SLOVENSKI STANDARD
SIST EN ISO 105-J03:1999

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Tekstilije - Preskuġanje barvne obstojnosti - Del J03: Raļ unanje barvnih razlik (ISO 105-J03:1995, vkljuļ no s tehniļ nim popravkom 1:1996)

Textiles - Tests for colour fastness - Part J03: Calculation of colour differences (ISO 105-J03:1995, including Technical Corrigendum 1:1996)

Textilien - Farbechtheitsprüfungen - Teil J03: Berechnung von Farbdifferenzen (ISO 105-J03:1995, einschließlich Technische Korrektur 1:1996)

Textiles - Essais de solidité des teintures - Partie J03: Calcul des différences de couleur (ISO 105-J03:1995, Rectificatif Technique 1:1996 inclus)

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Textiles - Tests for colour fastness - Part J03: Calculation of colour differences (ISO 105-J03:1995, including Technical Corrigendum 1:1996)

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Textilien - Farbechtheitsprüfungen - Teil J03: Berechnung von Farbdifferenzen (ISO 105-J03:1995, einschließlich Technische Korrektur 1:1996)

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Foreword

The text of the International Standard from Technical Committee ISO/TC 38 "Textiles" of the International Organization for Standardization (ISO) has been taken over as an European Standard by Technical Committee CEN/TC 248 "Textiles and textile products", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 1997, and conflicting national standards shall be withdrawn at the latest by October 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 105-J03:1995, including Technical Corrigendum 1:1996 has been approved by CEN as a European Standard without any modification.

INTERNATIONAL STANDARD

ISO 105-J03

First edition
1995-09-01

Textiles — Tests for colour fastness —

Part J03: Calculation of colour differences

Textiles — Essais de solidité des teintures —

Partie J03: Calcul des différences de couleur

Reference number
ISO 105-J03:1995(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 105-J03 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 1, *Tests for coloured textiles and colorants*.

This first edition of ISO 105-J03 constitutes a partial revision of the third edition of ISO 105-J01:1989.

ISO 105 was previously published in thirteen "parts", each designated by a letter (e.g. "Part A"), with publication dates between 1978 and 1985. Each part contained a series of "sections", each designated by the respective part letter and a two-digit serial number (e.g. "Section A01"). These sections are now being republished as separate documents, themselves designated "parts" but retaining their earlier alphanumeric designations. A complete list of these parts is given in ISO 105-A01.

Annexes A, B and C of this part of ISO 105 are for information only.

International Organization for Standardization
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Textiles — Tests for colour fastness —

Part J03:
Calculation of colour differences

1 Scope

This part of ISO 105 provides a method of calculating the colour difference between two specimens of the same material, measured under the same conditions, such that the numerical value $\Delta E_{cmc}(l{:}c)$ for the total colour difference quantifies the extent to which the two specimens do not match. It permits the specification of a maximum value (tolerance) which depends only on the closeness of match required for a given end-use and not on the colour involved, nor on the nature of the colour difference. The method also provides a means for establishing the ratio of differences in lightness to chroma and to hue.

NOTE 1 Annex A gives guidance on the interpretation of results. Annex B provides sample test data for use in checking computer programs. Annex C contains a sample computer program for calculating colour difference.

2 Principle

The CIE[1] 1976 $L^*a^*b^*$ (CIELAB) colour space has been modified to enhance its visual uniformity when calculating the colour difference between two specimens. The modifications to CIELAB by the CMC equation provide a numerical value, ΔE_{cmc}, which describes the colour difference between a sample and a reference in a more nearly uniform colour space. This permits the use of a single-number tolerance ("acceptability tolerance" or "pass/fail tolerance") for judging the acceptability of a colour match in which the tolerance is independent of the colour of the reference. The ellipsoid semi-axes (lS_L, cS_C and S_H) used to derive ΔE_{cmc} provide a means to interpret the three separate components of colour difference (lightness, chroma and hue) in manners suitable for a wide range of uses.

The equation for ΔE_{cmc} describes an ellipsoidal boundary (with axes in the directions of lightness, chroma and hue) centred about a reference. The agreed-upon ΔE_{cmc} acceptability tolerance describes a volume within which all specimens are acceptable matches to the reference.

The colour difference is composed of three components that comprise the differences between the reference and the specimen. These are:

a) a **lightness** component that is weighted by the lightness tolerance ($\Delta L^*/lS_L$). This is represented as ΔL_{cmc}.

   If the ΔL_{cmc} is positive, the specimen is lighter than the reference. If the ΔL_{cmc} is negative, the specimen is darker than the reference;

b) a **chroma** component that is weighted by the chroma tolerance ($\Delta C^*_{ab}/cS_c$). This is represented as ΔC_{cmc}.

