INTERNATIONAL STANDARD

ISO 10216

Third edition
2017-10

Anodizing of aluminium and its alloys — Instrumental determination of image clarity of anodic oxidation coatings — Instrumental method

Anodisation de l'aluminium et de ses alliages — Détermination de la netteté d'image sur couches anodiques — Méthode instrumentale

Reference number
ISO 10216:2017(E)

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Foreword

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

This third edition cancels and replaces the second edition (ISO 10216:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the tolerance of the width of the slit has been revised;

— the figures have been revised;

— a combed sliding shutter figure has been added;

— information about the test specimen has been added.

Introduction

Estimation of the image clarity of anodic oxidation coatings on aluminium and its alloys is normally carried out visually by observing the clearness of an image on the surface. However, the image can be observed at various angles and be confused with the gloss level of a surface, and while the degree of image clarity is mainly influenced by the clearness of the coating, it is also affected by image distortion caused by surface irregularities and the haziness of the coating layer. Standardized methods of determining image clarity are therefore required.

This document specifies the use of an instrumental method for measuring image clarity using an optical comb. A related document, ISO 10215, specifies the use of a chart scale also based on an optical comb together with a lightness scale to rank image clarity.

NOTE This instrumental method provides more accurate measurements of image clarity than visual evaluation and can be used in cases of dispute.

Anodizing of aluminium and its alloys — Instrumental determination of image clarity of anodic oxidation coatings — Instrumental method

1 Scope

This document specifies an instrumental method for determining the image clarity of anodic oxidation coatings on aluminium and its alloys by measuring reflection from the surface with the help of a sliding combed shutter.

The test can only be applied to a flat surface which can reflect the image onto the limited combed shutter and photo-receiver. This method can also be used to measure the optical evenness of anodic oxidation coatings on aluminium and its alloys.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7583, *Anodizing of aluminium and its alloys — Terms and definitions*

ISO 7668, *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°*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7583 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
image clarity
C_n
ability of the surface of an anodic oxidation coating to produce a clear image of an object facing the surface

Note 1 to entry: Image clarity is expressed as a percentage.

3.2
optical evenness
E
degree of evenness (surface irregularities) given by the ratio of the longitudinal and transverse values of the *image clarity* (3.1)

3.3
dispersion of light
D
degree of dispersion of reflected light by the test specimen

4 Principle

A light source illuminates the slit and is converted to parallel light through a collimating lens. It is reflected at the surface of the test specimen, which is set at 45° to the incident light, and is then focused on a combed sliding shutter through a de-collimating lens. In cases where the test specimen has a completely flat and smooth surface, the reflected light is concentrated as a sharp image of the slit at the combed sliding shutter. The shutter is slid laterally. When the transparent portion of the combed sliding shutter coincides with the reflected slit image, the reflected light passes completely and the maximum light intensity is received by the photo-receiver. In cases where the test specimen has a matt surface, the reflected light passes partially through the transparent portion of the combed sliding shutter and a lower light intensity is received, depending on the degree of dispersion by the test specimen. This difference corresponds to the image clarity. Optical evenness is shown by the ratio of the longitudinal and transverse values (see 8.4).

5 Apparatus

An example of the apparatus is shown in Figure 1.

5.1 Flat surface of the test specimen, set at 45° to the incident light and with the reflected image measured at 45° in the specular direction.

