BS EN 61988-2-3:2009

BSI Standards Publication

Plasma display panels —

Part 2-3: Measuring methods — Image quality: defects and degradation

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National foreword

This British Standard is the UK implementation of EN 61988-2-3:2009. It is identical to IEC 61988-2-3:2009.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

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

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English version

Plasma display panels -
Part 2-3: Measuring methods -
Image quality: defects and degradation

(IEC 61988-2-3:2009)

Panneaux d'affichage à plasma -
Partie 2-3: Méthodes de mesure -
Qualité d'image: défauts
et dégradation
(CEI 61988-2-3:2009)

Plasmabildschirme -
Teil 2-3: Messverfahren -
Bildqualität: Defekte
und Bildverschlechterung
(IEC 61988-2-3:2009)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 110/180/FDIS, future edition 1 of IEC 61988-2-3, prepared by IEC TC 110, Flat panel display devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61988-2-3 on 2009-09-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61988-2-3:2009 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 61966-5	NOTE	Harmonized as EN 61966-5:2009 (not modified).
IEC 61988-2-2	NOTE	Harmonized as EN 61988-2-2:2003 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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

Publication	Year	Title	EN/HD	Year
IEC 60068-1	1988	Environmental testing - Part 1: General and guidance	EN 60068-1[1)]	1994
IEC 60107-1	1997	Methods of measurement on receivers for television broadcast transmissions - Part 1: General considerations - Measurements at radio and video frequencies	EN 60107-1	1997
IEC 61988-1	-[2)]	Plasma display panels - Part 1: Terminology and letter symbols	EN 61988-1	2003[3)]
IEC 61988-2-1	2002	Plasma display panels - Part 2-1: Measuring methods - Optical	EN 61988-2-1	2002
CIE 15	2004	Colorimetry	-	-

[1)] EN 60068-1 includes A1:1992 to IEC 60068-1 + corr. October 1988.

[2)] Undated reference.

[3)] Valid edition at date of issue.

CONTENTS

PLASMA DISPLAY PANELS –

Part 2-3: Measuring methods – Image quality: defects and degradation

1 Scope

This part of IEC 61988 determines the measuring methods for defects and degradation of colour plasma display (PDP) module in the following areas:

a) cell defects;
b) image sticking;
c) luminance lifetime.

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 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60107-1:1997, *Methods of measurement on receivers for television broadcast transmissions – Part 1: General considerations – Measurements at radio and video frequencies*

IEC 61988-1, *Plasma display panels – Part 1: Terminology and letter symbols*

IEC 61988-2-1:2002, *Plasma display panels – Part 2-1: Measuring methods – Optical*

CIE 15:2004, *Colorimetry, 3rd Edition (ISBN 978 3 901906 33 6)*

3 Terms and definitions

For the purposes of this document, most of the terms and definitions used, comply with IEC 61988-1, IEC 60068-1 and IEC 60107-1, and the followings apply.

3.1
cell defect
cell showing a dark defect or a bright defect, or an unstable cell

3.2
defect luminance ratio
percentage of luminance difference from the full screen white-level luminance of each colour

3.3
unstable cell
cell that changes luminance in an uncontrollable way

4 Standard measuring conditions

4.1 Environmental conditions

Measurements shall be carried out under the standard environmental conditions, e.g. at a temperature of 25 °C ± 3 °C, a relative humidity of 25 % to 85 % and pressure of 86 kPa to 106 kPa. When different environmental conditions are used, it shall be noted on the report.

4.2 Lighting conditions

The following dark-room conditions shall be used for all measurements. Illuminance shall be less than 1 lx anywhere on the screen of the PDP module. When this illuminance significantly affects the measurement of the black level, the background subtraction method shall be used. In case of a different illuminance or if the background subtraction method is used, it shall be noted on the report.

4.3 Set-up conditions

Standard set-up conditions are given below. Each condition shall be noted on the specification form whenever any measurement is carried out under conditions that differ from the standard set-up conditions.

