BS EN 62922:2017

BSI Standards Publication

Organic light emitting diode (OLED) panels for general lighting — Performance requirements

bsi.

National foreword

This British Standard is the UK implementation of EN 62922:2017. It is identical to IEC 62922:2016.

The UK participation in its preparation was entrusted by Technical Committee CPL/34, Lamps and Related Equipment, to Subcommittee CPL/34/1, Electric lamps.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN STANDARD

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English Version

Organic light emitting diode (OLED) panels for general lighting - Performance Requirements (IEC 62922:2016)

Panneaux à diodes électroluminescentes organiques (OLED) destinés à l'éclairage général - Exigences de performance (IEC 62922:2016)

Organische-Licht-emittierende-Dioden- (OLED-) Panels - Anforderungen an die Arbeitsweise (IEC 62922:2016)

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

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European foreword

The text of document 34A/1942/FDIS, future edition 1 of IEC 62922, prepared by SC 34A "Lamps" of IEC/TC 34 "Lamps and related equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62922:2017.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-09-23
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-12-23

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The text of the International Standard IEC 62922:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-2-20:2008	NOTE	Harmonized as EN 60068-2-20:2008 (not modified).
IEC 60068-2-21:2006	NOTE	Harmonized as EN 60068-2-21:2006 (not modified).
IEC 60749-14:2003	NOTE	Harmonized as EN 60749-14:2003 (not modified).
IEC 61747-10-1:2013	NOTE	Harmonized as EN 61747-10-1:2013 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 60050-845	-	International Electrotechnical Vocabulary (IEV) - Chapter 845: Lighting	-	-
IEC 62868	-	Organic light emitting diode (OLED) panels for general lighting - Safety requirements	EN 62868	-
IEC/TR 62732	-	Three-digit code for designation of colour rendering and correlated colour temperature	-	-
IEC/TS 62972	-	General lighting - Organic light emitting diode (OLED) products and related equipment - Terms and definitions	-	-
ISO 11664-5/ CIE S 014-5/E	2009	Colorimetry - Part 5: CIE 1976 L*u*v* Colour space and u', v' uniform chromaticity scale diagram	EN ISO 11664-5	2011 [1]
CIE 013.3	1995	Method of measuring and specifying colour rendering properties of light source	-	-
CIE TN 001	2014	Chromaticity difference specification for light source	-	-

[1] Superseded by EN ISO 11664-5:2016 (SO/CIE 11664-5:2016).

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ORGANIC LIGHT EMITTING DIODE (OLED) PANELS FOR GENERAL LIGHTING – PERFORMANCE REQUIREMENTS

FOREWORD

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International Standard IEC 62922 has been prepared by subcommittee 34A: Lamps, of IEC technical committee 34: Lamps and related equipment.

The text of this standard is based on the following documents:

FDIS	Report on voting
34A/1942/FDIS	34A/1956/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

In this standard, the following print types are used:

– requirements: roman type,

– *test specifications: italic type,*

– notes: smaller roman type.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

ORGANIC LIGHT EMITTING DIODE (OLED) PANELS FOR GENERAL LIGHTING – PERFORMANCE REQUIREMENTS

1 Scope

This document specifies the performance requirements of OLED tiles and panels for use on DC supplies up to 120 V or AC supplies up to 50 V at 50 Hz or 60 Hz for indoor and similar general lighting purposes.

NOTE In this current edition, life (life time and maintained values) is not addressed. This is intended to be covered in a future amendment.

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 60050-845, *International Electrotechnical Vocabulary. Lighting* (available at http://www.electropedia.org)

IEC 62868, *Organic light emitting diode (OLED) panels for general lighting – Safety requirements*

IEC TR 62732, *Three-digit code for designation of colour rendering and correlated colour temperature*

IEC TS 62972, *General lighting – Organic light emitting diode (OLED) products and related equipment – Terms and definitions*

ISO 11664-5/CIE S 014-5/E:2009, *Colorimetry – Part 5: CIE 1976 L*u*v* Colour space and u', v' uniform chromaticity scale diagram*

CIE 013.3:1995, *Method of measuring and specifying colour rendering properties of light sources*

CIE TN 001:2014, *Chromaticity difference specification for light source*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845, IEC TS 62972 and IEC 62868 as well as 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
test voltage
input voltage at which tests are carried out

3.2
test current
input current at which tests are carried out

3.3
test power
input power at which tests are carried out

3.4
initial value
photometric and electrical characteristics at the end of the ageing and stabilization time

3.5
average luminance
L_{av}
luminance averaged over the light output surface of an OLED panel in a direction

4 General statement and test conditions

4.1 General statement

The requirements of this document apply in addition to the requirements of IEC 62868.

