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Anodizing of aluminium and its alloys — Visual determination of image clarity of anodic oxidation coatings — Chart scale method

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

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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 10215:2010), which has been technically revised.

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

— the normative reference of ISO/TR 8125 has been deleted since it has been withdrawn;

— ISO/TR 8125:1984, Table 2 has been added as Table 2;

— the specification of the test specimen has been revised.

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 can 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 a chart scale based on optical combs, together with a lightness scale to rank image clarity, and has been found to give good correlation with visual evaluation. A related document, ISO 10216, specifies an instrumental method of measuring image clarity, also by using optical combs. The instrumental method provides a more accurate measurement of image clarity than visual evaluation and should be used in cases of dispute.

Anodizing of aluminium and its alloys — Visual determination of image clarity of anodic oxidation coatings — Chart scale method

1 Scope

This document specifies a visual method for determining the image clarity of anodic oxidation coatings on aluminium and its alloys, using a chart scale and a lightness scale, which are defined. The method is applicable only to flat surfaces that can reflect the image of the chart scale pattern.

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*

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 address:

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

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

3.1
image clarity
C_V
ability of the surface of an anodic oxidation coating to produce a clear image of an object reflected in the surface

Note 1 to entry: In the method described in this document, image clarity is represented by a symbol C_V and is expressed as a numerical unit which is calculated by taking into account the image clearness, the image distortion and the haze value (see Clause 8).

3.2
image clearness
C
limit of visual resolution of fine details of a chart scale when reflected by a surface, given by the grade number on the chart scale

Note 1 to entry: Image clearness relies heavily on the roughness of the surface being measured, and the lower the roughness the clearer or sharper the image becomes, i.e. the nearer the surface becomes to a perfect mirror, the clearer the image becomes.

3.3
image distortion
I
degree of distortion of an image caused by the waviness of a surface, given by the grade number on the chart scale

Note 1 to entry: Image distortion depends on the evenness of the surface being measured. The distortion occurs because part of the incident light is reflected in a direction different from that of the bulk of the light due to an uneven surface. Even if the surface is mirror-finished, it will present a distorted image if waviness is present.

3.4
haze value
H_n
degree of opacity of the coating on a surface, expressed as a lightness unit

Note 1 to entry: Haze represents the opacity or transparency of the coating layer. Poor transparency causes absorption and scattering of normally reflected light, thus reducing the clarity of the image.

4 Principle

The image clarity of an anodic oxidation coating is determined by visual estimation of three properties of the coating layer: image clearness, image distortion and haze. These properties are determined by evaluating the image of a chart scale on the test specimens.

5 Apparatus

5.1 Chart scale, as shown in Figure 1, comprising a translucent plastic film or glass on which a pattern of optical combs is arranged using black and white lines with a range of specified widths (Grades 1 to 11). The light transmittance of the dark lines should be virtually zero.

The widths of the black lines, and the spaces between two adjoining black lines, for each grade, are the same and the lines are perfectly parallel. The lines for Grade 1 are the widest and those for Grade 11 are the narrowest. The widths of the lines for each grade are given in Table 1.

NOTE The widths of lines for Grades 1 to 7 form an arithmetical progression. The grades above Grade 7 are used for estimating comparatively high image clarity and Grades 7, 9 and 11 form a geometrical progression. Grade 8 is the median of Grades 7 and 9, and Grade 10 is the median of Grades 9 and 11.

