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Part 3: Evaluation methods for colour displays

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## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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## Template for comments and secretariat observations

|                  |                        |
|------------------|------------------------|
| Date: xx/xx/20xx | Document: ISO/DIS xxxx |
|------------------|------------------------|

| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/Figure/ Table/Note | Type of comment | Commend (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |



# 62B/1325/CD

COMMITTEE DRAFT (CD)

|                                                           |                                                 |
|-----------------------------------------------------------|-------------------------------------------------|
| PROJECT NUMBER:<br><b>IEC 62563-3 ED1</b>                 |                                                 |
| DATE OF CIRCULATION:<br><b>2023-07-07</b>                 | CLOSING DATE FOR COMMENTS:<br><b>2023-09-29</b> |
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|                                                                                                                                                                                 |                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| IEC SC 62B : MEDICAL IMAGING EQUIPMENT, SOFTWARE, AND SYSTEMS                                                                                                                   |                                                                                                                                                          |
| SECRETARIAT:<br>Germany                                                                                                                                                         | SECRETARY:<br>Ms Regina Geierhofer                                                                                                                       |
| OF INTEREST TO THE FOLLOWING COMMITTEES:<br>TC 110                                                                                                                              | PROPOSED HORIZONTAL STANDARD:<br><input type="checkbox"/><br>Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary. |
| FUNCTIONS CONCERNED:<br><input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input checked="" type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY |                                                                                                                                                          |

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TITLE:

**Medical electrical equipment - Medical image display systems - Part 3: Evaluation methods for colour displays**

NOTE FROM TC/SC OFFICERS:

The WG 51 Image Display is seeking input from the National Committees on the entire CD and more specifically on the following areas:

1. Measuring all possible colors of an n-bit color display is important for full characterization but might be challenging due to limitations of the instrumentation. In addition, areas of the image with very low luminance levels might not be so important due to limitations of the human color vision. WG51 is requesting input on how to define a threshold for the measurement and/or analysis of the display color performance.

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Should a 5 cd/m<sup>2</sup> cut-off be used for chromaticity evaluations of R, G, and B primary color shades for consistency with 62563-1? Or should we include more chromaticity measurements at low luminance levels even if a higher uncertainty is expected to characterize the display more fully? In addition, we seek input on the need for that threshold to be channel-specific (a different threshold for R, G, and B). See description in section 8.2.5, 8.2.6 and 8.2.7. Other alternatives include defining a lower threshold, measuring every point regardless of the luminance level, and defining a DDL threshold for R, G, and B channels.

2. It is claimed that color perceptual linearity is important in some applications because it seeks to ensure accurate data representation with color images. However, there is still some work to perform to understand several aspects of these emerging models and methods. Should visual methods that rely on the color perceptual linearity models be incorporated in the standard? See descriptions in 8.3.4 Also, should quantitative methods that rely on the color perceptual linearity models be incorporated in the standard? See description in section 8.2.8.

3. The ambient light contribution to the color performance of a display is an important parameter to control. Specifically, disturbing reflections present in the user's viewing environment cannot be detected by the proposed contact or integrated-sensor measurement methods. Should the standard advise the user to rectify the disturbing reflection situation? Should the standard advise the user to rectify the disturbing reflections for the telescopic measurement method, which may generate inconsistent results in comparison with contact or integrated-sensor measurement methods? However, these measurements add complexity to the proposed methods. Should color measurements of the contribution of the ambient light be included in evaluation methods?

Aldo Badano, Convenor SC 62B/WG 51

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MEDICAL ELECTRICAL EQUIPMENT –  
Medical image display systems –****Part 3: Evaluation methods for colour displays**

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International Standard IEC 62563-3 has been prepared by subcommittee 62B: Medical imaging equipment, software, and systems of technical committee 62: Medical equipment, software, and systems.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 62563 series, published under the general title *Medical electrical equipment – Medical image display systems*, can be found on the IEC website.

106

## INTRODUCTION

107 In recent years, colour medical images are increasingly used for diagnosis in most medical  
108 fields. Images created by technologies such as medical photography, digital pathology,  
109 computed tomography, magnetic resonance imaging, ultrasound, nuclear medicine, and X rays  
110 are often combined and enhanced using colour (true colour or pseudo colour) to distinguish  
111 important features.