The requirement applies for 95 % of the population (with a failure margin below 5 %, it is considered that the product passed the test).

It is understood that reference to an OLED panel also includes reference to OLED tiles in the requirements and tests of this document.

4.2 General test conditions

Unless otherwise specified, all measurements shall be made in a draught free room at a temperature of 25 °C with a tolerance of ±5 °C, a relative humidity of 65 % maximum and steady state operation of the OLED panel. The temperature shall be maintained within ±2 °C during the test. The temperature shall be measured in the integrating sphere or at the point within 1,5 m from the OLED panel.

The tests shall be conducted at the rated current or voltage unless otherwise specified in this document.

The test shall be made with the OLED panel in the horizontal mounting position with the surface emitting the largest fraction of luminous flux directed upwards, unless specified otherwise by the manufacturer. The mounting position shall be recorded in the documentation. If all surfaces are intended to emit the same luminous flux, the orientation is at the discretion of the test laboratory. The operating position shall be maintained during the entire test.

In the case of constant current operation: The test current, unless otherwise specified, shall be stable within ±0,5 % during the performance test of an OLED panel. The total harmonic content of the input shall not exceed 3 %.

In the case of constant voltage operation: The test voltage, unless otherwise specified, shall be stable within ±0,05 % or 5 mV whichever is greater during the performance test of an OLED panel. The total harmonic content of the input shall not exceed 3 %. The tolerance of ±0,05 % is applicable for DC supplies only. The tolerance for AC supplies is under consideration. The test voltage shall be measured at the terminals of the OLED panel.

The OLED panel shall be mounted in such a way that thermal contact between the measurement equipment, sample holder and OLED panel is minimal. During stabilization and measurement, an OLED panel shall only be in contact with the measurement equipment near its edges and contact ledges. All other parts of the panel, especially the light output surface and the opposing surface (the back of the OLED panel) shall be open to air, unless otherwise specified by the manufacturer.

NOTE The harmonic content is understood as the r. m. s. summation of the individual harmonic components using the fundamental as 100 %.

4.3 Stabilization

4.3.1 General requirements for stabilization

Stabilization is conducted in a draught free room at a temperature of 25 °C ± 5 °C. The temperature shall be maintained within ±2 °C during stabilization. The temperature shall be measured in the integrating sphere or the point within 1,5 m from the OLED panel.

If stabilization conditions, according to 4.3.2 or 4.3.3, are not achieved within 60 min, the measurement may be started and the observed fluctuations shall be reported.

4.3.2 Current-driven stabilization

This method of stabilization is used for OLED panels intended to be operated primarily in constant current mode and OLED panels for which the selection of the operating mode is left to the customer.

The OLED panel shall be powered with a constant input current stable within ±0,5 %.

During the stabilization period, measurements of the voltage are made at least at 1 min intervals. The OLED panel under test may be regarded as stable and suitable for test purposes if the difference of maximum and minimum readout voltage observed over the last 5 min is less than 0,5 %.

4.3.3 Voltage-driven stabilization

This method of stabilization is used for OLED panels intended to be operated primarily in constant voltage mode.

The OLED panel shall be powered with a constant input voltage stable within ±0,05 %.

During the stabilization period, measurements of the current are made at least at 1 min intervals. The OLED panel under test may be regarded as stable and suitable for test purposes if the difference of maximum and minimum readout current observed over the last 5 min is less than 1 %.

5 Marking

5.1 Contents and location

OLED panels shall be marked according to Table 1.

Table 1 – Contents and location of marking

Parameters	Location
Rated luminous flux (lm)	Mandatory on packaging or product information
Average luminance (cd/m^2)	Mandatory on packaging or product information
Photometric code (according to IEC TR 62732)	Mandatory on packaging or product information
Rated chromaticity coordinates (in u'v' coordinates) and chromaticity coordinate range (expressed by Δu'v', a u'v' circle or a u'v' quadrangle)	Mandatory on packaging or product information
Correlated colour temperature (K)	Mandatory on packaging or product information
Rated colour rendering index	Mandatory on packaging or product information
Operating temperature range (°C)	Mandatory on packaging or product information
Rated luminous efficacy (lm/W)	Mandatory on packaging or product information
Luminance uniformity (%)	Mandatory on packaging or product information
Luminous intensity distribution[a]	Mandatory on packaging or product information
Surface chromaticity uniformity and location of measurement spots (if applicable)	Mandatory on packaging or product information
Angular chromaticity uniformity	Mandatory on packaging or product information
Rated location and dimensions of the light output surface	Mandatory on packaging or product information
NOTE The operating temperature range specifies maximum and minimum temperatures of the OLED panel at which the OLED panel will function as intended. The operating temperatures are measured according to Annex F. [a] This requirement is fulfilled if the data file is made available electronically.	

