alpha}$ and $\delta'_{2\alpha} = \delta_{2\alpha}$ if the focal lengths of L$_2$ and L$_3$ are the same

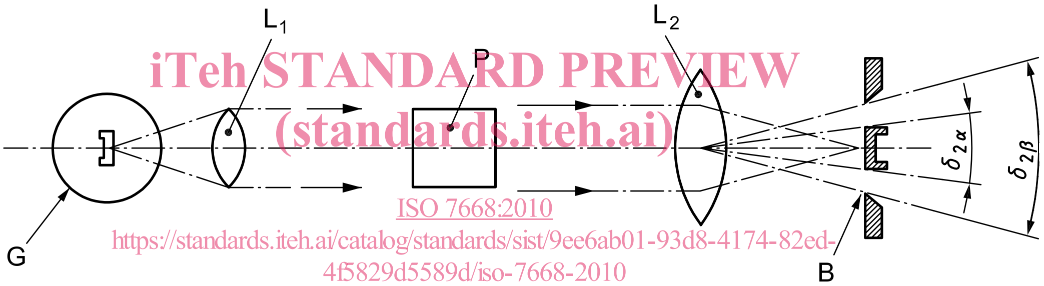
ε_1	incident angle
ε_2	receptor angle

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
L_1 and L_2	lenses
P	test surface
B	receptor field aperture
I	image filament
$\delta_{1\alpha}$ and $\delta_{2\alpha}$	source image angles
$\delta_{1\beta}$ and $\delta_{2\beta}$	receptor aperture angles
ε_1	incident angle
ε_2	receptor angle

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°)