4.3.1 Adjustment of PDP modules

For contrast adjustable PDP module, set the maximum contrast under the standard measuring environmental conditions (see 4.1), measurements shall be started when the PDP module achieves stability.

4.3.2 Warm-up condition of PDP modules

Measurements shall be started after warm-up when the PDP module achieves stability. The warm-up time shall be longer than 30 min with signal input set at 15 % grey level on full screen without gamma correction. Measurements shall be started after the above warm-up when the PDP module achieves stability, unless other specified measuring methods are used. When different warm-up conditions are used, they shall be noted on the report.

4.3.3 Conditions of measuring and driving equipment

a) The light measuring device shall be aligned perpendicular to the area to be measured on the screen of the PDP module.

b) The standard measuring distance ℓ_{X0} is 2,5 V, where V is the screen height or the short side length of the screen. The measuring distance shall be between 1,6 V and 2,8 V. The measuring distance shall be noted on the report (see Figure 1).

c) The light measuring device shall be set at a proper aperture angle less than or equal to 2 ° and shall measure an area of at least 500 pixels which has an extent less than 10 % of the screen height. This area corresponds to a circular measurement area of at least 26 lines in diameter in the case of a display panel having a square pixel consisting of 3 subpixels. The measuring distance and the aperture angle may be adjusted to achieve a viewing area greater than 500 pixels which has an extent less than 10 % of the screen height if setting the above aperture angle is difficult. Such deviations from standard conditions shall be noted on the report.

d) The standard field frequency of the driving signal equipment shall be 60 Hz, unless the module is intended to be used at a significantly different frequency. In any case, the field frequency used shall be noted on the report.

e) In case of visual inspection, the inspector shall observe the area to be measured on the screen of the colour plasma display module from the same position of light measuring devices.

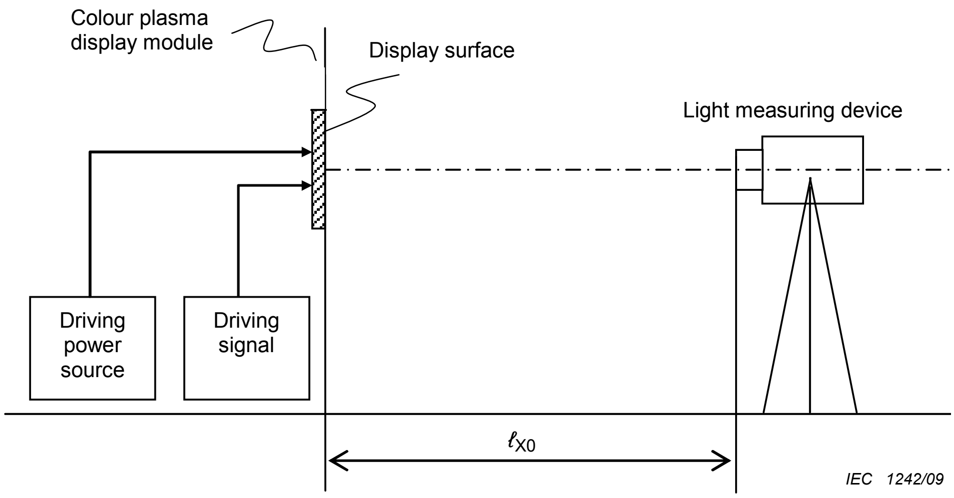


Figure 1 – Measuring system and its arrangement

5 Measuring methods

5.1 Cell defects

5.1.1 Purpose

The purpose of this method is to measure the cell defects of the PDP modules.