5.2 Lenses, focal length of 130 mm.

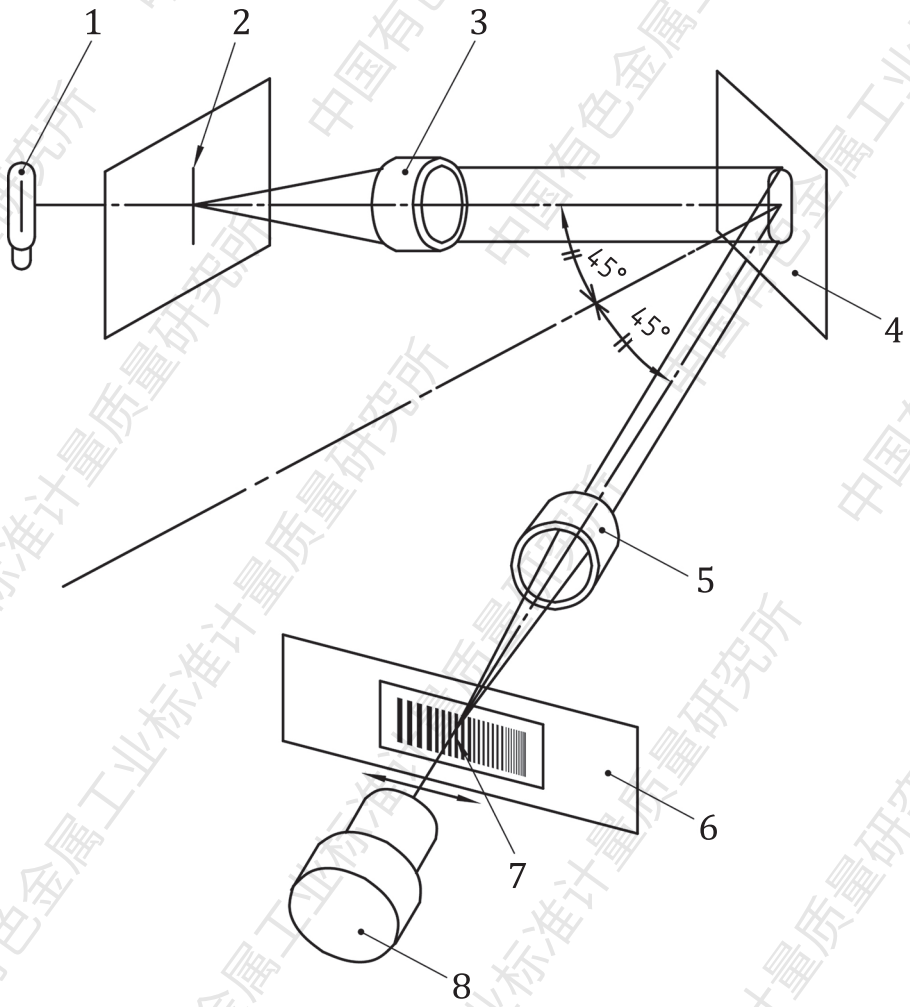
5.3 Light source, filament not larger than 0,05 mm and capable of providing a constant light intensity during measurement.

5.4 Slit, 0,02 mm ± 0,01 mm in width and about 20 mm in length.

5.5 Combed sliding shutter (see Figure 2), thin sheet with optical slits having a ratio of width of transparent portion to opaque portion of 1:1. Five different widths of 0,125 mm, 0,25 mm, 0,5 mm, 1,0 mm and 2,0 mm are incorporated.