112 For such colour use cases in medical applications, it is crucial that users understand the  
113 capability of each display based on standardised measurements of its attributes.

114 The lack of a standard methodology to evaluate colour attributes and reproducibility of colour  
115 displays associated with these imaging systems means that differences between displays  
116 showing the same image cannot easily be described and understood. For this, we propose this  
117 new standard.

118 This document defines evaluation methods for testing colour IMAGE DISPLAY SYSTEMS showing  
119 colour image information used in MEDICAL ELECTRICAL EQUIPMENT and medical electrical systems  
120 for diagnostic and viewing purposes.

121 On site or after installation, two types of testing can be carried out. An acceptance test is carried  
122 out after a new IMAGE DISPLAY SYSTEM has been installed, or major modifications have been  
123 made to the existing IMAGE DISPLAY SYSTEM. Since an IMAGE DISPLAY SYSTEM may degrade over  
124 time, the constancy test is carried out by the user in a periodic cycle to verify that the  
125 performance is maintained for the intended use.

126 The standard describes various evaluation methods without dictating what tests shall be used  
127 for acceptance and/or constancy tests.

128 Rather, it is the intention of this standard to be a reference for other standards and guidelines  
129 specific to each modality or to be defined by national authorities who will refer to the evaluation  
130 methods of this standard and mention limiting values and frequencies for acceptance and  
131 constancy tests.

132

## MEDICAL ELECTRICAL EQUIPMENT – Medical image display systems –

### Part 3: Evaluation methods for colour displays

#### 1 Scope

This part of IEC 62563 describes test methods for evaluating colour medical IMAGE DISPLAY DEVICES.

The scope of this standard applies to medical IMAGE DISPLAY SYSTEMS, which can display colour image information on colour IMAGE DISPLAY SYSTEMS. This standard applies to medical IMAGE DISPLAY SYSTEMS used for diagnostic (interpretation of medical images toward rendering clinical diagnosis) or viewing (viewing medical images for medical purposes other than for providing a medical interpretation) purposes and therefore having specific requirements in terms of image quality.

This document is directed to practical tests that can be evaluated visually or measured with basic test equipment to assess the device under test in its environment. More advanced or more quantitative measurements can be performed on these devices, but these are beyond the scope of this document.

This document is intended to be used in conjunction with IEC 62563-1. IEC 62563-3 includes additional methods for the evaluation of colour image information on colour medical displays expanding the list of test methods currently included in IEC 62563-1 which are limited to methods for greyscale characteristics.

It is not in the scope of this standard to define the requirements of acceptance and constancy tests or the frequencies of constancy tests.

Head mounted IMAGE DISPLAY DEVICES and IMAGE DISPLAY DEVICES used for confirming positioning and for operation of the system are not covered by this standard.

#### 2 Normative references

The following referenced documents are indispensable for the application 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.

IEC 60788:2004, *Medical electrical equipment – Glossary of defined terms*

ISO 11664-1:2019, *Colorimetry – Part 1: CIE standard colorimetric observers*

ISO 11664-5:2016, *Colorimetry — Part 5: CIE 1976 L\*u\*v\* colour space and u', v' uniform chromaticity scale diagram*

ISO 11664-6:2022, *Colorimetry — Part 6: CIEDE2000 colour-difference formula*

CIE S 010/E:2004 *Photometry – The CIE system of physical photometry*

## **3 Terms, definitions, symbols, and abbreviations**

### **3.1 Terms and definitions**

The terms and definitions in IEC TR 60788:2004 and the following apply.

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

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

#### **3.1.1 Greyscale Standard Display Function (GSDF)**

Mathematically defined mapping of input, DIGITAL DRIVING LEVEL (DDL) to LUMINANCE values based on the Barten model [1]

#### **3.1.2 accuracy**

**(to be pasted from -1)**

closeness of agreement between a test result and the accepted reference value

#### **3.1.3 precision**

**(to be pasted from -1)**

closeness of agreement between independent test results obtained under stipulated conditions

#### **3.1.4 IMAGE DISPLAY DEVICE**

specific hardware/medium used to display images presented through an interface

#### **3.1.5 IMAGE DISPLAY SYSTEM**

workstation consisting of an IMAGE DISPLAY DEVICE, DISPLAY CONTROLLER and computer hardware and software, capable of displaying images

#### **3.1.6 True colour**

An image is called a true-color image when it offers a natural color rendition, or when it comes close to it. This means that the colors of an object in an image appear to a human observer the same way as if this same observer were to directly view the object.

