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Paints and varnishes — Visual comparison of the colour of paints

0 INTRODUCTION

This International Standard is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products. It should be read in conjunction with ISO 1512, ISO 1513, ISO 1514 and ISO 2808.

For standardized colour comparison, it is necessary to have an observer with normal colour vision, and reproducible illumination and viewing conditions. Most paints are required to match a standard in daylight, but the spectral composition of daylight varies considerably. Although it is difficult to control precisely the spectral distribution of artificial daylight sources, individual sources are more stable over a limited period than daylight and therefore enable more reproducible colour comparisons to be made.

Unless otherwise agreed, this method of test makes use of diffuse daylight or an artificial light source representative of a phase of daylight with a correlated colour temperature of 6 504 K (CIE* Standard Illuminant D65) for routine comparisons. In case of dispute, it is considered that the referee comparison should always be made under the specified artificial light.

Specification and control of illuminants present difficulties and there is as yet no internationally agreed method for checking that the illumination in a viewing cabinet has a spectral composition sufficiently close to that of CIE Standard Illuminant D65. Control methods proposed by different countries (for example DIN 6173, Part 2, and BS 950, Part 1) vary greatly and it is considered that an international method needs to be devised.

For the time being, therefore, a statement of the method for control of the illumination should be part of the supplementary information to be added to this International Standard [see item f) below].

The method of test described below requires to be completed, for any particular application, by the following supplementary information. This information shall be derived from the national standard or other document for the product under test or, where appropriate, shall be the subject of agreement between the interested parties.

- a) Material and surface preparation of the substrate.

- b) Method of application of the test coating to the substrate.

- c) Thickness, in micrometres, of the dry coating and method of measurement in accordance with ISO 2808, and whether it is a single coating or a multicoat system.

- d) Duration and conditions of drying of the coated panel (or conditions of stoving and ageing, if applicable) before testing.

- e) Whether the comparison of colour is to be against a reference standard or against a freshly prepared standard.

- f) The light under which the comparison is to be made and, for artificial light, the method for controlling its spectral composition.

- g) Whether attention to metamerism is required and the conditions to be met.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for the visual comparison of the colour of films of paints or related products against a standard (either a reference standard or a freshly prepared standard) using either diffuse daylight or artificial daylight in a standard booth.

2 REFERENCES

ISO 1512, *Paints and varnishes — Sampling.*

ISO 1513, *Paints and varnishes — Examination and preparation of samples for testing.*

ISO 1514, *Paints and varnishes — Standard panels for testing.*

ISO 2808, *Paints and varnishes — Determination of film thickness.*

ISO 3270, *Paints and varnishes and their raw materials — Atmospheres for conditioning and testing.*

* International Commission on Illumination.

3 ILLUMINATION FOR COLOUR MATCHING

3.1 General

For routine colour matching, either natural or artificial daylight may be used. Because 'the quality of natural daylight is variable and observers' judgements are likely to be affected by surrounding coloured objects, for referee purposes closely controlled artificial illumination in a colour-matching booth shall be used. The observer shall wear clothing of a neutral colour, and no strongly coloured surfaces, other than panels under test, shall be permitted in the field of view.

3.2 Natural daylight illumination

Diffuse daylight, preferably from a partially cloudy north sky in the northern hemisphere and a partially cloudy south sky in the southern hemisphere, and not reflected from any strongly coloured object such as a red brick wall or green tree, shall be used. Illumination shall be uniform over the area in which test panels are displayed and at a level of at least 2 000 lx. Direct sunlight shall be avoided.

3.3 Artificial daylight illumination by means of a colour-matching booth

The colour-matching booth shall be an enclosure from which external light is excluded and which is illuminated by a light source giving a spectral power distribution falling on the test panel, approximating to that of CIE Standard Illuminant D65. Where a light source having an alternative spectral distribution is used, it shall be agreed by the interested parties.

The method for checking the closeness of conformity of the spectral distribution of the lighting device to Illuminant D65 shall be specified or agreed. In DIN 6173, Part 2, and BS 950, Part 1, are described techniques which have been found satisfactory in Germany and the United Kingdom respectively. The level of illumination at the colour-matching position shall be between 1 000 and 4 000 lx, a figure towards the upper end of the range being desirable for dark colours.

The interior of a booth for general use shall be painted a matt neutral grey with a luminance factor of about 15 % (for example Munsell reference N4 to N5). However, when mainly light colours and near-white colours are to be compared, the interior of the booth may be painted so as to have a luminance factor of 30 % or higher (for example Munsell reference N6) in order to give a lower brightness contrast with the colour to be examined; when mainly dark colours are to be compared, the interior of the booth may be painted matt black.

To secure an appropriate surrounding field for colour comparison, the table surface in the booth shall be covered by a neutral grey panel, its luminance factor being chosen to be similar to that of the samples to be compared.

A diffusing screen shall normally be used to avoid the reflection of an image of the lamp from the test panel. The spectral distribution properties of the lighting device shall include the spectral transmission of the screen.

The manufacturer of the artificial light source shall disclose the number of running hours during which his product can be expected to conform to this International Standard.

4 OBSERVER

Observers must be selected carefully because a significant proportion of people have defective colour vision. An Ishihara test will reveal severe defects, but for selecting critical colour matches, more sensitive tests, for example the Farnsworth test or anomaloscope measurements, are desirable. If an observer wears glasses to correct his vision, these must have a uniform spectral transmission throughout the visible spectrum. As colour vision changes significantly with age, observers over 40 years of age shall be tested using an anomaloscope or a method whereby the observer is requested to choose the best match from a metameric series of colours.