5.2 Information on reliability of electrical connection

Information shall be provided in the datasheet on how the electrical connection of an OLED panel is made, unless the connection method is obvious. This information shall include, as applicable, information on:

– requirements for connectors (e.g. wire size, material, connector specification);
– method for attaching connectors (e.g. solder time and temperature);
– reliability of connection (e.g. maximum pull force and appropriate test setup);
– additional safeguards required (e.g. external strain relief).

6 Input power

The general test conditions and stabilization according to 4.2 and 4.3 shall apply. The input power of the OLED panel is measured.

The measured input power shall not exceed the rated power by more than 10 %.

7 Initial photometric characteristics

7.1 General

The initial values of photometric characteristics shall be measured after stabilization of the OLED panel.

For operation, stabilization and test conditions of an OLED panel, 4.2 and 4.3 apply.

7.2 Luminous flux

Annex C applies.

The initial luminous flux shall not deviate by more than 10 % from the rated initial luminous flux.

NOTE A review of the methods in use for luminous flux measurement is given with CIE 084:1989 and CIE S 025:2015, 4.5 and 6.2. A more specific measurement method for OLED panels is in preparation in CIE.

7.3 Luminous efficacy

OLED panel efficacy shall be calculated from the measured initial luminous flux of the individual OLED panel, divided by the measured initial input power of the same individual OLED panel.

The OLED panel efficacy shall not be less than 90 % of the rated OLED panel efficacy as declared by the manufacturer of the responsible vendor.

7.4 Chromaticity coordinates

The chromaticity coordinates shall be derived from the spatially integrated measured spectral characteristics. The test is performed as described in 7.2. The u',v' chromaticity coordinates are calculated as described in ISO 11664-5 CIE S 014-5/E.

For the calculation of $\Delta(u',v')$, CIE TN 001:2014, Clause 4 applies.

Where only a rated chromaticity coordinate pair is given in the datasheet: the difference $\Delta(u',v')$ between the rated and measured chromaticity coordinate shall be less than 0,005.

Where a range of chromaticity coordinates is stated in the datasheet: The measured chromaticity coordinate of an OLED panel shall not fall outside the rated chromaticity coordinate range.

7.5 Correlated colour temperature (CCT)

The CCT shall be derived from the spatially integrated measured spectral characteristics. The test is performed as described in 7.2.

A requirement is not needed here as it is given for chromaticity coordinates already.

NOTE For further information about calculation of the CCT, see A. R. Robertson, “Computation of Correlated Color Temperature and Distribution Temperature,” Journal of the Optical Society of America, Vol 58, Issue 11, pp. 1528-1535 (1968)

7.6 Colour rendering index (CRI)

The CRI shall be derived from the spatially integrated measured spectral characteristics. The test is performed as described in 7.2. The CRI shall be calculated according to CIE 013.3:1995.

The initial CRI shall not be less than the rated CRI minus 5.

7.7 Luminance uniformity

7.7.1 Average luminance (L_{av})

7.7.1.1 The initial average luminance shall not deviate from the rated average luminance by more than 10 %.

7.7.1.2 If using an imaging luminance measurement devices (ILMD), the measurement of average luminance (L_{av}) shall be carried out in perpendicular direction to the light output surface of an OLED panel. The average luminance shall be calculated from an image of the entire light output surface with an exclusion zone of 1 mm to 3 mm from the edge.

7.7.1.3 If using a spot luminance meter, the measurement of average luminance (L_{av}) shall be carried out in perpendicular direction to the light output surface of an OLED panel. The distance from the edge of the light output surface to the closest measurement spot perimeter shall be at least 3 mm.

The remaining lighting area shall then be subdivided into quadrilateral areas with a side length corresponding to a viewing angle of not more than 0,5° at a viewing distance of 1,5 m. The spot size shall fit into the quadrilateral area with a clearance of at least 1 mm.