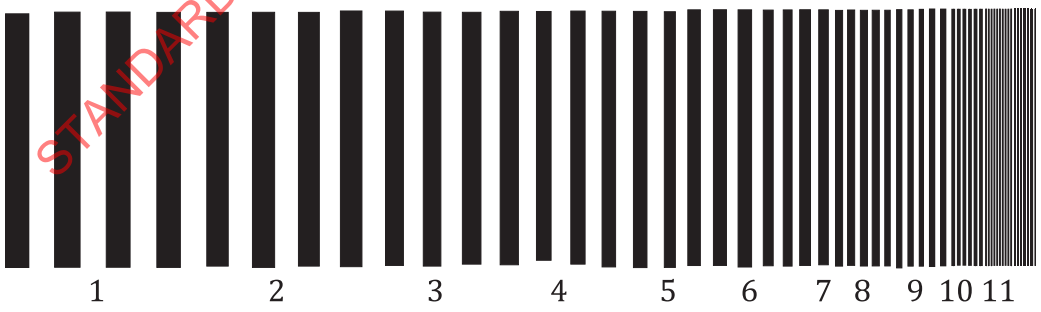


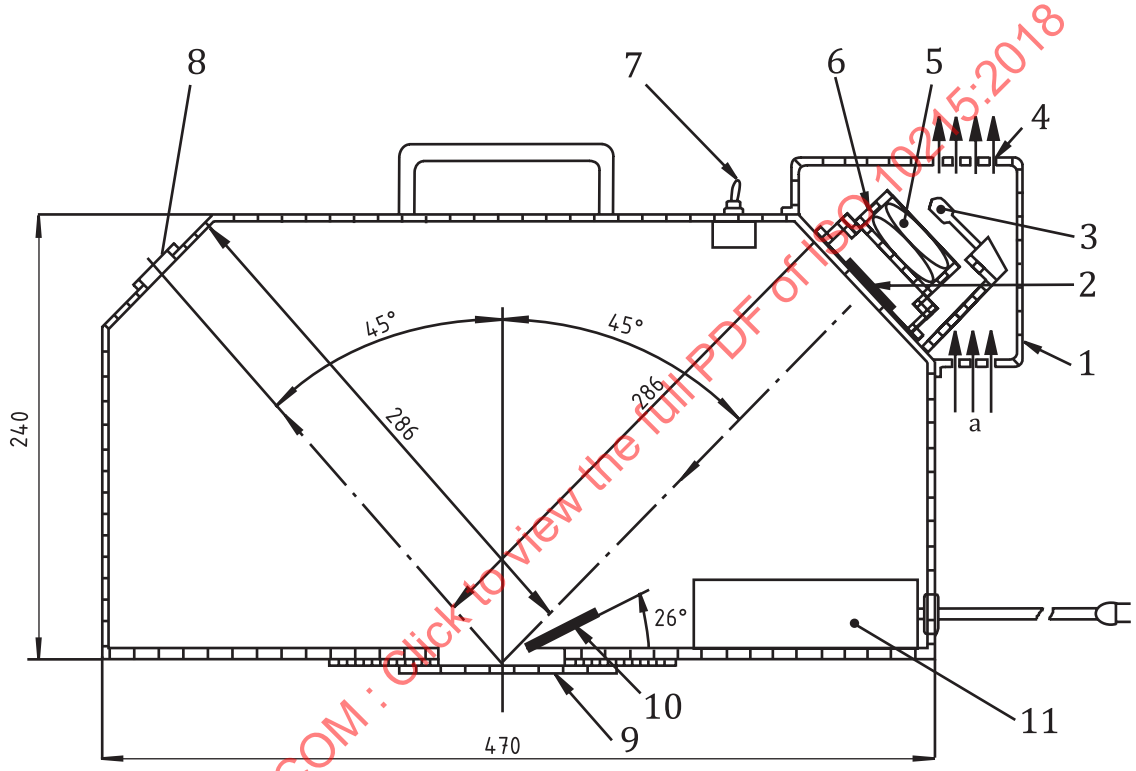
Figure 1 — Chart scale with Grades 1 to 11

Table 1 — Width of lines for each grade of the chart scale

Grade	1	2	3	4	5	6	7	8	9	10	11
Width mm	2,0	1,75	1,5	1,25	1,0	0,75	0,5	0,375	0,25	0,188	0,125

5.2 Observation box, as shown in Figures 2 and 3, which accommodates the chart scales used. It has a window in which the scale (Grades 1 to 11) may be set, and an observation window on the other side. The window for the test specimens is at the base of the box.

