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TECHNICAL SPECIFICATION

Household electric appliances – Specification of the properties of a digital system for measuring the performance

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HOUSEHOLD ELECTRIC APPLIANCES –

Specification of the properties of a digital system for measuring the performance

FOREWORD

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IEC 63350 has been prepared by subcommittee SC 59K: Performance of household and similar electrical cooking appliances, of IEC technical committee TC 59: Performance of household and similar electrical appliances. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
59K/350/DTS	59K/356/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

In this document, the following print types are used:

- terms defined in Clause 3: **bold type**.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at https://www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC subcommittee 59K has agreed to make a collection of existing and future requirements on a **digital system** used in testing the performance of appliances under the scope of SC 59K, cooking appliances.

This document bundles the generic requirements given in IEC 60350-1 and IEC 60350-2 that are updated, aligned, and supplemented by further requirements. The reference colour system is changed from a proprietary colour system to the standardized and widely used CIELAB-based reference colour system.

The intention with this publication is to ensure that using a **digital system**, which complies with the stated requirements and described methods, leads to reproducible results.

Currently, this document focuses on test methods described in IEC 60350-1 and IEC 60350-2 but further applications based on visually detectable performance criteria might be supplemented.

HOUSEHOLD ELECTRIC APPLIANCES –

Specification of the properties of a digital system for measuring the performance

1 Scope

This document specifies generic requirements for creating a **digital system** that is used for measuring the characteristics of visually detectable performance, such as browning intensity and lightness.

It defines the metrological requirements of this **digital system** and demonstrates the procedures for compliance. The **digital system** contains the measuring instrument, the software, and the reference materials necessary to realize the measurement process.

References to this document can be made by a customer when specifying the **digital system** and by the suppliers when specifying products offered.

Interested parties can agree to use this document as an input for satisfying measurement management system requirements in any activities.

NOTE 1 The principles of ISO 10012 are followed to ensure the capability of the systems.

NOTE 2 Possible suppliers for the recommended **digital system** can be found in the supplementary file located at: https://www.iec.ch/sc59k/supportingdocuments

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.

CIE 15, *Colorimetry*

ISO 12647-7, *Graphic technology – Process control for the production of half-tone colour separations, proof and production prints – Part 7: Proofing processes working directly from digital data*

ISO 15076-1, *Image technology colour management – Architecture, profile format and data structure – Part 1: Based on ICC.1:2010*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1
digital system
system that is used for measuring the characteristics of visually detectable performance

3.2
assessment area
area of the **digital system** within which the requirements stated in this document shall be met and the **items under test** are positioned

3.3
shade chart
sample representing the reference values for the colour and lightness recognition and used for calibration of the **digital system**

3.4
items under test
IUT
objects positioned in the **assessment area** for evaluation

EXAMPLE 1 Shortbread, small cakes, broccoli, white bread, in accordance with IEC 60350-1.

EXAMPLE 2 Floured disc, in accordance with IEC 60350-2.

3.5
terms and definitions of international lighting vocabulary

L*	CIELAB lightness
a*, b*	CIELAB a*, b* coordinates
C^*_{ab}	CIELAB chroma
h_{ab}	CIELAB hue angle
ΔL^*	CIELAB lightness difference
ΔE^*_{ab}	CIELAB colour difference
ΔE_{00}	CIEDE2000 colour difference

4 Test setup

4.1 Illumination

The measurement is taken under an illumination similar to the CIE Standard Illuminate used for the definition of the **shade charts** (see Clause 5).

The maximum calculated deviation of rendering the **shade charts** under the used light shall be $\Delta L^* \leq 1$ for a measurement system for lightness recognition, and $\Delta E_{00} \leq 5$ for a measurement system for colour recognition.

To calculate the deviation of the colour rendering, the 10° tristimulus values of the reference colours shall be calculated with the spectral distribution of the reference colours defined in the corresponding performance test for the relative spectral power distribution of CIE D65 and the relative spectral power distribution of the test setup illumination. The calculation shall be performed from 400 nm to 700 nm with a step of increment no more than 10 nm.

Test setup illumination spectral power distribution measurement is made on the central axis of the beam, and with the sensing surface normal to this direction. The spectroradiometer sensing surface is placed at a distance which ensures sufficient light for a measurement to be taken

while eliminating any stray light. The light shall stabilise before measurements are made (e.g. stable temperature).

