

INTERNATIONAL
STANDARD

ISO
22700

IULTCS/IUF474

First edition
2019-03

**Leather — Measuring the colour and
colour difference of finished leather**

Cuir — Mesurage de la couleur et des écarts de couleur des cuirs finis

STANDARDSISO.COM : Click to view the full PDF of ISO 22700:2019



Reference numbers
ISO 22700:2019(E)
IULTCS/IUF474:2019(E)

© ISO 2019

STANDARDSISO.COM : Click to view the full PDF of ISO 22700:2019



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle	2
5 Apparatus and materials	3
6 Procedure	4
6.1 Standardization of colour measuring instrument.....	4
6.2 Sampling.....	4
6.3 Measuring procedure.....	5
7 Method of calculation	5
7.1 General.....	5
7.2 Tristimulus values.....	5
7.3 CIE 1976 L^* , a^* , b^* , C^*_{ab} and h_{ab}	6
7.4 Calculation of the CIEDE2000 total colour difference formula.....	7
8 Test report	8
Annex A (informative) Background to standard procedure for measuring the colour of finished leather	9
Bibliography	12

STANDARDSISO.COM : Click to view the full PDF of ISO 22700:2019

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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by the Fastness Test Commission of the International Union of Leather Technologists and Chemists Societies (IUF Commission, IULTCS) in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 289, *Leather*, the secretariat of which is held by UNI, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

IULTCS, originally formed in 1897, is a world-wide organization of professional leather societies to further the advancement of leather science and technology. IULTCS has three Commissions, which are responsible for establishing international methods for the sampling and testing of leather. ISO recognizes IULTCS as an international standardizing body for the preparation of test methods for leather.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Leather — Measuring the colour and colour difference of finished leather

1 Scope

This document specifies a method for the correct measurement of the colour of finished leather by instrumental means. The document describes general concepts of colour measurement adapted to leather and the calculation of differences in colour.

This document defines the following:

- a) the use of D65 as the standard light source for the leather industry;
- b) the use of D65 light source 10° as standard conditions for colour matching, for the definition of daylight simulators and as the reference light source for metamerism analysis;
- c) the use of CIEDE2000 as the colour difference formula.

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 2419, *Leather — Physical and mechanical tests — Sample preparation and conditioning*

ISO 11664-3, *Colorimetry — Part 3: CIE tristimulus values*

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

ISO/CIE 11664-6, *Colorimetry — Part 6: CIEDE2000 Colour-difference formula*

EN 15987, *Leather — Terminology — Key definitions for the leather trade*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15987 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1

colour measurement

numerical representation of the colour of a specimen obtained by use of a *colour measuring instrument* (3.2) in terms of tristimulus values, colour coordinates or spectral response within the visible and near UV spectra

3.2

colour measuring instrument

device which measures reflected radiations in the visible spectrum (wavelengths between 360 nm and 780 nm) covering as a minimum area wavelengths between 400 nm and 700 nm

Note 1 to entry: Instruments included in this definition are named colorimeters and spectrophotometers.

3.3 geometry

<colour measuring instrument> relative position illumination/observer (detector)

Note 1 to entry: Typical geometries include the following:

- d/0°;
- 0°/d;
- 0°/45°;
- 45°/0°;

with a tolerable angle of 0° to 10° on the diffuse geometries and 45° ± 2° on the 45° geometries. Different geometries may generate different results on the same specimen.

3.4 specularity

<colour measuring instrument> *specular reflectance* (3.6) on glossy, metallic and reflective specimens caused by illumination, with the potential to disturb colour measurement

Note 1 to entry: Specular reflectance may be included "SPINC" (for matt specimens) or excluded "SPEX" (for reflective specimens); different specularity may generate different results on the same specimen.

3.5 area of view

<optical aperture; colour measuring instrument> area and shape of the target covered by the instrument in a single colour measurement

3.6 specular reflectance

reflection without diffusion, in accordance with the laws of optical reflection

Note 1 to entry: As in a mirror.

3.7 standardization

<colour measuring instrument> measurement of one or more calibrated materials with a colour measuring instrument for the purpose of calculating a set of correction factors to be applied to subsequent measurements

Note 1 to entry: Calibrating materials are normally a white tile for the white standardization, and a light trap or black tile for the black standardization.

3.8 verification standard

<colour measurement> stable material which is used for the purpose of confirming (or verifying) the validity of an instrument standardization

Note 1 to entry: Colour measurements, which are made immediately following standardization, are compared with the original measurements of one standard, or series of standards, to verify the correct standardization.