Dimensions in millimetres, unless otherwise indicated

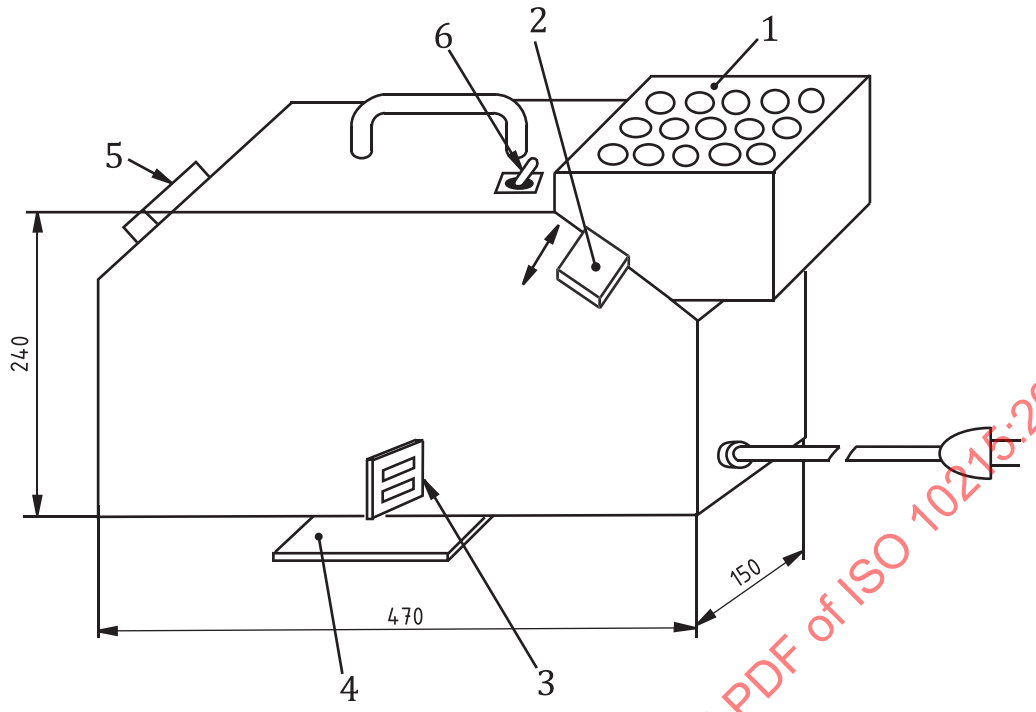


Key

1 lamp box
2 chart scale
3 source of white light
4 air vent
5 lens φ 39,5 mm, focus 50 mm × 2 mm
6 diffuser
a Air.
7 power switch
8 observation window
9 test specimen
10 lightness scale
11 power source

Figure 2 — Diagram of a typical observation box

Dimensions in millimetres



Key

1 lamp box
2 chart scale
3 lightness scale
4 test specimen
5 observation window
6 power switch

Figure 3 — Appearance of typical observation box

5.3 Lightness scale, a neutral scale which has 18 lightness chips ranging from H_n = 9,5 to H_n = 1,0, with a pitch of 0,5; the value of each chip is assigned according to Table 2.

NOTE Manufacturers often use symbol V instead of H_n on lightness chips.

Table 2 — Lightness scale

H_n	L^*[a]	H_n	L^*[a]	H_n	L^*[a]
9,5	96,00	6,5	66,67	3,5	36,00
9,0	91,08	6,0	61,70	3,0	30,77
8,5	86,21	5,5	56,66	2,5	25,61
8,0	81,35	5,0	51,58	2,0	20,54
7,5	76,48	4,5	46,41	1,5	15,60
7,0	71,60	4,0	41,22	1,0	10,63

[a] L^* are determined in accordance with ISO 11664-3.