Example: For an 0,5° viewing angle, the side length ***l*** of a subdivision is given by ***l*** = tan(0,5°) x 1,5 m = 0,013 m = 1,3 cm. So a 10 x 10 cm^2 lighting area would have to be divided into 10/1,3 ≈ 7,7, i. e. 7 x 7 segments.

The arithmetic average of all luminance values of the measured areas is taken as the initial average luminance.

7.7.2 Luminance uniformity (U)

The initial luminance uniformity shall be not more than 5 % below the rated luminance uniformity.

The luminance uniformity quantifies how large the change of luminance within the rated light output area is. It is calculated using the following formula:

$$U = [1 - (L_{max} - L_{min})/(L_{max} + L_{min})] \times 100\ \% = [2 \times L_{min}/(L_{max} + L_{min})] \times 100\ \% \quad (1)$$

L_{min} and L_{max} are the minimum and maximum luminance values measured according to 7.7.1.

If using an ILMD, the average luminance in the measurement areas as specified in 7.7.1.3 may be used for determining L_{min} and L_{max} and calculating the initial luminance uniformity.

NOTE The luminance uniformity calculated in this way does not necessarily represent the human perception of uniformity accurately. Luminance distributions with the same uniformity value can have quite different visual appearance.

7.8 Luminous intensity distribution

Luminous intensity distribution data shall be available. This data shall be provided in accordance with an established international or regional format. It shall be available in electronic file format (see Annex A).

Unless otherwise specified by the manufacturer, the luminous intensity distribution of an OLED panel shall be measured in far-field condition, where the inverse-square law is sufficiently satisfied.

7.9 Surface chromaticity uniformity

The initial surface chromaticity uniformity shall not deviate by more than 0,003 from the rated surface chromaticity uniformity.

The surface chromaticity uniformity is measured by means of an ILMD or an instrument capable of measuring directional chromaticity.

The chromaticity measuring device shall be aligned perpendicular to the light output surface.

The measurement areas are determined according to 7.7.1.3.

The u',v' chromaticity coordinates at each measurement area are used to determine the chromaticity difference between all pairs of areas i and j, where i ≠ j. The following formula is used:

$$\Delta(u',v') = \sqrt{\left(u'_{\mathrm{i}} - u'_{\mathrm{j}}\right)^2 + \left(v'_{\mathrm{i}} - v'_{\mathrm{j}}\right)^2} \tag{2}$$

The surface chromaticity uniformity is defined as the largest colour difference $\Delta(u',v')$ between any two areas.

7.10 Angular chromaticity uniformity

The initial angular chromaticity uniformity shall not deviate by more than 0,003 from the rated angular chromaticity uniformity.

The angular chromaticity uniformity quantifies how visible the change of colour with the viewing angle is for an observer. The viewing angle is defined as the angle to the surface normal.

The viewing angle dependent chromaticity coordinates of an OLED panel are measured for viewing angles of 0° to 80° in steps of 5° and expressed in u',v'. For every combination of chromaticity coordinate pairs, the chromaticity difference $\Delta(u',v')$ is calculated according to Equation (2).

Unless a preferred azimuthal measurement direction is specified by the manufacturer, azimuthal symmetry of the OLED panel is assumed.

The angular chromaticity uniformity is the average of the colour differences between all pairs of chromaticity coordinates.

Unless otherwise specified by the manufacturer, the angular chromaticity uniformity of an OLED panel should be measured in far-field condition, where the inverse-square law is sufficiently satisfied.

NOTE See Annex B for an example calculation.

8 Maintained photometric characteristics

Placeholder clause for future amendments.

9 Reliability

9.1 High temperature – high humidity operation

OLED panels shall sustain operation under high temperature and high humidity conditions.

An OLED panel is kept in a humidity cabinet having a relative humidity of (90 ± 5) % for 48 h. A temperature of internal air shall be maintained at (60 ± 2) °C. The test shall be conducted so that no condensation or water droplets appear on any part of the OLED panel. The OLED panel shall be operated inside the humidity cabinet with rated current or rated voltage, as applicable. After the high temperature – high humidity operation, the luminous flux and chromaticity of the OLED panel are measured according to 7.2 and 7.4, respectively.

Compliance:

The measured luminous flux of OLED panels shall not be less than 90 % of the initial luminous flux.

The colour difference $\Delta(u',v')$ between the measurements according to 7.4 taken before and after the high temperature operation shall not exceed 0,005 in the u',v' colour space.

For constant current operation, the measured voltage shall not exceed 105 % of the initial voltage. For constant voltage operation, the measured current shall not drop below 90 % of the initial current.

