SRI LANKA STANDARD 1256: PART 42: 2019
(ISO 3668: 2017)
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METHODS OF TEST FOR PAINTS AND VARNISHES
PART 42: VISUAL COMPARISON OF COLOUR OF PAINTS

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard
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PART 42: VISUAL COMPARISON OF COLOUR OF PAINTS

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This Standard does not purport to include all the necessary provisions of a contract

Sri Lanka Standard
METHODS OF TEST FOR PAINTS AND VARNISHES
PART 42: VISUAL COMPARISON OF COLOUR OF PAINTS

NATIONAL FOREWORD

This Standard was approved by the Sectoral Committee on Chemical and Polymer Technology and authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2019-10-22

The text of the International Standard ISO 3668: 2017 Paints and varnishes – Visual comparison of colour of paints has been accepted for adoption as a Sri Lanka Standard which specifies a method for the visual comparison of the colour of films of paints or related products against a standard using artificial light sources in a standard booth.

This Standard is identical with ISO 3668: 2017 Paints and varnishes – Visual comparison of colour of paints, published by the International Organization for Standardization (ISO).

TERMINOLOGY AND CONVENTIONS

The text of the International Standard has been accepted as suitable for publication, without deviation, as a Sri Lanka Standard. However, certain terminology and conventions are not identical with those used in Sri Lanka Standards. Attention is therefore drawn to the following:

a) Wherever the words “International Standard” appear referring to a particular Standard they should be interpreted as “Sri Lanka Standard”.

b) The comma has been used throughout as a decimal marker. In Sri Lanka Standards it is the current practice to use the full point at the base as the decimal marker.

c) Wherever page numbers are quoted, they are ISO page numbers.

Cross References

International Standard	Corresponding Sri Lanka Standard
ISO 1514, Paints and varnishes - Standard panels for testing	SLS 1256, Methods of test for paints and varnishes Part 40 Preparation of standard panels for testing (panels other than burnished steel, glass, wood and asbestos)
ISO 3270, Paints and varnishes and their raw materials - Temperatures and humidities for conditioning and testing	No corresponding Sri Lanka Standard
ISO 11664-2, Colorimetry - Part 2: CIE standard illuminants	No corresponding Sri Lanka Standard
ISO 18314-1, Analytical colorimetry - Part 1: Practical colour measurement	No corresponding Sri Lanka Standard
ISO 23603, Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour	No corresponding Sri Lanka Standard

SLS 1256 Part 42: 2019

INTERNATIONAL STANDARD

ISO 3668

Third edition
2017-05

Paints and varnishes — Visual comparison of colour of paints

Peintures et vernis — Comparaison visuelle de la couleur des peintures

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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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This third edition cancels and replaces the second edition (ISO 3668:1998), which has been technically revised with the following changes:

— testing using natural daylight has been deleted;

— CIE illuminant FL 11 has been added as third type of artificial light source;

— determination of the film thickness has been deleted because it is irrelevant for the assessment of colour (the paint layer needs to be sufficient in hiding; the hiding power is more important);

— the normative references have been updated;

— the supplementary test conditions previously in Annex A have been integrated in the test report.

INTERNATIONAL STANDARD **ISO 3668:2017(E)**

Paints and varnishes — Visual comparison of colour of paints

1 Scope

This document 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 artificial light sources in a standard booth.

It is not applicable to coatings containing special-effect pigments, e.g. metallic, without previous agreement on all details of illuminating and viewing conditions

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

ISO 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

ISO 11664-2, *Colorimetry — Part 2: CIE standard illuminants*

ISO 18314-1, *Analytical colorimetry — Part 1: Practical colour measurement*

ISO 23603, *Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour*

CIE 15.3, *Colorimetry*

CIE 51.2, *A method for assessing the quality of daylight simulators for colorimetry*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Principle

The colours of the paint films to be compared are observed under specified illumination and viewing conditions, using a colour matching booth. For the expression of colour difference components (hue, chroma and lightness) a procedure is described, i.e. description by using a particular rating scheme. Assessment of metamerism is also taken into account.