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 the part of edge for possible distortion and/or non-uniformity.

Where it is impossible to test the product itself, a test specimen which is representative of the product may be used. In this case, the test specimen used 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 should be the same conditions as those of the product.

Pretreatment, anodizing and sealing should 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 greater than 90 mm in length by 65 mm in width.

6.3 Treatment before testing

The test specimen shall be clean, free from dirt, stains and other foreign matters. 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 solvents which can corrode test specimens or generate protective films on test specimens shall not be used.

7 Procedure

7.1 General

Image clearness, C, and image distortion, I, are determined using the chart scale (5.1) and the haze value, H_n, is determined using the lightness scale (5.3).

Image clarity, C_v, is calculated from these values.

7.2 Determination of image clearness, C

Place the chart scale on the observation box (5.2) and put the box on the test specimen. Illuminate the chart scale and observe the range of white and black lines reflected by the test specimen, as illustrated in Figure 2. Establish the highest grade number for which a clear image can be distinguished in the longitudinal and transverse directions.

EXAMPLE For a test specimen having high image clearness (mirror-like), the boundary of a black and a white line for Grade 11 can be clearly distinguished and the image clearness of the test specimen is Grade 11. If it cannot be distinguished clearly, observe the group of lines for the next lower grade in turn. If it can be distinguished for Grade 9, but not for Grade 10, the image clearness of the sample is Grade 9.

7.3 Determination of image distortion, *I*

After estimating the image clearness, observe the distortion in the width of the black lines and the rate the grade for longitudinal and transverse directions in a similar way to 7.2. When the line is distorted and the width of a thin portion is about half the normal width of a black line for a certain grade (see Figure 4), assign the next lower grade to this test specimen.

EXAMPLE If the line of Grade 5 with a width of 1 mm (see Table 1) is distorted and the width of the thin portion is about half (0,5 mm) as illustrated in Figure 4, assign Grade 4, as image distortion, which is one grade lower than Grade 5.

Dimensions in millimetres

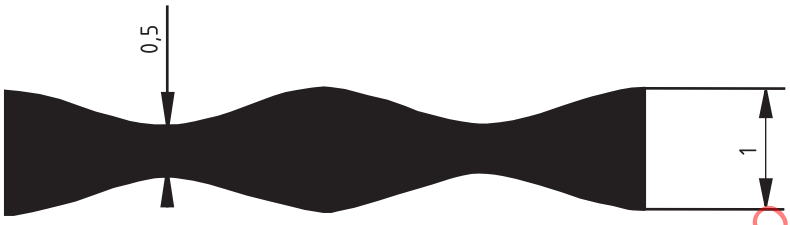


Figure 4 — Example of distortion of image — Line of Grade 5

7.4 Determination of haze value, H_n

Place the lightness scale in the observation box and compare the black lines for Grade 1 with it to find a lightness scale chip that gives identical lightness to the black line. Assign this lightness unit value to the test specimen as the haze value. If the lightness of a test specimen is identical with Grade 5 of the lightness scale, assign 5 as the haze value.

NOTE A simple visual method in which the visual estimation is performed by judging the shape of a reflected object or the image of a light source is not sufficient, as individual observers appear to find it difficult to differentiate between gloss and image clarity.

8 Expression of results

Calculate the image clarity, C_v, from the image clearness, image distortion and haze values using Formula (1):

$$C_v = \left(\frac{C_L + C_T}{2} + \frac{I_L + I_T}{2} \right) \times \frac{1}{H_n} \quad (1)$$

where

C_v is the image clarity, expressed in grade number;

C_L and C_T are the image clearness, in longitudinal and transverse directions respectively, expressed in grade number;

I_L and I_T are the image distortion, in longitudinal and transverse directions respectively, expressed in grade number;

H_n is the haze value, expressed in lightness units, *V*.