9.2 High temperature – high humidity storage

OLED panels shall sustain storage under high temperature and high humidity conditions.

An OLED panel is kept in a humidity cabinet having a relative humidity of (90 ± 5) % for 500 h. A temperature of internal air shall be maintained at (60 ± 2) °C. The OLED panel shall be placed in the humidity cabinet where humidity and temperature is maintained without supplying electricity. The test shall be conducted so that no condensation or water droplets appear on any part of the OLED panel. After the high temperature – high humidity storage test, the luminous flux and chromaticity of the OLED panel are measured according to 7.2 and 7.4, respectively. Any convenient mounting position may be used during storage.

Compliance:

The measured luminous flux of OLED panels shall not be less than 90 % of the initial luminous flux.

There shall be no visible defect (such as dark spots) larger than 0,5 mm when the OLED panel is switched on.

The colour difference $\Delta(u',v')$ between the measurements according to 7.4 taken before and after the load shall not exceed 0,005 in the u',v'colour space.

For constant current operation, the measured voltage shall not exceed 105 % of the initial voltage. For constant voltage operation, the measured current shall not drop below 90 % of the initial current.

9.3 Reliability of connection

The information on reliability of connection shall be accurate.

The test sample is installed as instructed in the manufacturer's literature. The sample is subjected to all test methods for which the manufacturer has made performance claims in the instructions.

Compliance:

If the test method is destructive, the measured performance shall not be less than 95% of the claimed performance (e.g. pull force).

If the test method is non-destructive, no parts of the OLED panel may become detached during the test. The OLED panel, when switched on after the test, shall not show any visible defects.

NOTE For examples of appropriate test methods, see Annex D.

10 Information for controlgear design

Information for controlgear design is given in Annex E. This should be followed for proper operation of OLED tiles and panels.

Annex A
(informative)

Use of regional standards

In some regions the use of local standards, as alternatives to those detailed in the text of this document may be preferred. Details of those that have been made known by national committees are as follows:

Europe

EN 13032-1:2004+A1:2012, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 1: Measurement and file format*

EN 13032-2:2004/AC:2007, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 2: Presentation of data for indoor and outdoor work places*

EN 13032-3:2007, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 3: Presentation of data for emergency lighting of work places*

Canada and USA

IES-LM75-01, *Goniophotometer Types and Photometric Coordinates*

IES-LM-63-02, *Standard File Format for the Electronic Transfer of Photometric Data and Related Information*

IES-LM-58-94, *Guide to Spectroradiometric Measurements*

IES-LM-77-09, *Intensity Distribution of Luminaires and Lamps Using Digital Screen Imaging Photometry*

ANSI/IES-RP-16-07, *Nomenclature and Definitions for Illuminating Engineering*

Japan

JISC8152-2, *Photometry of white light emitting diode for general lighting – Part 2: LED modules and LED light engines*

JISC8152-3, *Photometry of white light emitting diode for general lighting – Part 3: measurement methods for lumen maintenance*

JISC8105-5, *Luminaires – Part 5: Gonio-photometric methods*

JISZ8724, *Methods of colour measurement Light -source -colour*

JISZ8725, *Methods for determining distribution temperature and color temperature or correlated color temperature of light sources*

JISZ8726, *Method of Specifying Colour Rendering Properties of Light Sources*

Annex B
(informative)

Measuring method of angular chromaticity uniformity

Example calculation of angular chromaticity uniformity

If the measured, angle-dependent chromaticity coordinates are as shown in Table B.1, the colour difference between 0° and 10°:

$$\Delta(u',v') = \sqrt{(u'_0 - u'_{10})^2 + (v'_0 - v'_{10})^2} = \sqrt{(0{,}254 - 0{,}252)^2 + (0{,}520 - 0{,}521)^2} = 0{,}002\ 236$$

Table B.1 – Chromaticity coordinates for all viewing angles between 0° and 80° in 5° steps

Angle to surface normal	CIE 1976 u'	CIE 1976 v'
0°	0,254	0,520
5°	0,253	0,520
10°	0,252	0,521
15°	0,251	0,521
20°	0,250	0,521
25°	0,249	0,521
30°	0,248	0,522
35°	0,247	0,522
40°	0,246	0,522
45°	0,245	0,522
50°	0,244	0,523
55°	0,243	0,523
60°	0,242	0,523
65°	0,240	0,523
70°	0,239	0,524
75°	0,238	0,524
80°	0,237	0,524

The colour difference sets calculated from Equation (2) are given in Table B.2.

