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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Electronic displays –
Part 3-5: Evaluation of optical performance – Colour capabilities



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ELECTRONIC DISPLAYS –

Part 3-5: Evaluation of optical performance – Colour capabilities

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IEC 62977-3-5 has been prepared by IEC technical committee 110: Electronic displays. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
110/1547/FDIS	110/1563/RVD

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 International Standard is English.

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 www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62977 series, published under the general title *Electronic displays*, can be found on the IEC website.

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- withdrawn, or
- revised.

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INTRODUCTION

The standards in IEC TC 110 that have been mainly concerned with the measurement and evaluation of electronic displays refer to a set of methods and procedures that are similarly performed at the condition of the display system complying with the standard requirement.

This document is intended to describe colour and chromaticity capabilities at the system condition set to the required usage, together with suitable precautions and diagnostics, as a reference for R&D engineers, third party experts and reviewers to avoid miscommunication and duplication of efforts among them.

In this document, the methods are available for the verification or test purpose of the display product development or evaluation by the users. The aim of this document is to evaluate the available range of chromaticity and colour.

Introduction of the optical measurements of electronic displays (OPTs) is also related to a structure where each kind of optical measurement finds its unambiguous position for identification of similarities to other methods or for clarification of distinctions. This structural classification together with a general taxonomy is supposed to make the process of standards production easier, faster and thus more effective.

The basic application comparison with the related documents is summarized in Table 1. The display system means an integrated product with device hardware, firmware or application software, or both. The display system characteristics addressed in this part of IEC 62977 are normally evaluated at the R&D stage or product sample test purpose rather than for quality assurance in mass-production.

Table 1 – Application comparison with the related documents

	IEC 62977-2-1	**IEC TS 62977-3-1**	**IEC 62977-3-5**
Application	Display device module and display system	Display device module and display system	Display device module and display system
Purpose	Fundamental optical capabilities of displays with unbounded input signals	Viewing directional colour deviation of displays with unbounded input signals	Colour and chromaticity capabilities of displays with unbounded input signals
Usage	Mass-production and sample test	Sample test	Sample test
Colour and chromaticity dependence on viewing direction	Measures luminance and chromaticity variation with viewing direction	ΔE between the normal and a viewing direction based on relative deviation from the reference white at the viewing direction	Absolute chromaticity difference by $\Delta u'v'$ between the normal and a viewing direction
		ΔE calculated based on the reference white at each viewing direction	$\Delta u'v'$ not influenced by the white of each viewing direction
Chromaticity gamut area	The three primary colours (RGB) measured at the screen centre and parallel to the display normal	-	60 points connecting the RGB primaries Primary colour mixture by location Intersection and directional gamut area
Colour reproduction accuracy	-	-	Normal direction and viewing directional variation
Colour gamut volume	Total volume in normal direction	-	Directional volume Intersection volume

ELECTRONIC DISPLAYS –

Part 3-5: Evaluation of optical performance – Colour capabilities

1 Scope

This part of IEC 62977 specifies standard evaluation methods for determining the colour capabilities of electronic display modules and systems with respect to colour accuracy, colour gamut volume, and their intersection with a reference colour space. Also included is evaluation with respect to the chromaticity gamut area. These methods apply to emissive and transmissive direct view displays that render real 2D images on a flat panel or on a curved panel with a local radius of curvature larger than 1 500 mm. This document evaluates the optical characteristics of these displays under darkroom conditions. This document applies to the testing of display performance in response to standard analogue or digital input signals that are not absolute luminance encoded. The input signal is relative RGB without metadata information that codes for real luminance, colour space or colour coordinates. These methods are limited to input signals with typical opto-electronic transfer functions (OETFs) such as defined in IEC 61966-2-1, Recommendation ITU-R BT.601 [18][1], Recommendation ITU-R BT.709, and Recommendation ITU-R BT.2020. The tests in this document are not suitable for use with HDR input signals.

NOTE A flat panel or flat panel display is a display with a planar surface that emits light from the surface. The display can consist of light valves modulating a backlight or be self-luminous. Emissive, transmissive, or reflective hybrid displays can be non-planar panel, non-planar panel displays, curved (design) panel, or curved (design) panel displays.

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.

IEC 61966-2-1, *Multimedia systems and equipment – Colour measurement and management – Part 2-1: Colour management – Default RGB colour space – sRGB*

IEC 62977-2-1:2021, *Electronic displays – Part 2-1: Measurements of optical characteristics – Fundamental measurements*

IEC TS 62977-3-1:2019, *Electronic displays – Part 3-1: Evaluation of optical performances – Colour difference based viewing direction dependence*

IEC 61747-30-4, *Liquid crystal display devices – Part 30-4: Measuring methods for liquid crystal display modules – Dynamic backlight units*

IEC 62341-6-3:2017, *Organic light emitting diode (OLED) displays – Part 6-3: Measuring methods of image quality*

CIE 015:2018, *Colorimetry*

CIE 168:2005, *Criteria for the evaluation of extended-gamut colour encodings*

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[1] Numbers in square brackets refer to the Bibliography.

Recommendation ITU-R BT.709, *Parameter values for the HDTV standards for production and international programme exchange*

Recommendation ITU-R BT.2020, *Parameter values for ultra-high definition television systems for production and international programme exchange*

SMPTE ST 431-1:2006, *D-Cinema Quality – Screen Luminance Level, Chromaticity and Uniformity*

3 Terms, definitions and abbreviated terms

3.1 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 http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
chromaticity gamut intersection area
area defined by the intersection between the chromaticity gamuts of the display and a standard colour space such as Recommendation ITU-R BT.709

Note 1 to entry: Colour and colour gamut are described and calculated three-dimensionally. The chromaticity area was used in lieu of colour gamut for legacy displays that were additive. However, modern displays are not necessarily additive so a distinction between chromaticity and colour is necessary [24].

3.1.2
colour gamut intersection volume
volume defined by the intersection between the colour gamuts of the display and a standard colour space such as Recommendation ITU-R BT.709

Note 1 to entry: The colour gamut intersection can be represented by the ratio of the intersecting volume to the volume of a reference colour space such as Recommendation ITU-R BT.709 (see CIE 168).

3.1.3
white balance
DUT mode or condition that attempts to adjust the incoming white signal (R = G = B = maximum code value) so that a pre-defined white point is achieved

Note 1 to entry: The pre-defined white point can be expressed in terms of standard CIE illuminants, for example D50, D65, or D93 [22].

3.1.4
$\Delta E_{00,D50}$
colour difference calculated based on adaptation to D50 using CIE 1931 colour-matching functions (CMFs)

Note 1 to entry: $\Delta E_{00,D50}$ calculation used in this document uses a 2° observer, and is different from CIE ΔE_{00}.

Note 2 to entry: For the formula of CIE ΔE_{00}, see CIE 015 or ISO/CIE 11664-6 [31].