5 Illumination for colour matching

5.1 General

The quality of natural daylight is variable and observers' judgements are likely to be affected by nearby coloured objects. For referee purposes, therefore, 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.

5.2 Artificial 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, CIE standard Illuminant A (as specified in ISO 11664-2) or CIE illuminant FL 11 (as specified in CIE 15.3).

Where a light source having a different spectral distribution is used, it shall be agreed by the interested parties.

The quality of simulation of daylight shall be assessed by the CIE method specified in CIE Publication No. 51.2 and ISO 23603. The spectral distribution of the illuminant shall be in category BC (CIELAB) or better.

The level of illumination at the colour-matching position shall be between 1 000 lx and 4 000 lx, a figure towards the upper end of the range being desirable for dark colours.

The interior of the colour-matching booth for general use shall be painted a matt neutral grey (the amount of a^* and b^* should be less than 1,0) with a lightness L^* of about 45 to 55. 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 lightness L^* of about 65 or higher 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 with a lightness L^* of about 25.

NOTE L^*, a^* and b^* refer to the CIELAB System (see ISO 11664-4).

To ensure 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 the same colour as the light booth.

Some diffusing element (e.g. a diffusing screen) shall normally be used to ensure a distribution spread of light and to avoid the reflection of an image of the lamp from the test panel. The spectral distribution properties of the light source shall include the spectral transmission of the screen.

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

6 Observer

Observers shall have normal colour vision and shall be selected carefully because a significant proportion of people have defective colour vision. An Ishihara test will reveal severe defects, but to confirm an observer's suitability, more sensitive tests, for example the Farnsworth 100 hue test or stricter anomaloscope measurements, are desirable. If an observer wears glasses to correct his or her vision, these shall have uniform spectral transmission throughout the visible spectrum. As colour vision changes significantly with age, it is desirable that observers over 40 years of age are tested using a proper method whereby the observer is requested to choose the best match from a metameric series of colours. For colour comparison work, not only normal colour vision but also colour discrimination ability or experience is important.

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.

7 Test panels and reference standards

7.1 General

Both test panels and reference colour standards shall be flat and preferably about 150 mm × 100 mm in size. Suitable materials for test panels are tinplate, hard aluminium, glazed cardboard, steel or glass, complying with ISO 1514.

Panel size and viewing distance shall be chosen so that the panel subtends a field of observation having an opening making an angle at the eye of about 10°. If larger panels are used, a viewing field corresponding to the 10° observer shall be formed by using a grey mask.

Typical viewing distances and sizes for the square openings of the mask are given in Table 1.

Table 1 — Viewing distances and opening sizes of masks

Viewing distance cm	Opening size cm × cm
30	5,4 × 5,4
50	8,7 × 8,7
70	12,3 × 12,3
90	15,8 × 15,8

7.2 Reference standards

Only colour standards of satisfactory colour permanence shall be used as 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.

Store the reference panels at ambient temperature of (23 ± 5) °C and not exposed to direct sunlight, preferably in a dark location. Put the panels into contaminant-free paper bags, or equivalent, to protect the surface of the panels against hits and scratches.

7.3 Preparation and coating

Prepare the test panels 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.

The film thickness applied should preferably be such as to ensure complete hiding of the substrate, in order to eliminate the influence of the substrate. To check that in this case, black and white charts may be used.

7.4 Drying

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

8 Procedure for colour comparison

8.1 General

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

Artificial average daylight illumination is represented by CIE standard illuminant D65. Incandescent illumination is additionally used to check for metamerism. Incandescent illumination is represented by CIE standard illuminant A; alternatively, a fluorescent light source such as CIE illuminant FL 11 may be used as a secondary light source to check for metamerism.