Spectral distribution of the reference colours for the calculation shall be acquired with a diffuse eight-degree geometry, specular component included measurement mode (di:8°) spectrometer in accordance with CIE 15.

NOTE 1 Necessary information on calculating the tristimulus, spectral distribution of D65, L*, a*, b* and ΔE_{00} can be found in the ISO 11664 series.

An Excel[1] evaluation program, which corresponds to the described method, is available as an example for the automatic calculation of the deviation of the colour rendering for measured light spectra from at least 400 nm to 700 nm with a step of increment 10 nm; see Annex D. This document includes the light spectra of the proposed reference colours of this document and the light spectra of the CRI calculation colours (CIE 15).

NOTE 2 The supplementary file for the described method is located at: https://www.iec.ch/sc59k/supportingdocuments.

4.2 Measurement environment

During the measurements, no movable items other than the **IUT** shall be near or inside the **assessment area**. The **assessment area** shall be kept as constant as possible since every item can alter the illumination by absorption or reflection.

5 Determination of shade charts

5.1 Principals of shade creation

Shade charts represent the reference values for the colour and lightness recognition. Since the recognition is based on classes, the **shade chart** shall represent the centre point of each class.

For recognition based on 1-dimensional classes (e.g. L*), the values of the defined reference colour shall be in the centre of the boundaries of each class. This is achieved by mathematically creating the reference colours along a line in the 3-dimensional CIELAB colour space.

For recognition based on multiple dimensions within the CIELAB colour space, the defined reference colours shall be located with equal distances within a space defined by at least 3 coordinates. The equal distancing between the defined colours shall be based on at least two values of the CIELAB system (ISO/CIE 11664-4). This results in a colour gradient with a linear step size in at least 2 dimensions.

Defined colours shall be printed in accordance with the proof process described in ISO 12647-7 on matt proofing paper simulating PS5 (print substrate 5 in accordance with ISO 12647-2) as spot colours. The printed colour samples shall be calibrated with a diffuse eight-degree geometry, specular component included measurement mode (di:8°) spectrometer CIE 15 and shall be in a range of $\Delta L^* \leq 1{,}5$ if used as reference colours for the lightness recognition and $\Delta E_{00} \leq 5$ if used as reference colours for the colour recognition.

Proof process defined in ISO 12647-7 is referring to spectral measurement defined in ISO 13655 which is (45°:0°) or (0°:45°) geometry and D50 reference illumination. For proper colour communication, conversion of the colour information to a reference colour space

[1] Excel is the trade name of a product supplied by Microsoft Corporation. This information is given for the convenience of users of this standard and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

described in ISO 15076-1 is necessary. Converted values and the applied conversion models for the exemplary **shade charts** shown in this document can be found in Annex B and Annex C.

Created **shade charts** shall be within the limits of the sRGB colour space.

NOTE 1 Requirements for colour measuring instruments in accordance with CIE 15 for (di:8°) and (45°:0°) or (0°:45°) geometry can be found in Annex A.

NOTE 2 Necessary information on transforming the CIEXYZ colour space to sRGB can be found in IEC 61966-2-1 and transforming the CIELAB colour space to the CIEXYZ colour space can be found in ISO 11664-4.

5.2 Brown shade charts

Brown **shade charts** are used to verify the lightness recognition of the digital measurement system. The relevant value for the brown **shade charts** is L*.

The ΔL* of each defined colour step shall be equal. To achieve a linear colour gradient between the defined colours the $\begin{pmatrix} L^* \\ a^* \\ b^* \end{pmatrix}$ coordinates shall lie on a line that connects at least 2 (maximum 4) reference colours within the 3-dimensional CIELAB colour space. This results in a uniform Euclidean distance (ΔE^*_{ab}) of the points that lie on the same line.

As an example, the calculated values of 14 reference colours located on 2 lines based on 3 L*, a* and b* coordinates are shown in Table 1.

In the example, the 3 defined $\begin{pmatrix} L^* \\ a^* \\ b^* \end{pmatrix}$ coordinates are $\begin{pmatrix} 27{,}8 \\ 6{,}4 \\ 4{,}4 \end{pmatrix}$, $\begin{pmatrix} 60{,}7 \\ 16{,}4 \\ 33{,}0 \end{pmatrix}$, $\begin{pmatrix} 88{,}9 \\ 2{,}9 \\ 27{,}0 \end{pmatrix}$.