4 Principle

The surface of a finished leather specimen is measured by reflectance methods in order to obtain a numerical representation of the colour of the specimen. This numerical representation may have two different scopes:

- the definition of a certain colour by absolute chromatic coordinates or by definition of a specific spectral distribution;

- the definition of a colour difference to define a specimen “pass/fail” boundary related to a reference sample within a uniform perceptible tolerance.

Considering that the chromatic coordinates as well as spectral distribution specifications depend on the instrument’s geometry and measuring conditions, all relevant data such as reference illuminant, photopic/scotopic observer angle, instruments geometry and measurement area shall be reported.

Proper equipment set-up, standardization of the colour measuring instrument and presentation of the test specimens to the instrument are recommended to achieve consistent, reliable and meaningful reflectance measurement results.

In general, instrumental colour measurement procedures are dictated by the type of specimen to be measured and the instrument with which it will be measured. Many types of colour measuring instrumentation are available, differing in such features as area of view, illumination method and geometry. Conflicting results will be obtained through comparisons of data acquired on instruments of different designs. It is recommended that selected instruments conform with inter-instrumental agreement and profiling protocols, to ensure acceptable absolute measurements on different instruments.

5 Apparatus and materials

5.1 Reflectance colour measuring instrument, for illuminating a specimen and measuring the amount of light which is reflected from the surface of the specimen in the visible region of the spectrum (comprising the wavelengths from 360 nm to 780 nm, and including as a minimum the region from 400 nm to 700 nm). Illumination is usually polychromatic (white light).

Reflectance colour measuring instruments may be broadly divided into two groups.

- Spectrophotometers** (typically diffuse/0, using polychromatic illumination) diffract and measure the spectrum of light reflected from the specimen relative to a reference white at regular intervals. The spectral step width and optical band width shall be ≤ 20 nm (preferably 5 nm or 10 nm). These data may be used to calculate the desired tristimulus values (X, Y, Z) for any given illuminant and observer. Some spectrophotometers (typically 0/diffuse) illuminate the sample with monochromatic light and measure the amount of light reflected from the surface as the sample is illuminated at regular wavelength intervals.
- Colorimeters** measure the tristimulus values (X, Y, Z) directly through broadband filters which are designed to produce colorimetric values for one illuminant and observer. Colorimeters with D65 illumination and 10° observer are recommended. Measurement of reflectance factors at specific wavelengths is not possible with a colorimeter.

The recommended geometry for the colour measuring instruments should be one of the following combinations:

- d/0;
- 0/d;
- 0/45;
- 45/0;

where

d is diffuse;

0 is the normal (0° to 10°);

45 is ($45^\circ \pm 2^\circ$).

The 0/45 and 45/0 geometries exclude the specular reflectance in the measurements and provide measurements corresponding to visual changes in the specimen appearance caused by changes in the pigment colour or changes in the surface gloss or texture. Diffuse (d) geometry instruments commonly include specular reflectance in the measurements. This avoids the differences caused by surface unevenness and provides measurements of the differences caused by changes in pigment colour only. These instruments may also exclude specular reflectance.

5.2 White calibrated standard, with which to standardize the instrument. The colorimetric values for this calibration standard are stored in the instrument or the software and require only that a specific standard be used to standardize the instrument.

5.3 Black standard, required for some instruments. It may be of zero reflectance (a light trap) or it may be calibrated, in which case the comments in [5.2](#) apply.

5.4 Verification standard or set of verification standards, required to verify the acceptability of absolute measurements in a single spectrophotometer or as profiling reference between different instruments.

5.5 Instrument calibration, the instructions of the instrument manufacturer regarding the calibration must be strictly followed.

6 Procedure

6.1 Standardization of colour measuring instrument

Proper standardization of any colour measuring instrument is necessary in order to achieve more precise and accurate results. In general, instrument standardization involves measuring a clean white surface of known reflectance factors and calculating (through built-in software operating the instrument or computer program) a series of correction factors which will be applied to subsequent measurements. Some instruments also require a black tile (or light trap) and a standard coloured tile or set of coloured tiles to verify accordance of the instrument standardization to absolute values. Each of these materials shall be maintained in its original clean, unscratched condition.

The frequency with which this standardization is performed depends on many factors, including the type of instrument, the environmental conditions in which the instrument operates, the required accuracy of the result and the number of measurements. For most applications, an interval of 8 h or 100 flashes is acceptable.

Once the standardization step has been performed, it is important to verify the success of the procedure by measuring one or a series of verification standards and comparing the resulting colorimetric values with the original values for these materials. If the measured values do not fall within an acceptable variation from their original values, the standardization is not considered valid. The number of verification standards and the acceptability limits depend on user requirements, but are typically one to three standards and an acceptance limit of 0,20 CIEDE2000 D65/10° units.