1) Commission Internationale d'Éclairage, Central Bureau, Kegelgasse 27, A-1030, Vienna, Austria.

If the ΔC_{cmc} is positive, the specimen is more chromatic than the reference. If the ΔC_{cmc} is negative, the specimen is less chromatic than the reference;

c) a **hue** component that is weighted by the hue tolerance ($\Delta H^*_{ab}/S_H$). This is represented as ΔH_{cmc}.

If the ΔH_{cmc} is positive, the hue difference of the specimen is anti-clockwise from the reference in the CIELAB a^*, b^* diagram. If the ΔH_{cmc} is negative, the hue difference of the specimen is clockwise from the reference in the CIELAB a^*, b^* diagram.

3 Procedure

3.1 Calculation of CIELAB values

Calculate the CIELAB L^*, a^*, b^*, C^*_{ab}, h_{ab} values from the X, Y, Z tristimulus values for both the reference and specimen as follows:

$L^* = 116(Y/Y_n)^{1/3} - 16$ if $Y/Y_n > 0{,}008\ 856$

or

$L^* = 903{,}3(Y/Y_n)$ if $Y/Y_n \leqslant 0{,}008\ 856$;

$a^* = 500[f(X/X_n) - f(Y/Y_n)]$;

$b^* = 200[f(Y/Y_n) - f(Z/Z_n)]$

where

$f(X/X_n) = (X/X_n)^{1/3}$ if $X/X_n > 0{,}008\ 856$

or

$f(X/X_n) = 7{,}787(X/X_n) + 16/116$ if $X/X_n \leqslant 0{,}008\ 856$;

$f(Y/Y_n) = (Y/Y_n)^{1/3}$ if $Y/Y_n > 0{,}008\ 856$

or

$f(Y/Y_n) = 7{,}787(Y/Y_n) + 16/116$ if $Y/Y_n \leqslant 0{,}008\ 856$;

$f(Z/Z_n) = (Z/Z_n)^{1/3}$ if $Z/Z_n > 0{,}008\ 856$

or

$f(Z/Z_n) = 7{,}787(Z/Z_n) + 16/116$ if $Z/Z_n \leqslant 0{,}008\ 856$;

$C^*_{ab} = \left(a^{*2} + b^{*2}\right)^{1/2}$;

h_{ab} = arctan (b^*/a^*) expressed on a 0° to 360° scale with the a^* positive axis being 0° and the b^* positive axis at 90°.

For these equations, X_n, Y_n and Z_n are the tristimulus values of the illuminant/observer combination in which it is desired to calculate CMC(l:c) colour differences. The preferred illuminant/observer combination is D_{65}/10°. Table 1 gives the values for this and five other combinations.

Table 1 — Tristimulus values for six illuminant/observer combinations

Illuminant/observer combinations	Tristimulus values		
	X_n	Y_n	Z_n
$D_{65}/10°$	94,811	100,00	107,304
$D_{65}/2°$	95,047	100,00	108,883
C/10°	97,285	100,00	116,145
C/2°	98,074	100,00	118,232
A/10°	111,144	100,00	35,200
A/2°	109,850	100,00	35,585

3.2 Calculation of CIELAB colour differences values

Calculate the CIELAB colour differences ΔL^*, Δa^*, Δb^*, ΔC^*_{ab}, ΔE^*_{ab}, ΔH^*_{ab} using the following equations, in which the subscripts R and S refer respectively to the reference and specimen CIELAB values:

$$\Delta L^* = L^*_S - L^*_R;$$

$$\Delta a^* = a^*_S - a^*_R;$$

$$\Delta b^* = b^*_S - b^*_R;$$

$$\Delta C^*_{ab} = C^*_{ab,S} - C^*_{ab,R};$$

$$\Delta E^*_{ab} = \left[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\right]^{1/2};$$

$$\Delta H^*_{ab} = pq\left[(\Delta E^*_{ab})^2 - (\Delta L^*)^2 - (\Delta C^*_{ab})^2\right]^{1/2}$$

where

$p = 1$ if $m \geqslant 0$

or

$p = -1$ if $m < 0$

and $q = 1$ if $|m| \leqslant 180$

or

$q = -1$ if $|m| > 180$

where $m = h_{ab,S} - h_{ab,R}$

in which $|...|$ indicates that the *positive* value is to be used regardless of the sign of the expression between the two lines.

or the equivalent

$$\Delta H^*_{ab} = t[2(C^*_{ab,S}C^*_{ab,R} - a^*_S a^*_R - b^*_S b^*_R)]^{1/2}$$

where

$t = 1$ if $a^*_S b^*_R \leqslant a^*_R b^*_S$

or

$t = -1$ if $a^*_S b^*_R > a^*_R b^*_S$