To avoid eye fatigue effects, pastel or complementary colours shall not be viewed immediately after strong colours. When comparing bright saturated colours, if a decision cannot be made rapidly, the observer shall look away for some seconds at the neutral grey of the surrounding field before attempting a further comparison.

The quality of visual judgements falls off severely if the observer works continuously. Rest periods of several minutes during which no colour matching is attempted shall, therefore, be taken frequently.

5 TEST PANELS AND REFERENCE STANDARDS

5.1 General

Both test panels and reference colour standards shall be flat and preferably at least 150 mm × 100 mm in size, but in no case less than 120 mm × 50 mm. Panels of length 120 mm, when viewed from a distance of 500 mm, subtend an angle at the eye of about 10° in accordance with the CIE 1959 recommendation. Suitable materials for test panels are tinplate, hard aluminium, steel or glass, which comply with ISO 1514.

5.2 Reference standards

Only colour standards of satisfactory colour permanence shall be used for reference standards. Wherever possible, the reference standards shall be of the same size as the test panels and shall have closely similar gloss and surface texture.

5.3 Preparation and coating of test panel

Prepare the test panel as specified and, where appropriate, in accordance with ISO 1514. The panel shall be coated by a closely specified or agreed method, because the method of application and film thickness may affect the colour considerably.

If the test panel is to be compared against a standard paint, it shall be coated with the paint or system under test and a similar panel coated with the standard paint or system. The method of application and the applied film thickness shall be as closely as possible identical.

5.4 Drying of test panel

Dry (or stove) the panel for the specified time and under the specified conditions and, unless otherwise specified, condition in the standard atmosphere according to ISO 3270, for a minimum of 16 h, with free circulation of air and not exposed to direct sunlight.

5.5 Thickness of coating

Determine the thickness, in micrometres, of the dry coating by the method specified, using one of the procedures specified in ISO 2808.

6 PROCEDURE FOR COLOUR COMPARISON

6.1 Routine method

View the two panels, or the panel and the reference colour standard, either under natural daylight (as in 3.2) or in artificial daylight in the colour-matching booth (3.3).

Place the panels side by side, touching or overlapping and in the same plane, at a distance of about 500 mm from the eyes. Compare the colour of the paint film prepared from the material under test with that of the reference colour standard or of the film prepared from the standard paint. To improve accuracy of comparison, compare the colours with the positions of the panels reversed from time to time.

In the case of certain finishes such as metallic finishes, the method of viewing shall be agreed between the interested parties.

When, exceptionally, films of widely different levels of gloss are to be compared, special viewing techniques are required. The panels may be viewed either in natural daylight or in a colour-matching booth.

a) Viewing in natural daylight

View the panels at an angle which minimizes gloss differences, for example from a nearly normal direction so that the specular reflection does not reach the eye.

b) Viewing in a colour-matching booth

View the panels at an angle of 45° with illumination at an angle of 0° .

6.2 Referee method

In case of dispute, comparisons shall be made in artificial daylight, conforming to CIE Standard Illuminant D65, unless an alternative light source has been agreed between the interested parties.

7 ASSESSMENT OF METAMERISM

If the standard and test panels contain dissimilar pigment mixtures, they may match under the standard source but not under another light. This phenomenon is known as metamerism (see annex).

If a numerical description of the metamerism is required, spectral measurements shall be made using both CIE Standard Illuminants D 65 and A (tungsten lamp) and the colour difference calculated using Supplement No. 1 to CIE Publication No. 15, *Special metamerism index : Change in illuminant* (September 1972).

8 TEST REPORT

The test report shall contain at least the following information :

- a) a reference to this International Standard or to a corresponding national standard;
- b) the type and identification of the product under test;
- c) the items of supplementary information referred to in the introduction to this International Standard;
- d) the national standard or other document supplying the information referred to in c) above;
- e) whether the comparison of colour has been carried out using natural daylight or artificial daylight;
- f) any deviation, by agreement or otherwise, from the procedure specified;
- g) the result of the test, including any metamerism noted, and whether the comparison has been carried out against a freshly prepared standard or against a reference colour standard;
- h) the date of the test.

ANNEX

METAMERIC MATCHES

When two paints have identical spectral reflection curves, they will match visually under any illuminant irrespective of its spectral characteristics; this is termed a "spectral match".

It is also possible for two paints having different spectral reflection curves to match visually under a given light source but not to match under another light source with different spectral characteristics; such matches are termed "metameric".

Where the pigments in two matching paints are different, some metamerism inevitably occurs; there may be, in certain cases, a small degree of metamerism even when the same pigments are used.

A small degree of metamerism, whether arising with the same or with different pigments, may be acceptable, depending on the particular circumstances, as the importance of metamerism depends very much on the use for which the paint is intended. Where close colour matching in different lighting conditions is important, the acceptable degree of metamerism, if any, shall be agreed between the interested parties.

The simplest method of determining whether a match made under an artificial light source conforming to this International Standard is metameric or not is to inspect it also under the light from a tungsten filament lamp and it is recommended that this be done unless it is known that identical pigments have been used. If the match is maintained under the tungsten lamp, it is unlikely to be metameric; if the paints no longer match, but the degree of mis-match is not obvious, then it is unlikely that any greater degree of mis-match will occur under most generally used natural or artificial illuminants with continuous spectra. However, this may not be the case for illuminants with line emission, such as sodium and mercury vapour lamps.

A metameric match made under an artificial light source conforming to this International Standard may not match under certain daylight conditions (for example north light from a blue sky or sunlight from a low sun), but it will match under the most frequently occurring phases of daylight. It must be noted, however, that in any case of metamerism, differences in the colour vision of normal observers may influence their assessment as to whether the colours of two paints match or not.