6.2 Sampling

Given that this is a non-destructive test, the whole leather sample can be used as a specimen. In addition, the measurement can be used to verify colour differences between different areas of the leather. The sample shall be as big as possible to be able to take many different measurements at different spots. The higher the number of measurements, the more representative the test result. At least three measurements shall be taken at different spots on the leather sample. For structured leather surfaces, for example suede or velour, and leather pieces with variable colour, at least five measurements shall be taken. For large leather pieces at least six measurements shall be taken at different spots.

6.3 Measuring procedure

6.3.1 Condition the specimen according to ISO 2419.

6.3.2 Calibrate the instrument according to 6.1.

6.3.3 Present the specimen to the colour measuring instrument following any special techniques required for the type of finish of the leather being measured. The following handling techniques according to the type of leather finish shall be observed.

- **Sueded articles (suede, split, nubuk):** gently brush the specimen in the fibre direction before colour measuring. Suggested measurement is with geometry d/8° and SPINC (specular included) specularity.
- **Glossy finishes (patent leather, metallized leather):** to remove the gloss effect on the colour, the instrument shall exclude the specular component for colour measurement, or adopting a 0/45° // 45°/0 geometry.
- **Aniline finish:** when there is a glossy finish, the gloss effect shall be removed by excluding the specular component for colour measurement or adopting a 0/45° // 45°/0 geometry.
- **Pigmented or semi-pigmented finish:** no handling technique is required before colour measurement. Included or excluded specular depending on the glossiness of the sample.
- **Wool-on skins:** gently brush the wool fibres in one direction before colour measuring. Suggested measurement is with geometry d/8° and SPINC (specular included) specularity.

6.3.4 Measure the specimen colour and obtain the spectral reflectance values, the tristimulus values and/or the L^* , a^* , b^* absolute coordinates of the CIELAB colour space.

6.3.5 For the determination of the difference in colour between two leathers, first take the absolute leather colour measurement using the colour reference, according to 6.3.3 and 6.3.4, and then measure in the same way the colour of the specimen on which the difference in colour is to be determined. Colour difference values are expressed in CIEDE2000 units, with reference to light source (normally D65) and standard observer angle (2° or 10°, normally 10° for CIEDE2000).

7 Method of calculation

7.1 General

Most calculations of colorimetric nature are performed by the software being used to operate the colour measuring instrument. In normal cases of reference to this method it will not be necessary for the user to perform these calculations; however, they are described here as a means of reference and standardization for those who may need to perform the calculations in accordance with ISO/CIE 11664-6.

7.2 Tristimulus values

The tristimulus values (X , Y , Z) are derived from spectral data and are the basis for all colorimetric calculations, in accordance with ISO 11664-3. The exact (X , Y , Z) values derived from a set of spectral data depend on several factors, including the wavelength range and interval of measurement and the user's choice of illuminant/observer functions used in the calculation.

NOTE 1 In order to obtain results that are compatible between users, the tristimulus values are calculated according to ASTM E308-15[1]. Most calculations of tristimulus values are performed by computer programs and a user therefore verifies with the instrument/software supplier that they are thus calculated.

NOTE 2 One method to verify that the correct calculations are being made is to enter 100 % reflectance values into the computer program and have the system calculate the tristimulus values. These values agree with the values in ASTM E308-15:2015, Table 1[4], to the second decimal place for the illuminant being checked.

7.3 CIE 1976 L^* , a^* , b^* , C^*_{ab} and h_{ab}

Calculate the L^* , a^* , b^* , C^*_{ab} and h_{ab} values from the X , Y , Z tristimulus values for both the reference and the specimen, in accordance with ISO 11664-4, using [Formulae \(1\)](#) to [\(5\)](#).

$$L^* = 116 \left[f(Q_y) \right] - 16 \tag{1}$$

$$a^* = 500 [f(Q_x) - f(Q_y)] \tag{2}$$

$$b^* = 200 [f(Q_y) - f(Q_z)] \tag{3}$$

where

$$Q_x = \left(\frac{X}{X_n} \right); Q_y = \left(\frac{Y}{Y_n} \right); Q_z = \left(\frac{Z}{Z_n} \right)$$

and

$$f(Q_i) = \sqrt[3]{Q_i} \text{ if } Q_i > \left(\frac{6}{29} \right)^3$$

or

$$f(Q_i) = \left(\frac{841}{108} \right) Q_i + \frac{4}{29} \text{ if } Q_i \leq \left(\frac{6}{29} \right)^3$$

where i varies as X , Y and Z .

$$C^*_{ab} = \sqrt{(a^*)^2 + (b^*)^2} \tag{4}$$

$$h_{ab} = \arctan \left(\frac{b^*}{a^*} \right) \tag{5}$$

expressed on a 0° to 360° scale with the a^* positive axis being 0° and the b^* positive axis 90° .