5.1.2 Measuring equipment

The following equipment shall be used:

a) Driving power source

b) Driving signal equipment

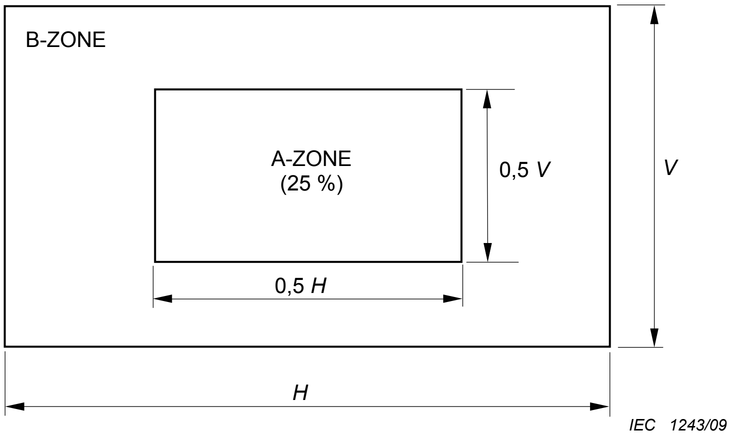
c) Automatic defect inspection instrument (optional).

5.1.3 Measuring layout

Measurements shall be carried out at the standard measuring layout shown in Figure 1. When a different measuring layout is used, this shall be noted on the report. When visual inspection is used, the inspector should observe the module from the same place as the light measuring equipment which is defined in the standard measuring layout.

5.1.4 Division of display zone

The whole screen is usually divided into two zones during the measurement, as shown in Figure 2.



Key

1 A-zone, the 25 % area of inner box

2 B-zone, the remaining 75 % area in the outer box

Figure 2 – Example of display zone

In this example, the centre of A-zone collides to the screen centre and the ratio of the size of A-zone to that of the screen area may be defined. Figure 2 shows an example of 25 % area and the horizontal and vertical ratio are both 0,5.

For the measurement of cell defects, the number of defect cells may be separately observed on each separated screen zone as shown in Figure 2, when required in the relevant specification.

5.1.5 Classification of cell defects

Cell defects are classified as follows: dark defect, bright defect and unstable cell.

For the definitions, see 3.3 of this standard and IEC 61988-1.

5.1.6 Luminance levels of defective cells

The luminance level for each defect on each screen condition is defined as the defect luminance ratio *X*, *Y*, *Z* or *V* as follows:

– A dark defect (R, G, or B) has a luminance which is darker than *X* % of the luminance of full screen R, G or B respectively (see Figure 3).
– A bright defect (R, G, or B) on white, or same colour screen has a luminance which is brighter than *Y* % of the luminance of full screen R, G, or B respectively (see Figure 4).
– A bright defect (R, G, or B) on black screen has a luminance which is brighter than *Z* % of the luminance of full screen R, G or B respectively (see Figure 5).
– A bright defect (R, G, or B) on other colours (for an example, red bright defect on full screen green, or phosphor contamination) has a luminance which is brighter than *V* % of the luminance of full screen R, G or B respectively (see Figure 6).

The *X*, *Y*, *Z* or *V* values can be different for each colour defect. The values chosen for *X*, *Y*, *Z* and *V* shall be given in the report.