Table B.2 – Colour difference between all chromaticity coordinate pairs

	0°	5°	…	40°	…	70°	75°	80°
0°	–	0,001 00		0,008 25		0,015 5	0,016 5	0,017 5
5°		–		0,007 28		0,014 6	0,015 5	0,016 5
10°				0,006 08		0,013 3	0,014 3	0,015 3
15°				0,005 10		0,012 4	0,013 3	0,014 3
20°				0,004 12		0,011 4	0,012 4	0,013 3
25°				0,003 16		0,010 4	0,011 4	0,012 4
30°				0,002 00		0,009 22	0,010 2	0,011 2
35°				0,001 00		0,008 25	0,009 22	0,010 2
40°				–		0,007 28	0,008 25	0,009 22
45°						0,006 32	0,007 28	0,008 25
50°						0,005 10	0,006 08	0,007 07
55°						0,004 12	0,005 10	0,006 08
60°						0,003 16	0,004 12	0,005 10
65°						0,001 41	0,002 24	0,003 16
70°						–	0,001 00	0,002 00
75°							–	0,001 00
80°								–

The chromaticity angular uniformity is the average of all the colour differences in Table B.2. In this example, the chromaticity angular uniformity is 0,006 59.

Annex C
(normative)

Measuring method for luminous flux

C.1 General

There are two typical methods of measuring luminous flux: one is a spherical photometer method with an integrating sphere and the other is a light distribution measurement method with a goniophotometer of any type for measurement of luminous flux.

C.2 Integrating sphere measurements

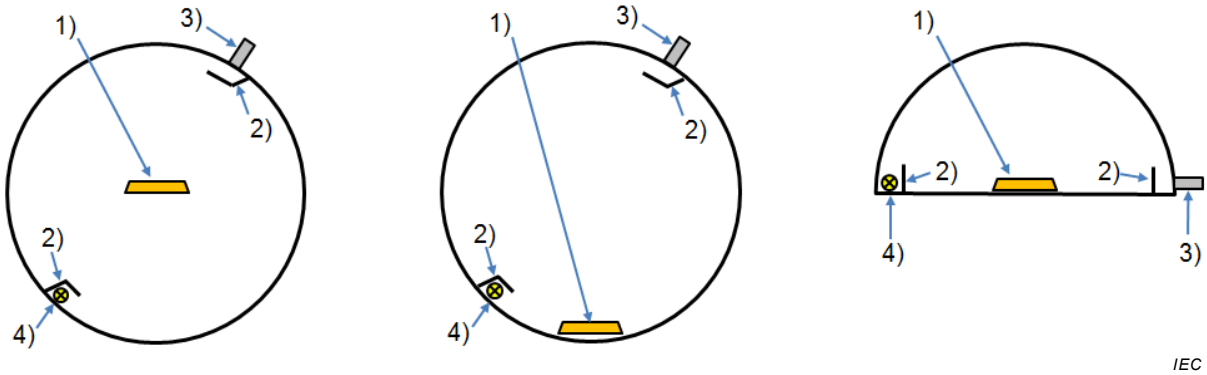
C.2.1 Integrating sphere methods and installation position

Three integrating sphere setups can be used for OLED panels: 4π geometry using a sphere, 2π geometry using a sphere or 2π geometry using an integrating hemisphere. In all cases, the OLED panel shall be installed in such a way that light emitted from edges is included in the measured value. Figure C.1 shows exemplary measurement setups for the three methods.

For OLED panels designed for emitting light from both sides and for non-planar OLED panels, the 4π geometry shall be used.

For the 4π geometry and the 2π geometry hemisphere, the OLED panel shall be positioned in the centre of the spherical portion.

For the 2π geometry sphere, the OLED panel shall be placed on the surface of the sphere.



Key

1) OLED panel under test
2) Screen
3) Measuring port
4) Auxiliary lamp

Figure C.1 – 4π geometry (left), 2π geometry sphere (centre) and 2π geometry hemisphere (right)

C.2.2 Size of the integrating sphere

In the 4π geometry, the total surface area of the OLED panel should be less than 2 % of the total area of the sphere wall.

In the 2π geometry hemisphere, the total surface area of the OLED panel should be less than 4 % of the total area of the hemisphere wall.

The longest physical dimension of an OLED panel should be less than 2/3 of the diameter of the sphere or hemisphere.

For a 2π geometry sphere having an opening for mounting purposes, this opening should be less than 1/3 of the diameter of the sphere.

