INTERNATIONAL STANDARD

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

Aluminium et alliages d'aluminium anodisés — Détermination de la netteté d'image sur couches anodiques — Méthode instrumentale

Reference number
ISO 10216:1992(E)

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.

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.

International Standard ISO 10216 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Sub-Committee SC 2, *Anodized aluminium*.

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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 were therefore required.

This International Standard specifies the use of an instrumental method of measuring image clarity using optical combs. A related International Standard (ISO 10215:1992, *Anodized aluminium and aluminium alloys — Visual determination of image clarity of anodic oxidation coatings — Chart scale method*) specifies the use of a chart scale also based on optical combs together with a lightness scale to rank image clarity.

NOTE 1 This instrumental method provides more accurate measurements of image clarity and should be used in cases of dispute.

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

1 Scope

This International Standard specifies an instrumental method for determining the image clarity of anodic oxidation coatings on aluminium and aluminium 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 on the limited combed shutter and photo-receiver. This method can also measure the optical evenness of anodic oxidation coatings on aluminium and aluminium alloys.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2128:1976, *Anodizing of aluminium and its alloys — Determination of thickness of anodic oxide coatings — Non-destructive measurement by split-beam microscope.*

ISO 7668:1986, *Anodized aluminium and aluminium alloys — Measurement of specular reflectance and specular gloss at angles of 20 degrees, 45 degrees, 60 degrees or 85 degrees.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 image clarity, C_n: The ability of the surface of an anodic oxidation coating to produce a clear image of an object facing the surface. In this method, it is represented by a symbol C_n and is expressed as a percentage.

3.2 optical evenness, E: The overall uniformity of reflection diminished by the orientation of surface irregularities. It is given by the ratio of the longitudinal and transverse values of the image clarity, because the values of image clarity are usually different in these directions.

3.3 dispersion of light, D: The change in image clarity produced by altering the comb width.

4 Principle

Light comes through a first slit which serves as a light source and it is converted to parallel light through a first lens (collimator), reflected at the surface of the test piece, which is set at 45° to the light beam, and is then focussed at a combed shutter through a second lens (condensing lens). If the test piece has a completely flat and smooth surface, the reflected beam is concentrated as a sharp image of the first slit at the combed shutter when the shutter is slid laterally. When the centre of the comb space coincides with the image, the beam passes completely through the space of the comb and generates a signal maximum on the photo-receiver. Otherwise, the beam cannot pass through the comb completely and generates a lower signal, depending on the degree of dispersion of the light. This signal 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. This instrument is constructed in a similar way to the split-beam microscope in ISO 2128. The reflected image is focussed at the combed shutter and the quantity of light coming through the space of the combed shutter is measured on the photo-receiver. The photo-receiver is connected to a recorder which shows the horizontal progression of the combed shutter on the X-axis and the quantity of light coming through the spaces of the combed shutter on the Y-axis. The general image clarity is thus illustrated exactly by the heights of the waves.

The essential characteristics of the apparatus are given in 5.1 to 5.7.

5.1 A flat test piece surface, set at 45° to the incident light and with the reflected image measured at 45° in the specular direction.

5.2 Lenses, of good quality and with a focal length of 120 mm.

5.3 A light source, consisting of a lamp with a filament not larger than 0,05 mm and capable of providing a constant quantity of light during the measurement.

5.4 A slit, 0,1 mm ± 0,02 mm in width and about 20 mm in length.

5.5 A combed sliding shutter, consisting of a thin sheet with optical slits having a ratio of width of light portion to dark portion of 1:1. Five different widths of 0,125 mm (see note 2); 0,25 mm; 0,5 mm (see note 3); 1,0 mm and 2,0 mm are incorporated and the moving speed of the shutter is approximately 10 mm/min.

NOTES

2 The slit forming the light source is 0,10 mm ± 0,02 mm in width and this is similar to the width of this combed shutter. Therefore it is only suitable for very flat products.