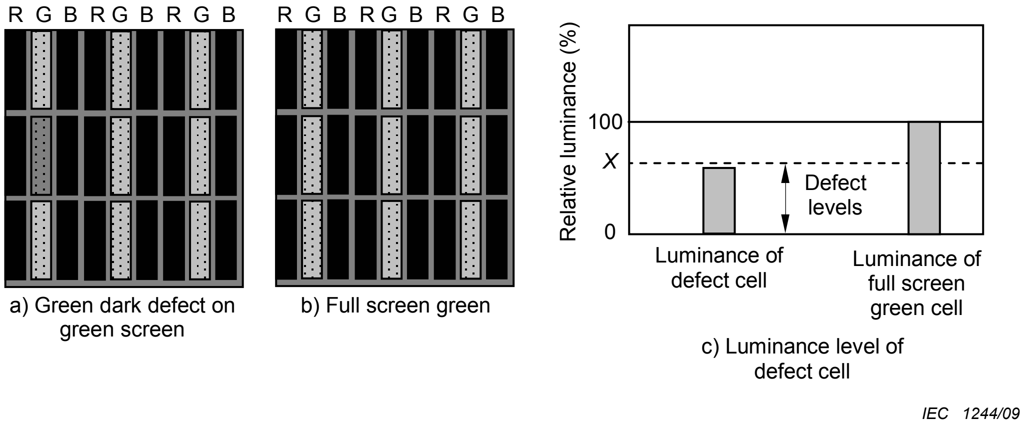


Figure 3 – Dark defect on green screen and its luminance level

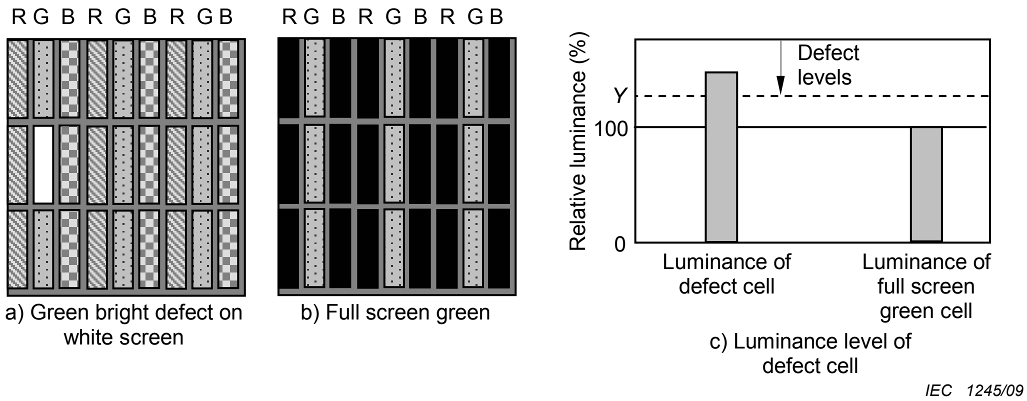


Figure 4 – Bright defect on white screen and its luminance level

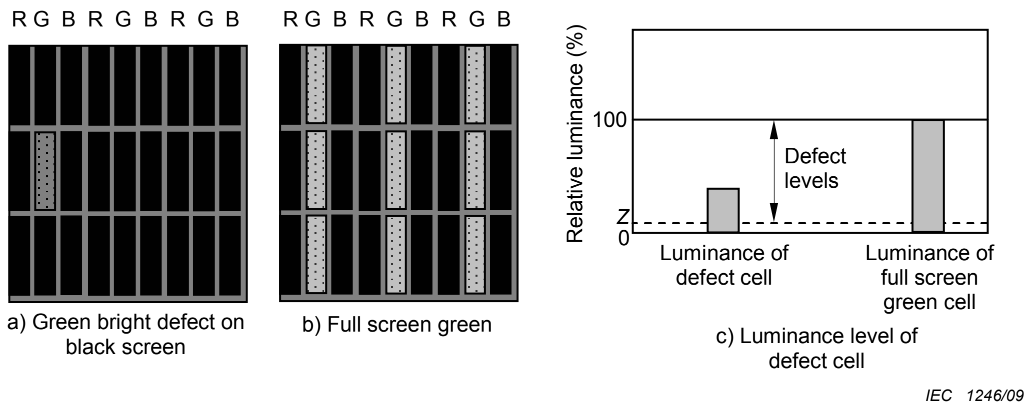


Figure 5 – Bright defect on black screen and its luminance level

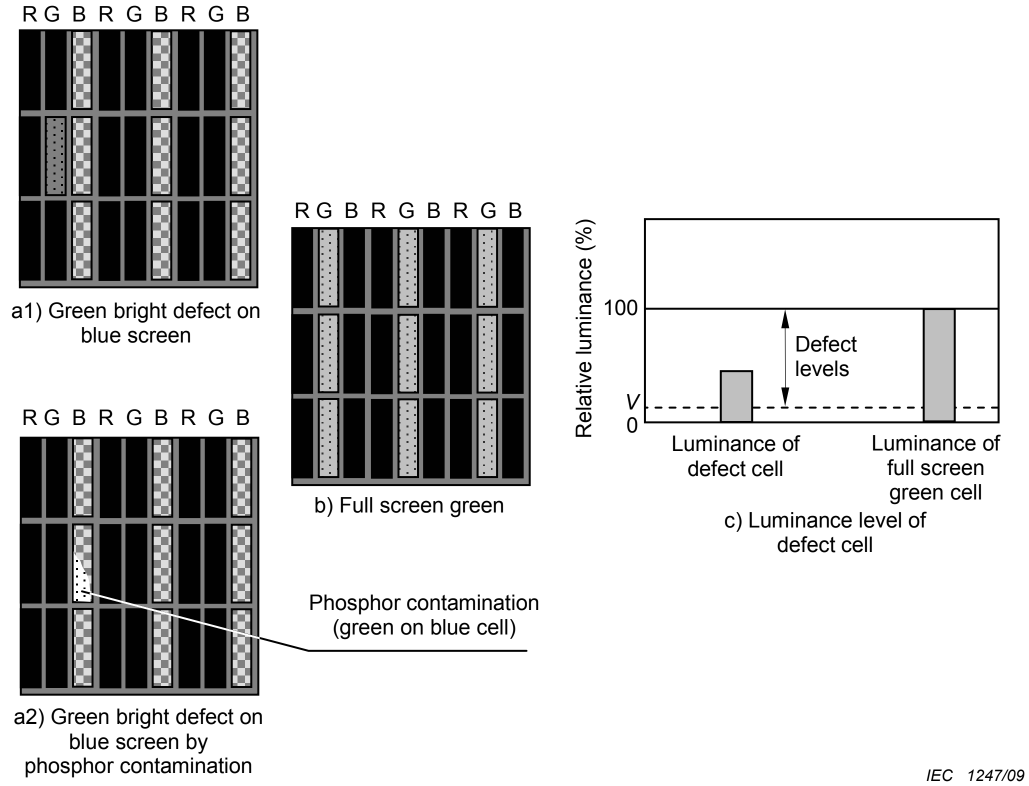


Figure 6 – Bright defect on other colour screen and its luminance level

Peak to peak luminance variation ratio of unstable cell, W_R W_G W_B: The peak to peak luminance variation of an unstable cell is greater than *W* % of the full screen R, G and B respectively.

The judgment whether a cell is a defect cell or not, is specified on the relevant specification.

5.1.7 Measuring procedure

Warm up the PDP module according to the procedure described in 4.3.2. The measurement shall be performed under dark-room conditions (see 4.2.1).

Applied input signals are full screen black, full screen white, full screen red, full screen green, and full screen blue. When different screen condition(s) are applied, they shall be reported.

Observed defect types on each screen are as follows:

– dark defect, bright defect and unstable cell on full screen white,
– bright defect and unstable cell on full screen black,
– bright defect, red dark defect and unstable cell on full screen red,
– bright defect, green dark defect and unstable cell on full screen green, and