NOTE 1 For general guidance on the use of integrating spheres, see CIE 084:1989 and CIE S 025:2015, 4.5 and 6.2.

NOTE 2 In the case of a rectangular OLED panel, the longest physical dimension is the diagonal.

C.3 Goniophotometric measurements

Goniophotometry may be used for OLED panels of all sizes as an alternative to integrating sphere photometry. Care should be taken to include the emitted light from the edges in the measurement.

In the absence of an integrating sphere of appropriate size relative to the OLED panel to be measured, a goniophotometer shall be used.

NOTE For general guidance on the use of goniophotometers, see CIE 084:1989 and CIE S 025:2015, 4.5 and 6.2.

Annex D
(informative)

Tests of robustness of terminations and connectors

D.1 General

Terminations of an OLED panel should have appropriate robustness to maintain its performance.

The test samples should be tested according to D.2, D.3 or D.4. Choice of the appropriate tests depends on the type of devices. The relevant specification should state which tests are applicable.

The results of the tests should be given in accordance with relevant standard or specification provided by the manufacturer.

D.2 Wire terminations and pin type connectors

D.2.1 General

The wire termination and pin type connectors should be examined by D.2.2 to D.2.4.

After the test, inspection should be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 3 x to 10 x, depending on the size of objects.

An OLED panel should have no breakage, loosening or relative motion between the termination and the OLED panel after the test.

D.2.2 Tensile test

This test should be conducted in accordance with test Ua_1 of IEC 60068-2-21.

D.2.3 Bending test

This test should be conducted in accordance with test Ub of IEC 60068-2-21.

D.2.4 Torsion test

This test should be conducted in accordance with Clauses 7 and 8 of IEC 60749-14:2003. This test is only applied for pins and pin type connectors.

D.3 Flexible flat terminations

D.3.1 General

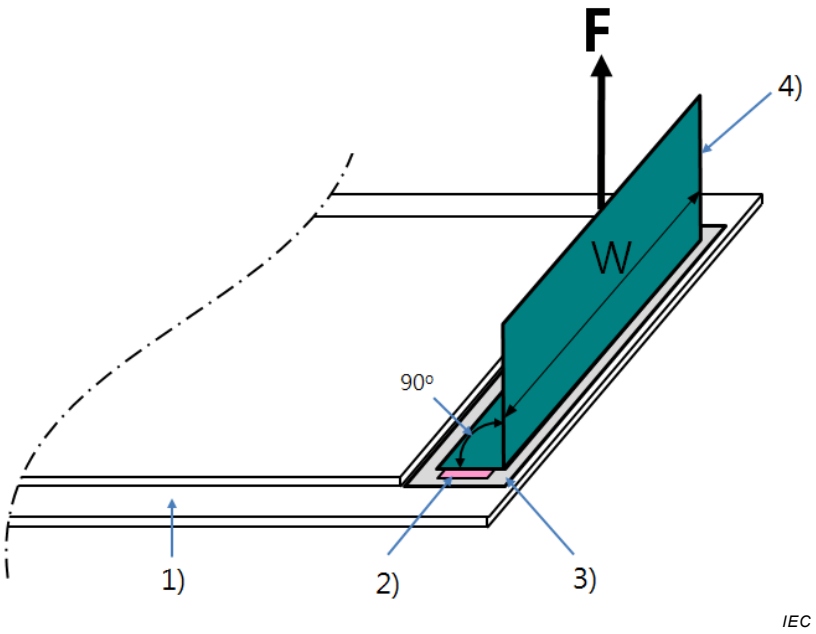
The flexible flat terminations such as flexible printed circuit board (f-PCB) and flexible flat cables should be tested according to D.3.2 or D.3.3. Choice of the appropriate tests depends on the type of devices. The relevant specification should state which tests are applicable.

The bond strength of adhesive bond shall not be less than 3 N/cm.

D.3.2 Peel test A

The peel test A is conducted according to Figure D.1. The OLED panel is securely fixed on the test equipment. The flexible flat termination should be drawn until it breaks off from the OLED panel.

Pull speed should be 50 mm/min with direction perpendicular to the substrate surface of the OLED panel. The bond strength of adhesive bond is defined as quotient of the maximum load of tension (F) for breakage by the width (W) of flexible PCB.



Key

1) OLED panel under test
2) Conductive glue
3) Contact ledge
4) f-PCB

Figure D.1 – Schematic diagram of peel test A

D.3.3 Peel test B

The peel test B is conducted in accordance with 5.7.5 of IEC 61747-10-1:2013.