5.6 Photo-receiver, adjustable to the received light intensity.

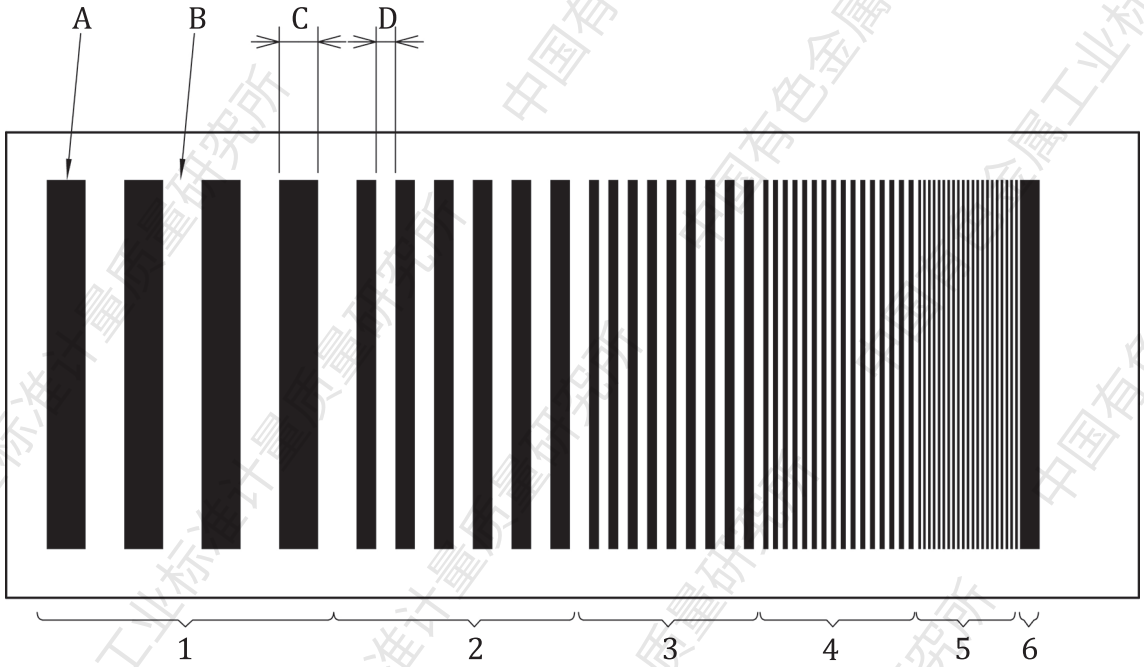
5.7 Black glass, which shall conform to ISO 7668.



Key

1	light source	5	de-collimating lens
2	slit	6	combed sliding shutter
3	collimating lens	7	reflected slit image
4	test specimen	8	photo-receiver

Figure 1 — Example of apparatus for image clarity measurement



Key

A opaque portion
B transparent portion
C width of opaque portion
D width of transparent portion

1 transparent and opaque portions each 2,0 mm in width
2 transparent and opaque portions each 1,0 mm in width
3 transparent and opaque portions each 0,5 mm in width
4 transparent and opaque portions each 0,25 mm in width
5 transparent and opaque portions each 0,125 mm in width
6 opaque portion

Figure 2 — Example of combed sliding shutter

6 Test specimen

6.1 Sampling

The test specimen shall be taken from a significant flat surface of the product and shall not be taken from part of the edge because of possible distortion and/or non-uniformity.

Where it is impossible to test the product itself, a test specimen may be used. However, in this case, the test specimen used shall be one which is representative of the product and it shall be made from the same material and prepared under the same conditions of finishing as those used for the preparation of the product.

The aluminium alloy, the manufacturing conditions (kind and temper of the material) and the surface condition before treatment shall be the same as those of the product.

Pretreatment, anodizing and sealing shall be performed in the same baths and under the same conditions as the treatment of the product.

6.2 Size

The standard size of the test specimen should be about 50 mm × 50 mm.

6.3 Treatment before measurement

The test specimen shall be clean, free from dirt, stains and other foreign matter. Any deposits or stains shall be removed with a clean, soft cloth or similar material which is wetted by water or an appropriate organic solvent such as ethanol. Organic solvent which can corrode the test specimens or generate protective films on the test specimens shall not be used.

7 Procedure

7.1 Measurement of black glass

Set the black glass on the holder and measure the received light intensity by moving the combed sliding shutter. Adjust the minimum light intensity to zero.

7.2 Sensitivity adjustment by test specimen

Set the test specimen on the holder and measure the received light intensity by moving the combed sliding shutter, in order not to saturate the photo-receiver. In case the test specimen has directionality, measure in both longitudinal and transverse directions. Use the higher light intensity as the maximum light intensity. Adjust the full scale standardization sensitivity so that the maximum light intensity is not saturating.