– bright defect, blue dark defect and unstable cell on full screen blue.

Applied signal conditions and observed defect types are summarized in Table 1.

Input one of a full screen black, white, red, green and blue signals to the module. Each signal is described in Table 1. Observe cell defects and classify them to three types of cell defects. Record the number of three type cell defects. Observation area on the screen may be divided into two zones as shown in Figure 2. An input signal is changed to another signal after the observation of the cell defects of one signal is completed.

After the measurement of all input signals, record the total number of the defects and finish the measurement.

The record of cell defects may be summarized as Table 2.

Table 1 – Input signal for cell defect observation

Signal	Input signal level %			Observed defect of each colour (R, G, B)[a]			Display area
	Red	Green	Blue	Bright defect	Dark defect	Unstable cell	
Full screen black	0	0	0	R, G, B	-	R, G, B	Full screen
Full screen white	100	100	100	R, G, B	R, G, B	R, G, B	Full screen
Full screen red	100	0	0	R, G, B	R	R, G, B	Full screen
Full screen green	0	100	0	R, G, B	G	R, G, B	Full screen
Full screen blue	0	0	100	R, G, B	B	R, G, B	Full screen

[a] On black screen a dark defect (R, G, or B) is not observed, and a red dark defect is not observed on other colour (G or B) screen for an example.

