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Anodizing of aluminium and its alloys — Determination of colour and colour difference of coloured anodic coatings

Anodisation de l'aluminium et de ses alliages — Détermination de la couleur et de la différence de couleur des couches anodiques colorées

Technical Report 8125 was drawn up by Technical Committee ISO/TC 79, *Light metals and their alloys*. The reasons which led to the publication of the document as a Technical Report are explained in the Introduction.

0 Introduction

The characteristics of surface reflection on coloured anodic oxidation coatings on aluminium and its alloys (hereafter called colour-anodized aluminium) is different from that of normal reflection on other objects, such as opaque paint.

The colour of colour-anodized aluminium is perceived differently from that of common objects, which creates confusion when determining the colour and colour difference of colour-anodized aluminium.

This is due to the fact that the colour of colour-anodized aluminium possesses the property of metamerism : i.e., two colours which appear identical when viewed at one angle or when observed under one light source, no longer match if the viewing angle or the light source is changed (see the note). For example, the colour of an exterior wall of a building coated with colour-anodized aluminium, e.g. a curtain wall, could appear different to any observer in a different environment, weather conditions, time and under a different viewing angle. Some experiments show that near-transparent colour-anodized aluminium presents, at a varied incident angle, a different change in gloss and hue from that of the surface of opaque coatings.

NOTE — Refer to *Geometric Metamerism*, by Ruth M. Johnston, **42**/*Color engineering*, May-June 1967, and *Metamerism — A study in dimension*, **38**/*Color engineering*, Nov.-Dec. 1968.

At present, many methods are employed for determining colour and colour difference. These methods fall into one of two categories : visual methods and instrumental methods. For the determination of colour, Munsell Colour Chips have long been used for colour matching of common objects, such as paints, by the visual method and are still being used for this purpose. However, this method for specifying colour by Munsell notation is qualitative, so it is not possible to correlate its specified value with the instrumentally determined value directly.

The visual method, which can specify colour in numerical units using the Munsell Colour Chips, has been developed recently, and it is possible to correlate this new technique with the instrumental method, particularly for specifying the colour of colour-anodized aluminium. However, this method is not yet in widespread use.

For the determination of colour difference, the only visual method available at present seems to be the method using the grey scale for assessing change in colour, which can be correlated with the instrumental method. However, as the grey scale is neutral, care must be taken when it is applied to the evaluation of test specimens which differ in hue and saturation.

From these points of view, it has been deemed preferable to publish, in the form of an ISO Technical Report, a new technique for specifying colour and colour difference which permits good correlation between visual and instrumental methods.

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Initially, it was necessary to identify the insufficiencies in the correlation between the visual and instrumental methods. Table 1 shows the contrast between the visual and instrumental methods. The technical terms are defined in the body of this Technical Report. It should be noted, however, that special subscripts marked v in table 1, such as $L^*_v\ a^*_v\ b^*_v$, are used to indicate that the colours of samples are first determined in Munsell notation visually and then converted into values on the CIE 1976 ($L^*a^*b^*$) colour scale system to obtain the relationship between visual and instrumental values.

The $L^*a^*b^*$ system described in section two was adopted since it is the most representative of those recommended by CIE in 1976.

Table 1 — Current and newly proposed visual and instrumental methods for specifying colour and colour difference

	Current method		Newly proposed method	
	Visual	Instrumental	Visual	Instrumental
Colour	Munsell system	(1) xyY system (2) CIE 1976 ($L^*a^*b^*$) colour scale system (3) CIE 1976 ($L^*u^*v^*$) colour scale system (4) Adam's system	$L^*_v a^*_v b^*_v$ system (specifying in $L^*a^*b^*$ using Munsell colour chips)	CIE 1976 ($L^*a^*b^*$) colour scale system
Colour difference	Grey scale method	(1) CIE 1976 ($L^*a^*b^*$) colour difference (2) CIE 1976 ($L^*u^*v^*$) colour difference (3) Adam's system colour difference	Grey scale method with the data of $L^*a^*b^*$ colour difference	$L^*a^*b^*$ colour difference

This technical report includes the following sections and annexes :

- Section one : Visual method
- Section two : Instrumental method
- Section three : Relation between instrumental and visual methods
- Annex A : Methods other than those described in sections one and two
- Annex B : Instruments applicable to the methods described in annex A.