The bond strength should be calculated in the same manner as in D.3.2.

D.4 Soldering

Soldering on an OLED panel should be tested in accordance with Clause 4 of IEC 60068-2-20:2008.

Annex E
(informative)

Information for controlgear design

E.1 General

Annex E describes typical characteristics of OLED panels and requirements for OLED controlgear. It is recommended for application only if the OLED panel manufacturer does not provide such information.

E.2 Operation

OLEDs should be driven in a constant current mode.

The dependence of luminance on forward current is approximately linear, while the luminance dependence on forward voltage is much stronger. Hence, constant current mode keeps the light output operating point stable over a wider variation of environmental parameters, including temperature, degradation, production variations and driver output tolerances.

Therefore, due to the degradation process of the OLED, the forward voltage increases with the ongoing operation time. As a result, in constant voltage operation, the forward current would decrease and the specified end of luminance lifetime would be reached earlier. See Figure E.1 for illustration.

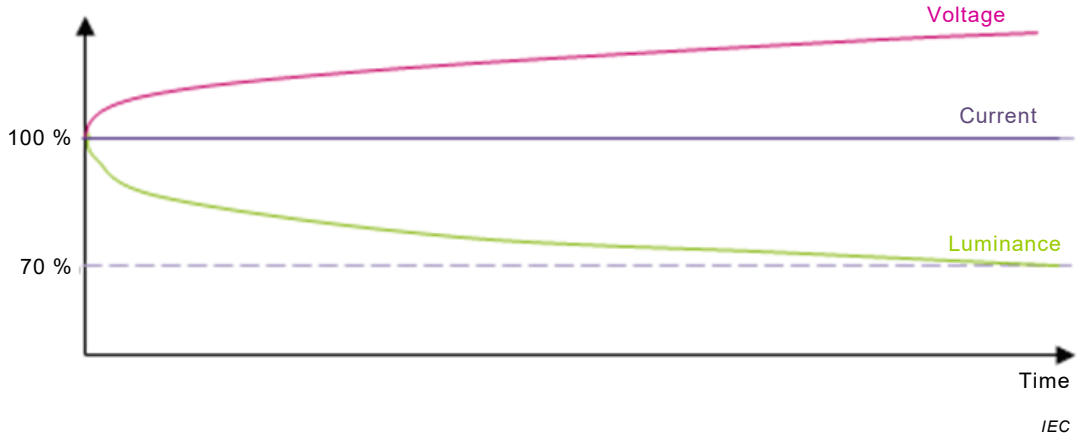


Figure E.1 – Voltage and luminance behaviour at constant current operation

E.3 Characteristics of the driver output current

The 100 % light output level should be set by adjusting the DC level of the output current.

It is recommended not to adjust the mean value of the output current by pulse-width modulation (PWM), because this would reduce the OLED lifetime. For example, for a 200 mA OLED one should not use a 350 mA driver by adjusting the duty cycle to 57 %.

The DC current should have a low ripple. Typical switch mode power supplies need a minimum current ripple, which leads to ripple current through the OLED. High ripple reduces the OLED lifetime. The peak value of the ripple should be kept below ±15 % of the mean value.

E.4 Characteristics of the driver output voltage

The forward voltage of an OLED may vary due to production tolerances, forward current, ambient temperature and self-heating.

The forward voltage can increase during nominal operational lifetime. Hence, for each OLED connected in series some allowance for voltage increase should be provided.

E.5 Dimming

Reducing the DC level of the forward current increases the lifetime more than proportionally, but may lead to light colour variations. Alternatively, reducing the forward current by PWM increases the lifetime only proportionally, but keeps the light colour stable. Drivers for PWM dimming should show no relevant voltage and only minor current peaks.

A logarithmic dimming curve should be applied. For LED lighting, logarithmic dimming curves are already common to avoid visible dimming steps in the region of low light output. As OLED light causes lower glare than LED light, the negative effects of linear dimming are even more visible. Typical dimmable lighting drivers provide a DALI interface and logarithmic dimming behaviour.

E.6 Short-circuit protection

One possible failure mode of an OLED is a short circuit or a so-called low ohmic bypass between anode and cathode. Hence, driver outputs should be short circuit proof.

Annex F
(informative)

Information for luminaire design

The operating temperature of an OLED panel should not exceed the operating temperature range under normal operation. The temperature should be measured at the centre of the light output surface of the OLED panel or at any other point specified by the manufacturer.

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