#### **3.1.7 Pseudo color**

Pseudocolor is defined as the display of color-coded scalar imaging data with no direct correlation with the actual color of the object being imaged. The technique is typically used as a means of highlighting image features of interest. An example of a pseudocolor application is perfusion studies based on magnetic resonance imaging (MRI) or computed tomography (CT) where color-coded maps are used for qualitative and quantitative assessment.

#### **3.1.8 Chromaticity**

objective specification of a color regardless of its luminance

#### **3.1.9 White Point**

A white point (often referred to as reference white or target white in technical documents) is a set of tristimulus values or chromaticity coordinates that serve to define the color "white".

### 3.1.10 Gamut

The gamut, or color gamut, is a certain complete subset of colors.

## 3.2 Symbols

The symbols of physical parameters used in this standard are listed in Table 1.

**Table 1: Overview to the definitions of physical parameters**

| Abbreviation                                      | Mathematically derived                                      | Definition and explanation                                                                                                                                                |
|---------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $E$                                               |                                                             | ILLUMINANCE.                                                                                                                                                              |
| $CIEXYZ$                                          | Given in ISO/CIE 11664-1:2019                               | CIEXYZ colour space according to the 2 degree standard observer                                                                                                           |
| $xy$                                              | $x = \frac{X}{X+Y+Z}$ $y = \frac{Y}{X+Y+Z}$                 | Chromaticity derived from CIEXYZ                                                                                                                                          |
| $u'v'$                                            | $u' = \frac{4x}{(-2x+12y+3)}$ $v' = \frac{9y}{(-2x+12y+3)}$ | Uniform chromaticity as defined in ISO/CIE 11664-5:2016.<br>If a colour meter outputs its values in x,y coordinate, those can be converted to u',v' using these formulae. |
| $\Delta u'v'$                                     | $\Delta u'v' = \sqrt{(u'_1 - u'_2)^2 + (v'_1 - v'_2)^2}$    | Distance in $u'-v'$ space.                                                                                                                                                |
| $CIEDE_{2000}$ or $\Delta E$ or $\Delta E_{2000}$ | Given in ISO/CIE 11664-6:2022                               | Perceptual colour difference evaluation as defined by CIE. This metric is also noted CIEDE2000.                                                                           |

## 3.3 Abbreviations

The following abbreviations are used in this standard.

|       |                                                                                     |
|-------|-------------------------------------------------------------------------------------|
| CIE   | commission internationale de l'éclairage (international commission on illumination) |
| CSDF  | colour standard display function                                                    |
| DDL   | digital driving level                                                               |
| DICOM | digital imaging and communication in medicine                                       |
| GSDF  | grayscale standard display function                                                 |
| RGB   | red green blue                                                                      |
| sRGB  | standard red green blue, defined in IEC 61966-2-1:1999/COR1:2014                    |

## 4 General

In IMAGE DISPLAY SYSTEMS, every individual component can limit or reduce the image quality of the system. Therefore, it is necessary to adopt suitable measures for quality monitoring. If IMAGE DISPLAY SYSTEMS are correctly adjusted and maintained, these devices can consistently generate similar images.

Simple test equipment is used (LUMINANCE meter, ILLUMINANCE meter, COLOUR meter, TEST PATTERNS) with PRECISION appropriate for a test. Before a test, all test equipment shall be checked for its functioning according to the manufacturer's specifications. IMAGE DISPLAY DEVICE should be placed in a likely clinical position while performing the measurements.

The manufacturer's data (e.g., requirements on operating voltage, humidity etc.) are required for the correct setting of the IMAGE DISPLAY SYSTEM and for correct installation. The manufacturer's data shall be enclosed with the technical documentation of the IMAGE DISPLAY SYSTEM. In addition to the evaluation methods defined in IEC 62563-1 that are directed to monochrome image information on IMAGE DISPLAY DEVICES, this document contains practical tests to evaluate colour reproducibility and performance that can be evaluated visually or measured with basic test equipment to assess the device under test in its environment. Colours are widely used in medical images, such as a subset of the test items or test methods described in this IEC 62563-3 standard and in IEC 62563-1 may be selected and applied in any appropriate order depending on the intended purpose of your display.