For these formulae, X_n , Y_n and Z_n are the tristimulus values of the illuminant/observer combination in which it is desired to calculate CIEDE2000 colour differences. The preferred illuminant/observer combination is D65/10°.

[Table 1](#) lists the tristimulus values for D65/10° and five other illuminant/observer combinations.

Table 1 — Tristimulus values

Illuminant/observer combinations	Tristimulus values		
	X_n	Y_n	Z_n
D65/10°	94,811	100,00	107,304
D65/2°	95,047	100,00	108,883
C/10°	97,285	100,00	116,145

Table 1 (continued)

Illuminant/observer combinations	Tristimulus values		
	X_n	Y_n	Z_n
C/2°	98,074	100,00	118,232
A/10°	111,144	100,00	35,200
A/2°	109,850	100,00	35,585

7.4 Calculation of the CIEDE2000 total colour difference formula

Colour difference in accordance with ISO/CIE 11664-6 is calculated using [Formula \(6\)](#).

$$\Delta E_{00} = \sqrt{\left[\left(\frac{\Delta L'}{k_L S_L} \right)^2 + \left(\frac{\Delta C'}{k_C S_C} \right)^2 + \left(\frac{\Delta H'}{k_H S_H} \right)^2 + R_T \left(\frac{\Delta C'}{k_C S_C} \right) \left(\frac{\Delta H'}{k_H S_H} \right) \right]} \quad (6)$$

where

$$L' = L^*;$$

$$a' = a^*(1 + G);$$

$$b' = b^*;$$

$$G = 0,5 \left[1 - \frac{\left(\overline{C_{ab}^*} \right)^7}{\sqrt{\left(\overline{C_{ab}^*} \right)^7 + 25^7}} \right];$$

$$S_L = 1 + \frac{0,015 \left(\overline{L'} - 50 \right)^2}{\sqrt{20 + \left(\overline{L'} - 50 \right)^2}};$$

$$S_C = 1 + 0,045 C^*;$$

$$S_H = 1 + 0,015 C^* T;$$

$$T = 1 - 0,17 \cos \left(\overline{h'} - 30 \right) + 0,24 \cos \left(2 \overline{h'} \right) + 0,32 \cos \left(3 \overline{h'} + 6 \right) - 0,20 \cos \left(4 \overline{h'} - 63 \right);$$

$$R_T = -\sin(2\Delta\Theta)R_C;$$

$$\Delta\Theta = 30 \exp \left\{ - \left[\left(\frac{\bar{h}' - 275}{25} \right) \right]^2 \right\};$$

$$R_C = 2 \frac{\sqrt{\left(\bar{c}'\right)^7}}{\sqrt{\left(\bar{c}'\right)^7 + 25^7}}.$$

Mean hue angle and $\Delta\Theta$ values are in degree units.

8 Test report

The test report shall include at least the following information:

- a) reference to this document, i.e. ISO 22700;
- b) all details necessary for complete identification of the sample and reference specimen(s) tested;
- c) identification of the spectrophotometer or colorimeter, including the CIE geometry type, with which the input data was obtained;
- d) whether the specular component was included or excluded;
- e) area of view;
- f) UV energy included or excluded;
- g) make and model of the spectrophotometer (including wavelength range and interval used) or colorimeter;
- h) the illuminant and observer conditions used in the calculations (e.g. D65/10°);
- i) date of test;
- j) specimen presentation;
- k) number of readings per sample measurement;
- l) the CIEDE2000 value(s) of the test specimen(s);
- m) the $\Delta L'$, $\Delta C'$ and $\Delta H'$ values, if required;
- n) if applicable, the acceptability tolerance used in making pass/fail judgements (see [Annex A](#));
- o) if required, the CIELAB L^* , a^* , b^* , C^*_{ab} and h_{ab} values for references and test specimen(s) and the associated ΔL^* , Δa^* , Δb^* , ΔC^*_{ab} and ΔH^*_{ab} values;
- p) any other relevant results.

Annex A (informative)

Background to standard procedure for measuring the colour of finished leather

A.1 General

Colour measurement with a reflectance spectrophotometer and the calculation of colour differences by colour difference formulae can reproduce the average human perception under standard conditions, and can predict metameric behaviour.