7.3 Measurement of test specimen

Measure the test specimen by moving the combed sliding shutter. Two different points are measured. If there is a large difference between those values, make an additional measurement and use the two largest values. In case the test specimen has directionality, measure in both longitudinal and transverse directions.

NOTE 1 The combed sliding shutter, 0,125 mm, is suitable for mirror finished specimens.

NOTE 2 The combed sliding shutter, 0,5 mm, is suitable for general use.

8 Expression of results

8.1 Calculation of image clarity, C_n

Calculate the image clarity using Formula (1); see Figure 3 and Figure 4:

$$C_n = \frac{M-m}{M+m} \times 100 \quad (1)$$

where

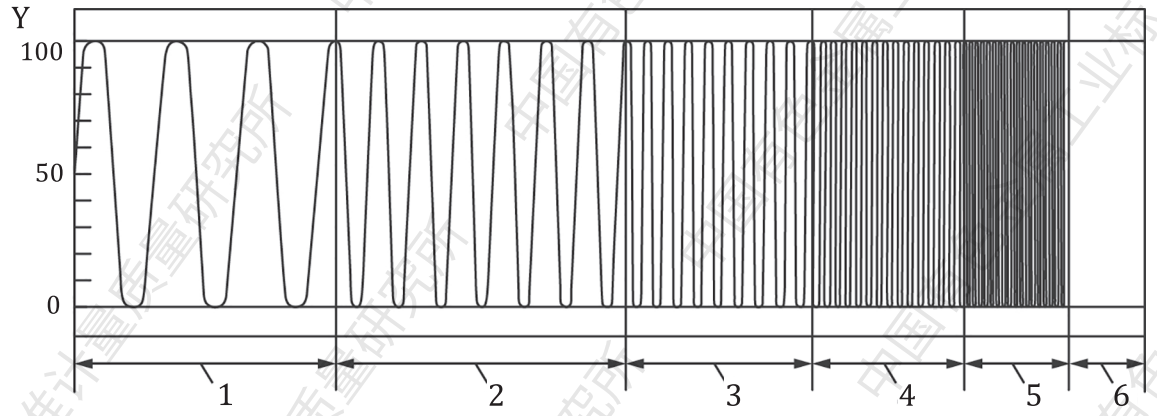
C_n is the image clarity;

M is the maximum light intensity;

m is the minimum light intensity;

n is the width of the combed sliding shutter.

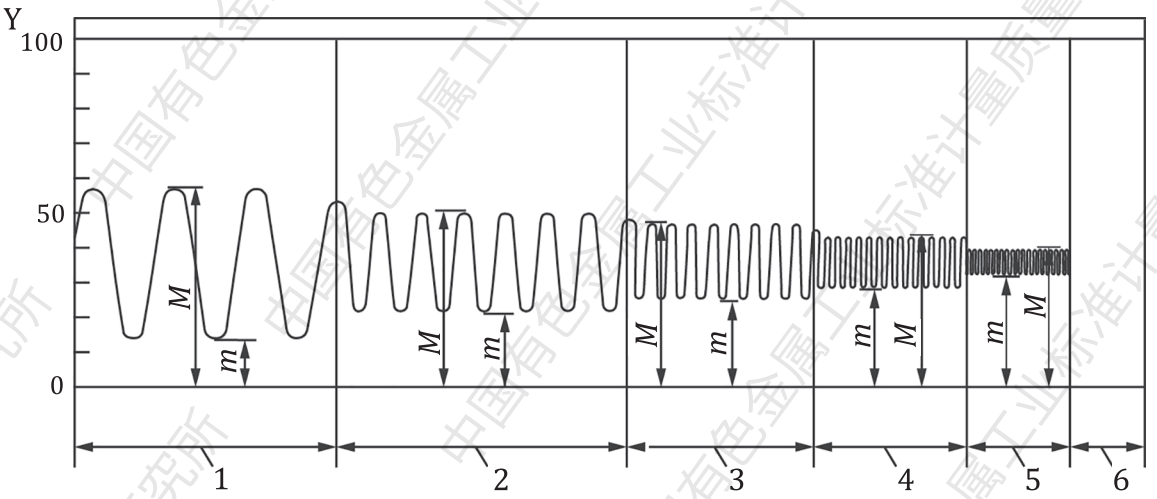
NOTE When the image clarity is high, the image can be seen clearly. On the contrary, when the image clarity is low, the image is distorted.



