

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

RECONFIRMATION

OF

AS/NZS 1580.601.3:1994

Paints and related materials—Methods of test

Method 601.3: Colour—Methods of colour measurement

RECONFIRMATION NOTICE

Technical Committee CH-003 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 30 May 2013.

Approved for reconfirmation in New Zealand on behalf of the Standards Council of New Zealand on 26 August 2013.

The following are represented on Technical Committee CH-003:

Australasian Corrosion Association
Australian Paint Approval Scheme
Australian Paint Manufacturers' Federation
Australian Pipeline Industry Association
Institution of Professional Engineers New Zealand
Master Painters New Zealand Association
Water Corporation Western Australia

NOTES

Australian/New Zealand Standard®

Paints and related materials—Methods of test

Method 601.3: Colour—Methods of colour measurement

PREFACE

This Standard was prepared by the Joint Australia/New Zealand Standards Committee CH/3 on Paints and Related Materials, under the direction of the Multitechnics Standards Policy Board, to supersede, in part, the 1975 editions of AS 1580, *Paints and related materials—Methods of test*, Method 601.2: *Colour—Instrumental measurement of colour difference using the ‘Colormaster’ differential colorimeter* and Method 601.3: *Colour—Instrumental measurement of colour difference using the ‘Color Eye’*.

This Standard is one of a series dealing with measurement of colour. Other Standards in the series are:

AS/NZS

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| 1580 | <i>Paints and related materials—Methods of test</i> |
| 1580.601.2 | Method 601.2: Colour—Principles of colour measurement |
| 1580.601.4 | Method 601.4: Colour—Calculation of colour differences |
| 1580.601.5 | Method 601.5: Colour—Calculation of small colour differences using the CMC equation |

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

FOREWORD

The readings obtained when using a spectrophotometer or tristimulus colorimeter to determine the colour of a sample will be influenced by the following factors:

- (a) The gloss and texture of the surface and the presence of any fluorescence in the sample.
- (b) The measurement geometry of the instrument.
- (c) The source and illuminant used.
- (d) The observer function.

When using instruments of different characteristics, the colour values obtained on the same sample will show slight to substantial differences. Comparative colour measurements will therefore only assist colour matching if the gloss level of the colour samples and the characteristics of the measuring equipment are the same. Further information and guidance on the measurement of colour is given in Appendix A and AS 1580.601.2.

METHOD

1 SCOPE This Standard sets out the method for determining the colour coordinates of coloured samples. The method is only applicable to surfaces that appear to be uniformly of one colour, when examined with normal vision.

NOTES:

- 1 For finishes containing oriented flake type pigments, the measured colour coordinates will vary significantly with the choice of optical geometry. For these samples, the multiple geometry instruments that are becoming available will provide better characterisation of geometric differences but this is outside the scope of this Standard.
- 2 Fluorescent materials require special treatment and are outside the scope of this Standard.
- 3 Appendix A provides information and guidance on some matters involved in the measurement of colour.
- 4 AS 2633 provides basic information on the specification of colours and the CIE* colorimetric system.

2 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS/NZS

1580	Paints and related materials—Methods of test
1580.601.2	Method 601.2: Colour—Principles of colour measurement
1580.601.4	Method 601.4: Colour—Calculation of colour differences
1580.602.2	Method 602.2: Specular gloss
1852	International Electrotechnical Vocabulary
1852.845	Part 845: Lighting
2310	Glossary of paint and painting terms
2633	Guide to the specification of colours

CIE

15.2	Colorimetry (second edition)
S001†	Colorimetric illuminants
S002‡	Colorimetric observers

DIN

5033	Colorimetry
5033.9	Teil 9: Reflectance standard for colorimetry and photometry

ISO

5725	Precision of test methods—Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests
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3 DEFINITIONS For the purpose of this Standard the definitions of AS 1852.845, AS 2310 and those below apply.

3.1 CIE Illuminant C—a colorimetric illuminant, representing daylight with a correlated colour temperature of 6774 K, defined by the CIE in terms of relative spectral power distribution (see CIE S001).

* Commission Internationale de l'Eclairage (International Commission on Illumination).

† Also available as ISO/CIE 10526, *CIE standard colorimetric illuminants*.

‡ Also available as ISO/CIE 10527, *CIE standard colorimetric observers*.

3.2 CIE Standard Illuminant A—a colorimetric illuminant representing the full radiator at 2855.6 K, defined by the CIE in terms of a relative spectral power distribution (see CIE S001).

3.3 CIE Standard Illuminant D₆₅—a colorimetric illuminant, representing daylight with a correlated colour temperature of 6504 K, defined by the CIE in terms of a relative spectral power distribution (see CIE S001).

3.4 Diffuse reflection—diffusion by reflection in which, on the macroscopic scale, there is no specular reflection.

3.5 Illuminant—radiation with a spectral power distribution defined over the range of wavelengths that influence object-colour perception.

3.6 Specular reflection (regular reflection)—reflection without diffusion, in accordance with the laws of optics, as in a mirror.

3.7 2-degree standard observer—the common name for the CIE 1931 Standard Observer; an ideal colorimetric observer with colour matching functions $\bar{x}(\lambda)$, $\bar{y}(\lambda)$, $\bar{z}(\lambda)$ corresponding to a field of view subtending a 2° angle on the retina (see CIE S002).