The reference conditions considered for calculations are related to colour perception variables (light – observer – object). The typical conditions set by CIE (Commission Internationale de l'Éclairage) are D65 illuminant (standard lightning source emitting at a 6 500 K colour temperature based on Planck's principle).

Several colour difference algorithms have been proposed in recent years to adapt colour measurement values to equal perceptual differences and tolerances in any area of the colour space. Each of these algorithms was based in a different mathematical or geometrical approach. The easiest to calculate was CIELab (adopted in 1976) which proposed the calculation of the distance between two points in a tri-dimensional space. Most of the early algorithms could not express uniform colour tolerances within different areas of the colour space. The evolution of the main ISO International Standard algorithms is explained in the following paragraphs.

It is clear that to adopt a colour difference algorithm defining standardized viewing conditions, we must first adopt a **standard for visual assessment of colour and colour differences**, and consequently a **standard test method for measuring colour on finished leather**.

A.2 Visual assessment of colour and colour differences

CIE defined the standard illuminant D65 as reference daylight spectral distribution as $Sp_{65}(\lambda)$ [2]. It represents a phase of daylight with a correlated colour temperature of approximately 6 500 K.

The standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour was defined by CIE in ISO 23603:2005[3]. It defines different qualities of standard D65 illuminants based on spectroradiometric measurements, defining a reference CIE 1976 $u'_{10} v'_{10}$ chromaticity coordinate, and a quality grade classification based on the metameric index.

Light booths should be a matt neutral grey, for example Munsell N5/N7, so as not to influence reflected light on the samples to be evaluated.

A.3 Colour difference formulae

In recent years, several colour difference formulae (ΔE) have been proposed by CIE, DIN and the Society of Dyers and Colourists, among others.

The first vectorial approach proposed by CIE to define the distance between two colours in a CIELAB colour space was ΔE_{ab} , defined in 1976 as in [Formula \(A.1\)](#).

$$\Delta E_{ab}^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2} \quad (\text{A.1})$$

Although this formula can define colour differences as arithmetic distance in a CIELAB colour space, perceived colour differences and tolerances are not uniform within the colour space due to human perceptual differences. This colour difference formula was adopted by ISO 105-J03¹⁾ in its original version.

In 1984 the Society of Dyers and Colourists proposed the CMC (*l:c*) formula, correcting from rectangular tolerances to ellipsoidal tolerances. This is shown in [Formula \(A.2\)](#)

$$\Delta E_{\text{CMC}}^*(l:c) = \sqrt{\left(\frac{L_2^* - L_1^*}{S_L}\right)^2 + \left(\frac{C_2^* - C_1^*}{S_C}\right)^2 + \left(\frac{\Delta H_{ab}^*}{S_H}\right)^2} \quad (\text{A.2})$$

The ellipsoid semi-axes from the L_R^* , $C_{ab,R}^*$ and $h_{ab,R}$ of the reference sample are calculated as follows:

$$S_L = \frac{0,040975L_R^*}{(1 + 0,01765L_R^*)} \text{ if } L_R^* \geq 16$$

$$\text{or } S_L = 0,511 \text{ if } L_R^* < 16$$

$$S_C = \left[0,0638C_{ab,R}^* / (1 + 0,0131C_{ab,R}^*) \right] + 0,638$$

$$S_H = (FT + 1 - F)S_C$$

where

$$F = \sqrt{\frac{(C_{ab,R}^*)^4}{\left[(C_{ab,R}^*)^4 + 1900 \right]}}$$

$$T = 0,36 + \left\| 0,4 \cos(35 + h_{ab,R}) \right\| \text{ if } h_{ab,R} \geq 345^\circ \text{ or } h_{ab,R}^* \leq 164^\circ; \text{ or}$$

$$T = 0,56 + \left\| 0,2 \cos(168 + h_{ab,R}) \right\| \text{ if } 164^\circ < h_{ab,R} < 345^\circ.$$

DE CMC (*l:c*) is a good approximation of perceptual colour differences, but some nonlinearities can be found in the medium grey shades and the boundaries defined by the T values, and because of the quasimetric approach of this algorithm. ISO 105-J03:2009^[4] adopted this colour difference formula for the textile industry, replacing the original ISO 105-J03:1995.

CIE defined a new algorithm which solves these differences. The new formula, 'CIEDE2000 total colour difference formula', was adopted as an International Standard in ISO/CIE 11664-6. This new algorithm

1) The same formula is proposed in the Norm UNI 9000 as UNILAB formula.