Key

Y relative light intensity
1 transparent and opaque portions each 2,0 mm in width
2 transparent and opaque portions each 1,0 mm in width
3 transparent and opaque portions each 0,5 mm in width
4 transparent and opaque portions each 0,25 mm in width
5 transparent and opaque portions each 0,125 mm in width
6 opaque portion

Figure 3 — Example of received light intensity from black glass



Key

Y relative light intensity
M maximum light intensity
m minimum light intensity
1 transparent and opaque portions each 2,0 mm in width
2 transparent and opaque portions each 1,0 mm in width
3 transparent and opaque portions each 0,5 mm in width
4 transparent and opaque portions each 0,25 mm in width
5 transparent and opaque portions each 0,125 mm in width
6 opaque portion

Figure 4 — Example of received light intensity from test specimen

8.2 Image clarity

Show all the values of image clarity in a table similar to Table 1.

Table 1 — Values of image clarity (example of tabular presentation of results)

Comb	Direction	
	Transverse	Longitudinal
$C_{0,125}$	XX,X	XX,X
$C_{0,25}$	XX,X	XX,X
$C_{0,5}$	XX,X	XX,X
$C_{1,0}$	XX,X	XX,X
$C_{2,0}$	XX,X	XX,X

8.3 Image clarity comparison and classification

The basis for comparison of image clarity is defined as the larger of the values obtained in the transverse or longitudinal direction with the 0,5 mm, $C_{0,5}$. The results can be broadly classified as shown in Table 2.

Table 2 — Classification of image clarity

Class	The larger value in the two directions, $C_{0,5}$ (%)	Description
S	$C_{0,5} \geq 90$	Mirror finishes
A	$90 > C_{0,5} \geq 70$	Glossy finishes
B	$70 > C_{0,5} \geq 30$	Low glossy finishes
C	$C_{0,5} < 30$	Matt finishes

8.4 Optical evenness, E

The optical evenness can be expressed using Formula (2) with $C_{0,5}$:

$$E_{0,5} = \frac{S_{0,5}}{L_{0,5}} \tag{2}$$

where

$S_{0,5}$ is the smaller value of $C_{0,5}$ in the transverse or longitudinal direction;

$L_{0,5}$ is the larger value of $C_{0,5}$ in the transverse or longitudinal direction.

8.5 Dispersion of light, D

The dispersion of light can be expressed using Formula (3), for class A upwards:

$$D_{0,125} = \frac{C_{2,0} - C_{0,125}}{C_{2,0}} \tag{3}$$

and Formula (4), for all other products:

$$D_{0,5} = \frac{C_{2,0} - C_{0,5}}{C_{2,0}} \tag{4}$$

9 Test report

The test report shall include at least the following information:

a) a reference to this document, i.e. ISO 10216:2017;

b) the type, application and identification of the product used;

c) the specification of the material used;

d) the type of finishing treatment used;

e) the values of image clarity (see Table1);

f) the image clarity class (see Table 2);

g) the optical evenness, $E_{0,5}$, if appropriate;

h) the dispersion of light, $D_{0,5}$ and/or $D_{0,125}$, if appropriate;

i) any deviation, by agreement or otherwise, from the procedure specified;

j) the date of the test.

Bibliography

[1] ISO 10215, *Anodizing of aluminium and its alloys — Visual determination of image clarity of anodic oxidation coatings — Chart scale method*

[2] KITA H., & SUGA S. *Advanced Measurement Technology for Image Clarity*. AIC2015 TOKYO – Color and Image Proceedings. 2015, pp. 85–90

ICS 25.220.20

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