Table 2 – An example record of cell defects

Signal	Bright defect			Dark defect			Unstable cell		
	Red	Green	Blue	Red	Green	Blue	Red	Green	Blue
Full screen black	1	0	2	-	-	-	0	0	1
Full screen white	0	0	0	2	1	3	2	2	(1)
Full screen red	0	1	0	(2)	-	-	0	0	1+(1)
Full screen green	0	0	0	-	2+(1)	-	(1)	(1)	(2)
Full screen blue	1	(1)	0	-	-	2+(3)	(2)	0	(1)
Total	2	1	2	2	3	5	2	2	2

NOTE The number in brackets is the count of previously measured same defects.

5.2 Image sticking

5.2.1 Purpose

The purpose of this method is to measure the image sticking of the PDP modules. We shall consider both the luminance and colour change during the measurement.

5.2.2 Measuring equipment

The following equipment shall be used:

a) driving power source;
b) driving signal equipment;
c) light measuring device.

5.2.3 Specification of image sticking

Image sticking is a general term that refers to a burned-in image, a ghost image or an image that decays slowly over time. This is measured after operating the PDP module for 1 h with a full white screen. See IEC 61988-1.

NOTE The 1h full white screen operation avoids confusion between image sticking and short term image retention that disappears quickly.

5.2.4 Measuring procedure

The PDP module shall be set in the standard measuring conditions and in the dark-room conditions. The layout diagram is shown in Figure 1.

Apply full screen white signal of level 100 % to the PDP module for 1 h, measure the initial luminance values and the initial chromaticity values at the measuring points P_0 to P_4 as shown in Figure 8, and then change to full screen red, green and blue in turn to measure the initial luminance values and the initial chromaticity values at the measuring points P_0 to P_4 as shown in Figure 8. Warm-up of the PDP module is not required here.

Apply white signal (*H*/5 . *V*/5) of level 100 % to the PDP module and maintain for the following selected time (8, 12, 24, 36, 48) hours (should be noted) in the standard measuring condition, the display pattern is shown in Figure 7. Afterwards, turn the PDP module power off and maintain for 1 h in the standard measuring condition.

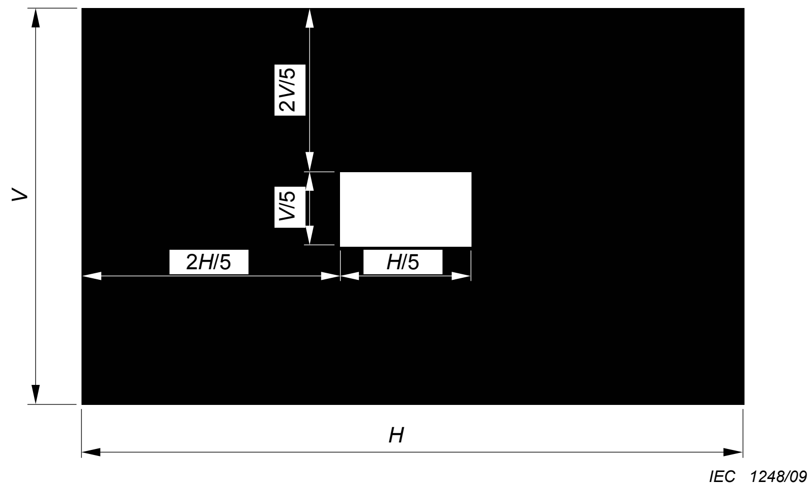


Figure 7 – Image sticking pattern

Apply full white signal of level 100 % to the PDP module for 1 h in the standard measuring condition, measure the final luminance values and the final chromaticity values at the measuring points P_0 to P_4 as shown in Figure 8, and then change to full screen red, green and blue in turn to measure the final luminance values and the final chromaticity values at the measuring points P_0 to P_4 as shown in Figure 8.

