

COLOR DIFFERENCE EVALUATION OF TEXTILE MATERIALS

Application

This procedure describes a method for determining the quantitative color difference between any two textile materials which meet the measurability requirements.

Apparatus Required

Spectrophotometer

Macbeth MS2000, MS2020 or Micromatch spectrophotometer system.

Source: Instrumental Color Systems Ltd.
Kennetside, Kennetside Park Industrial Estate
Newbury, Berkshire RTG14 5TE

Equivalent spectrophotometers may also be used provided they have been given prior approval by Ford Motor Company. In cases of dispute, the above system as used by Ford Materials Engineering will be used as referee.

Optical Geometry

Sample shall be diffusely illuminated by means of a diffusing sphere. The angle of viewing shall not exceed 10° . The converse geometry of illumination $< 10^\circ$ with diffuse viewing may also be used provided comparable test results are previously demonstrated.

Comparison Standards

Calibration of the machine shall be carried out at least twice per shift and preferably just prior to sample measurement, using the white and black calibration tiles furnished by the instrument manufacturer. Periodic checks of the absolute precision of the apparatus may be made by measuring:

- a. Pressed Barium Sulphate Powder ex Eastman Kodak.
- b. Calibrated Ceramic Tiles ex British Ceramic Research Association, Queens Road, Penkhull, Stoke on Trent ST4 7LQ.

Date	Action	Revisions
2001 03 14	Revised	Editorial – no technical change A. Cockman
1996 10 24		

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Standard Illuminants

CIE 1964 Color Matching Functions for Artificial Daylight (Illuminant D6500) for Total Color Difference.

CIE Color Matching Functions for Horizon Light (Illuminant A) and Cool White Fluorescent Light (Illuminant TL84 or CWF) for Metamerism Evaluation.

Standard Observer

1964 CIE 10° observer.

Color Difference Equation

CMC (Color Metrication Committee of the Society of Dyers and Colorists).

Conditioning and Test Conditions

All test values indicated herein are based on material conditioned in a controlled atmosphere of 23 +/- 2 °C and 50 +/- 5 % relative humidity for not less than 24 h prior to testing and tested under the same conditions unless otherwise specified.

Procedure

1. The instrument shall be set to include the specular (gloss) component of reflected light in all measurements. Particulate contamination of the diffusing sphere should be removed by vacuum prior to calibration.
2. The instrument shall be set up with the ultraviolet (UV) light filter removed from the optical path to include the UV component of the light source energy.
3. When monitoring the color of production batches of fabric it is essential that samples for measurement are taken from the center of the roll width in order to avoid localized weight variations close to the fabric edge.
4. The sample and standard shall be presented to the spectrophotometer in an identical manner and an average result recorded of a minimum set of 4 measurements on each, taken sequentially with the sample rotated through 90° between each measurement. To aid in determining the appropriate angle of rotation it is suggested that the first measurement on each sample should be taken with the principle rib or pile direction orientated along the vertical plain.
5. Fabrics with random crush effects should be measured with a combination of both rotation of the sample and also lateral movements across the machine direction in order to exclude the effects of localized crushing and improve repeatability.

6. Some measuring systems have the ability to monitor the variance of a single measurement from that of the mean of the previous measurements. This system may be used to restrict the number of sample measurements that are necessary to achieve a repeatable result for more uniform fabrics.

This system may be used in place of/or in addition to the rotational sampling method above where operational efficiencies can be demonstrated.

7. It should be noted that for fabrics with large repeating patterns it is necessary to center the measurement area so that an identical number of pattern design repeat units are assessed as on the master sample measurement.
8. In the case of face fabrics, yarns and semi-translucent samples, the material should be folded over onto itself sufficient times to make the composite opaque to light. The folding operation should be continuous in order to produce a face surface directly under the measurement surface.
9. A measurement is to be made of the standard immediately prior to each evaluation of an individual sample or series of batches. For those measuring systems which have the ability to store reflectance values, reference to previously recorded data values for the standard may be made rather than carrying out remeasurement.
10. Computation of color difference is to be by the CMC equation. Total color difference is to be reported as ΔE . Reporting of ΔL (Lightness Change), ΔC (Chroma Change) and ΔH (Hue Change) in the above system together with the direction of hue deviation may also be beneficial in terms of identifying progressive deviation from master and potential corrective treatment.
11. Estimation of the degree of metamerism (color change which occurs when changing from one illuminant to another) may be made by inspecting the change in the δL , C , H values when calculated for horizon light (Illuminant A) and fluorescent light (Illuminant TL84 or CWF).
12. Certain woven fabrics may not be amenable to the processes identified above. For these, in-house quality control color checks will be carried out by the supplier on knitted socks produced from the predyed yarn of the relevant production batch, and instrumental measurements taken relative to the yarn sock from which the design approved master was developed.

Chemicals, materials, parts, and equipment referenced in this document must be used and handled properly. Each party is responsible for determining proper use and handling in its facilities.