The visual assessment of colour differences using the components hue, chroma and lightness should preferably be performed in accordance with the rating scheme given in Annex A. By agreement between the interested parties, a simplified rating scheme comprising less than six steps may be used. However, in order to avoid confusion the meaning of the individual ratings given in Annex A shall not be changed.

8.2 Colour comparison

View the two panels, or the panel and the reference colour standard, in artificial daylight, conforming to CIE Standard Illuminant D65, in the colour-matching booth (5.2).

Place the panels side by side, touching 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.

When, exceptionally, films of widely different levels of gloss are to be compared, the method of viewing shall be agreed between the interested parties.

View the panels at an angle of 45° to the illumination direction.

Observe colour difference components of hue, chroma, and lightness with an indication of the order of prominence of these components. For example, note that a specimen is moderately yellower, slightly darker, and very slightly less in chroma than the standard panel or ΔH_{vis}: 3ye, ΔL_{vis}: –2 and ΔC_{vis}: –1 using the component difference rating scheme given in Annex A.

NOTE ΔH_{vis}, ΔL_{vis} and ΔC_{vis} are not colorimetric values, but just values used for difference classification.

9 Assessment of metamerism

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

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.

In addition to assessing the rating of the match under artificial average daylight illumination (D65), make the comparison under incandescent illumination (A) and/or fluorescent lighting (FL 11), and assess whether the match is maintained or not.

If a numerical description of the metamerism is required, spectral measurements shall be made in accordance with ISO 18314-1, the calculations of coloristic values and colorimetric variations will be calculated by bringing in at least two illuminants chosen by mutual agreement between the parties.

10 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) a reference to this document, i.e. ISO 3668;

c) details of the preparation of the test panels, including

   1) the material, the thickness and the surface preparation of the substrate (see 7.1),

   2) the method of application of the coating material to the substrate, including the duration and conditions of drying between coats in the case of a multi-coat system (see 7.3), and

   3) the duration and conditions of drying (or stoving) and ageing (if applicable) of the coating before testing (see 7.4);

d) 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;

e) any deviation from the test method specified;

f) any unusual features (anomalies) observed during the test;

g) the date of the test.

Annex A
(normative)

Colour difference rating scheme

Table A.1 — Rating scheme for components of colour differences[a]

Rating	Degree of difference
0	no perceptible difference
1	very slight, i.e. just perceptible difference
2	slight, i.e. clearly perceptible difference
3	moderate, i.e. very clearly perceptible difference
4	considerable, i.e. pronounced difference
5	severe, i.e. intense difference

[a] Derived from ISO 4628-1.

Components of colour differences are:

Hue differences

Designation: ΔH_{vis} (difference in hue)

Assessment: 0 to 5; more yellow (ye, y), more green (gr, g), more red (re, r), more blue (bl, b)

Example: ΔH_{vis}: 5ye (test specimen is 5 more yellow)

Chroma differences

Designation: ΔC_{vis} (difference in chroma)

Evaluation: 0 to 5; more (+) or less (–)

Example: ΔC_{vis}: –2 (test specimen is 2 less in chroma)

Lightness differences

Designation: ΔL_{vis} (differences in lightness)

Evaluation: 0 to 5; lighter (+) or darker (–)

Example: ΔL_{vis}: –2 (test specimen is 2 darker)

Annex B
(informative)

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; in certain cases, there may even be a small degree of metamerism when the same pigments are used.

The simplest method of determining whether a match made under an artificial light source conforming to this document 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 mismatch is not obvious, then it is unlikely that any greater degree of mismatch 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 spectrum, such as fluorescent, TL84 and sodium and mercury vapour lamps.

A metameric match made under an artificial light source conforming to this document may not continue to be a match under certain daylight conditions (for example north light from a blue sky or sunlight from a low sun), but it will continue to be a 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.

Bibliography

[1] ISO 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

[2] ISO 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* Colour space*

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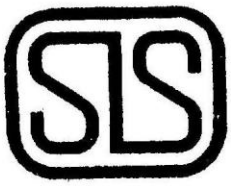

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