3.8 10-degree standard observer—the common name for the CIE 1964 Supplementary Standard Observer; an ideal colorimetric observer with colour matching functions $\bar{x}_{10}(\lambda)$, $\bar{y}_{10}(\lambda)$, $\bar{z}_{10}(\lambda)$, corresponding to a field of view subtending a 10° angle on the retina (see CIE S002).

4 PRINCIPLE The tristimulus values, X_{10} , Y_{10} , Z_{10} are measured by one of the following methods—

- (a) measurement of the spectral reflectance characteristics of the paint film with a spectrophotometer and calculation of the tristimulus values; or
- (b) measurement of the tristimulus values with a tristimulus colorimeter.

The chromaticity coordinates x_{10} , y_{10} , or the colour coordinates in the approximately uniform CIE 1976 ($L^*a^*b^*$) colour space, often abbreviated to CIELAB, are then calculated from the tristimulus values, as described in AS/NZS 1580.601.2.

5 CHOICE OF OBSERVER AND ILLUMINANT The 10-degree Standard Observer and Standard Illuminant D₆₅ shall be used.

NOTE: Some tristimulus colorimeters are provided with filters that are only suitable for determining tristimulus values with the 2-degree observer and Illuminant C and Standard Illuminant D₆₅.

For the determination of a metamerism index associated with the change in colour difference between two specimens, caused by substituting a test illuminant for the reference illuminant, Standard Illuminant A shall be used as the test illuminant.

NOTE: CIE 15.2 provides detailed information on the measurement of the metamerism index.

6 CHOICE OF ILLUMINATION AND VIEWING CONDITIONS

6.1 General One of the four measuring conditions for illumination and viewing specified in AS/NZS 1580.601.2 should be chosen. These are 45° illumination/normal viewing (45/0), normal/45° (0/45), diffuse/normal (d/0) and normal/diffuse (0/d). These illumination/viewing conditions are illustrated in Figure 1. The 0/45 instruments are now rarely used.

NOTE: The term 'normal' implies angles of less than 10°.

Instruments using 45° geometry do not necessarily give colour coordinates equivalent to those obtained using diffuse geometry instruments. Colour comparisons between instruments of differing geometry shall not be made. Comparisons may be made between instruments of d/0 and 0/d geometry provided the specular component is included in both cases for non-fluorescent colour samples.

The choice of measurement conditions depends on whether the specular reflection is to be included in, or excluded from, the measurement. In the absence of a specification on the treatment of the specular component, the diffuse illumination/normal viewing geometry (d/0) should be used and the specular component shall be included in the measurement and the calculations.

If a diffuse illumination or viewing geometry is used, the specular component shall be included (SPIN mode) in the measurement.

6.2 Measurement including the specular reflection (SPIN) Where the measurement is to include the specular reflection or no specification is made, the instrument geometry d/0 or 0/d shall be used.

NOTES:

- 1 Improved agreement with visual assessment may be obtained with high gloss samples if the reflectance values determined with d/0 or 0/d geometries (SPIN) are corrected for the surface reflection, by subtraction of the surface reflection component (approximately 4.0 percent) from each of the reflectance measurements, before calculation of the colour coordinates. For matt samples, no correction for surface reflection should be made.
- 2 If there is gloss difference, there may be a visually perceptible change in appearance without a change in colour, for example after weathering. In this case the colour coordinates measured, using SPIN, will generally not be influenced.

6.3 Measurement excluding the specular reflection Where it is specified that the measurement is to exclude the specular reflection, use the instrument geometry 45/0 or 0/45.

NOTE: If there is a gloss difference, the ratio of the diffuse and specular components of the surface reflection will change (with little change in the overall surface reflection). Only the regularly reflected specular component is excluded by the 45/0 and 0/45 geometry, so the colour coordinate values measured will change and the gloss change will be interpreted as a colour change.

For surfaces that have high gloss and are textured when viewed at 45°, the measuring condition 45/0 or 0/45 shall not be used because random specularly reflected light may reach the detector.

7 APPARATUS

7.1 Spectrophotometer—an instrument having repeatability, when measuring spectral reflectances or spectral reflectance factors, better than the larger of the following values: 0.2 percent of the reading or 0.001 (absolute). The repeatability over long time intervals should not exceed these values by a factor of more than 3.

NOTE: The repeatability of the measuring method is the value below which the absolute difference between two single test results obtained for the same paint film under the same conditions (same operator, same spectrophotometer, at a short time interval) may be expected to lie with a 95 percent probability. The repeatability is obtained from Table 1 (see also ISO 5725).

The accuracy should be better than the larger of the following two values: 1 percent of the reading or 0.004 (absolute).

NOTE: The accuracy is the closeness of agreement between the true value and the mean result which would be obtained by applying the same method of colorimetry on an extended number of tests.

If the colorimetric measurements are for the specification and maintenance of colour reference standards, a spectrophotometer of the type described above should be used in preference to a tristimulus colorimeter (see Clause 7.2).

7.2 Tristimulus colorimeter—an instrument in which the integration is performed optically with three or four tristimulus filters which are constituted so that the measurements appear in a simple linear relationship with the tristimulus values. Instruments of this category, which are termed tristimulus colorimeters, shall be equipped with a photometer head that satisfies the illumination and viewing conditions chosen as described in Clause 6.1.