Dimensions in millimetres, unless otherwise indicated

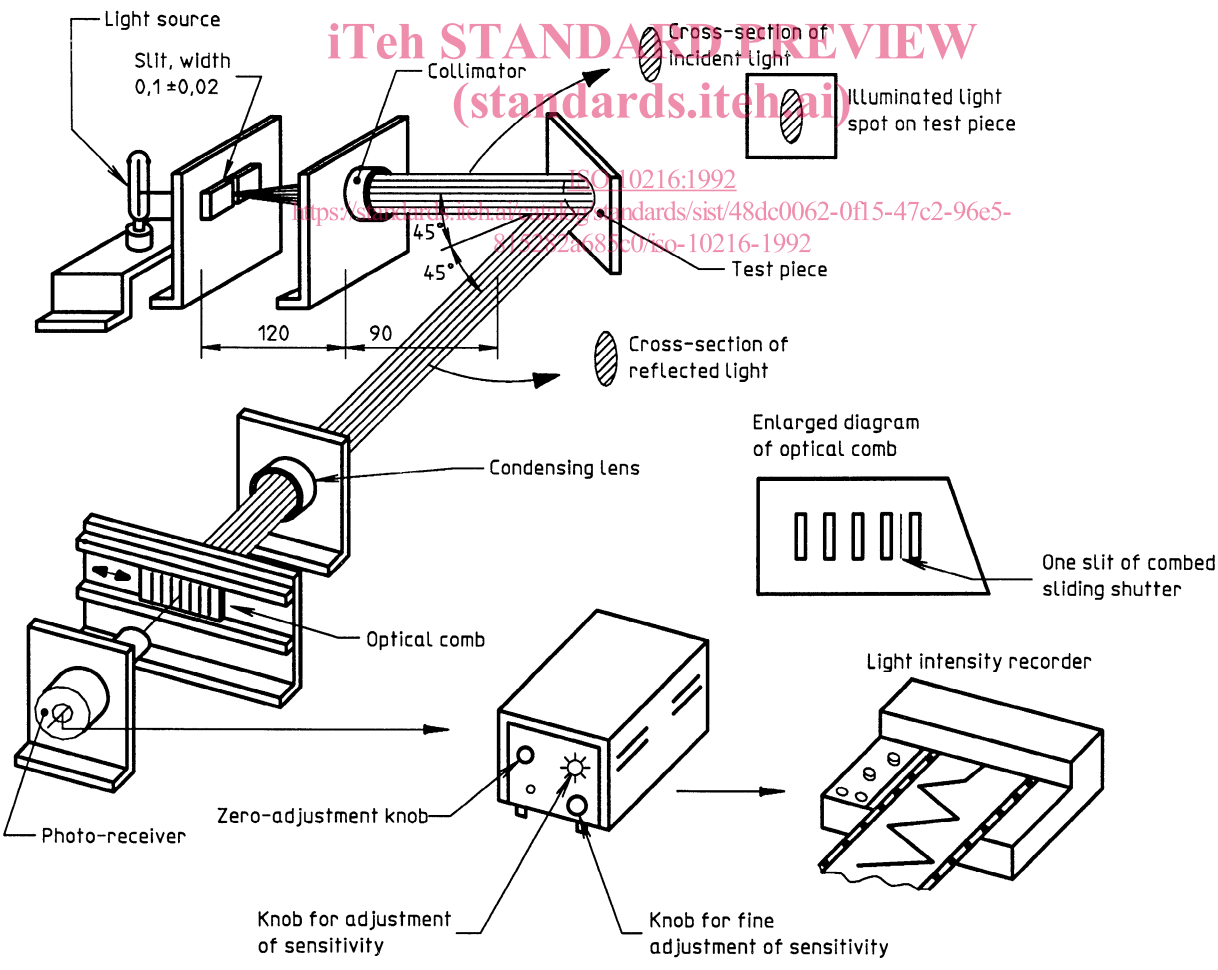

Figure 1 — Testing apparatus for image clarity measurement

3 The combed shutter used is about four times larger than the width of the light source and is suitable for general use as described in clause 7.

4 The light transmittance of the dark lines should be virtually zero.

5.6 A photo-receiver, the output of which is sufficiently adjustable to obtain a correct level of image clarity even when the test piece being examined gives a weak reflection.

5.7 Black glass standard sample (see note 5), which gives a constant height of wave on the recorder when any of the five widths of combed sliding shutter is used for passing light. The bottom level of the waves is defined as the standard zero level.

NOTE 5 The black glass standard surface used should conform to the specifications of ISO 7668.

6 Test piece

6.1 Sampling

The test piece shall be taken from a significant flat surface of the product. During sampling, care must be taken to avoid distortion or damage.

Where it is impossible to test the product itself, a test sample may be used. However, in this case, the test sample used shall be one which is representative of the product, and it shall be made from the same material (see note 6) and prepared under the same conditions of finishing (see note 7) as those used for the preparation of the product.

NOTES

6 The composition of the basis material, the manufacturing conditions (kind and quality of the material), the surface condition before treatment and all other conditions should be the same as those of the product.

7 Pretreatment and anodizing should be performed in the same bath and under the same conditions as the treatment of the product.

6.2 Size

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

6.3 Treatment before testing

The test piece 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.

7 Procedure

7.1 Measurement on the black glass standard

Mount the black glass standard (5.7) on the mounting base and record the effect of the received light by moving the combed sliding shutter (5.5). Adjust the bottom of the waves to zero by operating the zero-adjustment knob.

7.2 Initial setting for measurement of the test piece

Mount the test piece on the mounting base, and observe the effect of the received light by moving the combed sliding shutter. Make any necessary adjustments, by operating the sensitivity-adjustment device of the apparatus, so that the value of the highest wave falls at an appropriate position on the recording paper, to facilitate the measurement in 7.3.

7.3 Measurement on the test piece

Carry out measurements on the test piece using each width of comb space. Measure at two different points on each surface tested. If values are very different, make on additional measurement and record the two largest values. Perform the tests on the test piece turned through 90°, to obtain the values in the longitudinal and transverse directions.

8 Expression of results

8.1 Image clarity, C_n

Calculate the image clarity value from the recorded wave heights using the following equation (see figures 2 and 3):

$$C_n = \frac{M - m}{M + m} \times 100$$

where

C_n is the image clarity value, expressed as a percentage;

M is the maximum wave height;

m is the minimum wave height;

n is the symbol for the width of the space of the comb.

The values of image clarity are characteristic for the respective optical comb widths.

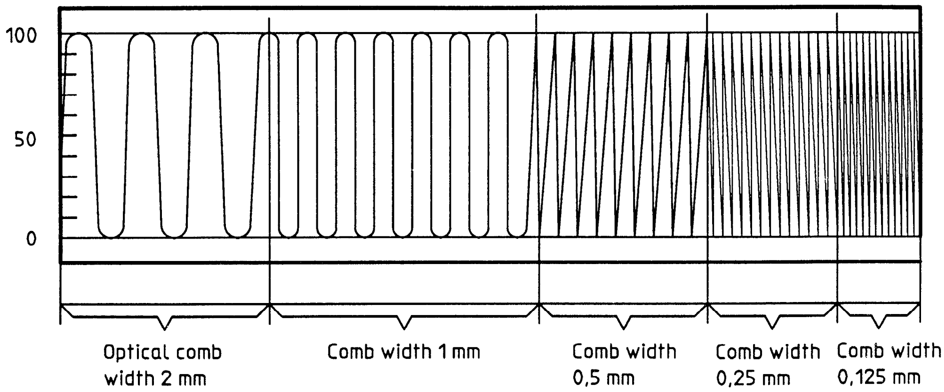

Figure 2 — Recorded wave form of light received from black glass standard sample

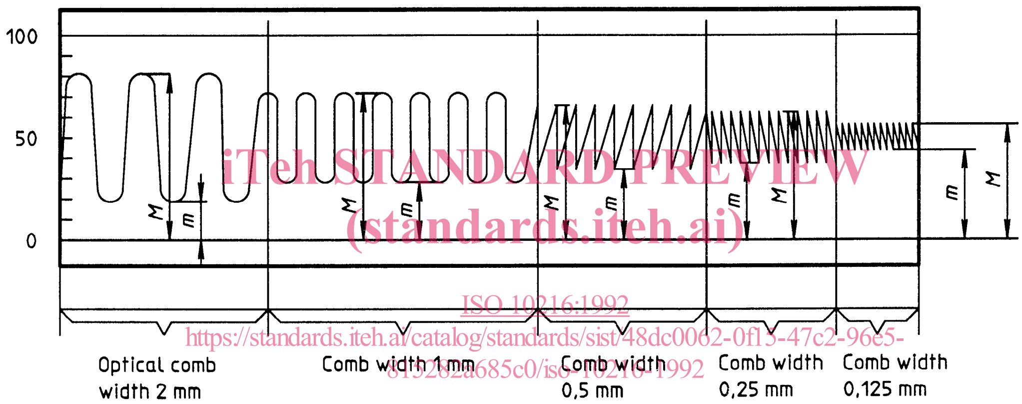

Figure 3 — Example of recorded wave form of light received from a test piece

8.2 Overall image clarity (range)

Show all the values of image clarity, which were measured using the five comb spaces, in a table similar to table 1.

Table 1 — Overall image clarities (example of tabular presentation of results)

Comb	Direction	
	Transverse (//)	Longitudinal (⊥)
$C_{0,125}$		
$C_{0,25}$		
$C_{0,5}$		
$C_{1,0}$		
$C_{2,0}$		

The larger of the values obtained in the two different directions with each comb is the value which corresponds to the visual appearance.

NOTE 8 This phenomenon is similar to the phenomenon of motion pictures, which show movement by the use of about 18 images per second.

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 comb, $C_{0,5}$. 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, $C_{0,5}$ (%)	Example
Special	⩾ 90	Mirror-like finishes
A	90 to 70	
B	Less than 70 to 30	
C	Less than 30	Very matt finishes

8.4 Optical evenness, E

Usually the values of image clarity in the transverse and longitudinal directions are considerably different from each other, and it may be convenient to show the ratio of the two values as an evenness factor, E. It is usually convenient to indicate optical evenness $E_{0,5}$, by using $C_{0,5}$ (see note 8). Then

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

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;

and, of course,

$E = 1,0$ for standard black glass.

NOTE 9 This may not be possible in cases where a test sample is used in place of the actual product.

8.5 Degree of dispersion of light

The following equation can be used to determine the concentration of dispersed light over each range of width. The degree of dispersion of light, D, is given by

$$D_{0,125} = \frac{C_{2,0} - C_{0,125}}{C_{2,0}} \quad \text{for class A upwards}$$

and

$$D_{0,5} = \frac{C_{2,0} - C_{0,5}}{C_{2,0}} \quad \text{for all other products}$$

9 Test report

The test report shall contain at least the following information:

a) the type, application and identification of the product tested;

b) a reference to this International Standard;

c) the specification of the material used;

d) the type of finishing treatment used;

e) the overall image clarity values (table 1);

f) the image clarity class (table 2);

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

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