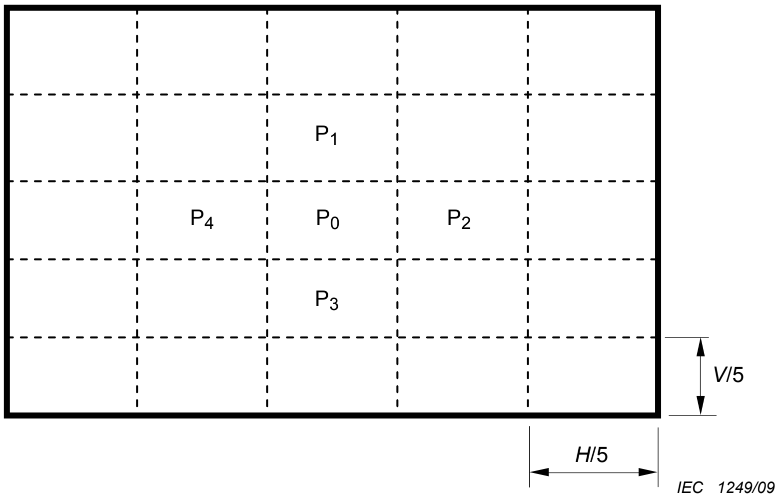


Figure 8 – Image sticking measuring position

The image sticking luminance ratio $IS_R(t)$, $IS_G(t)$, $IS_B(t)$ and $IS_W(t)$ for red, green, blue and white are as below:

$$IS_R(t) = \left(1 - \frac{L_{R,P0}(t) / L_{R,av}(t)}{L_{R,P0}(t_0) / L_{R,av}(t_0)}\right) \times 100\ \%$$

$$IS_G(t) = \left(1 - \frac{L_{G,P0}(t) / L_{G,av}(t)}{L_{G,P0}(t_0) / L_{G,av}(t_0)}\right) \times 100\ \%$$

$$IS_B(t) = \left(1 - \frac{L_{B,P0}(t) / L_{B,av}(t)}{L_{B,P0}(t_0) / L_{B,av}(t_0)}\right) \times 100\ \%$$

$$IS_W(t) = \left(1 - \frac{L_{W,P0}(t) / L_{W,av}(t)}{L_{W,P0}(t_0) / L_{W,av}(t_0)}\right) \times 100\%$$

where

$L_{R,P0}(t_0)$ is the luminance at the measuring point P0 of the full screen red before the image loading,

$L_{R,P0}(t)$ is the luminance at the measuring point P0 of the full screen red after the image loading for a loading period t,

$L_{R,av}(t_0)$ is the average luminance of 4 measuring points (P1, P2, P3 and P4) of the full screen red before the image loading,

$L_{R,av}(t)$ is the average luminance of 4 measuring points (P1, P2, P3 and P4) of the full screen red after the image loading for a loading period t, and t is the image loading time.

The image sticking chromatic deviation $(\Delta u'(t), \Delta v'(t))_R$, $(\Delta u'(t), \Delta v'(t))_G$, $(\Delta u'(t), \Delta v'(t))_B$, and $(\Delta u'(t), \Delta v'(t))_W$ at the measuring point P_0 for red, green, blue and white are as below:

$$(\Delta u'(t), \Delta v'(t))_R = (u'(t), v'(t))_R - (u'(t_0), v'(t_0))_R$$

$$(\Delta u'(t), \Delta v'(t))_G = (u'(t), v'(t))_G - (u'(t_0), v'(t_0))_G$$

$$(\Delta u'(t), \Delta v'(t))_B = (u'(t),v'(t))_B - (u'(t_0),v'(t_0))_B$$

$$(\Delta u'(t), \Delta v'(t))_W = (u'(t),v'(t))_W - (u'(t_0),v'(t_0))_W$$

where u' and v' are CIE 1976 UCS diagram coordinates defined in CIE 15.

The values of u' and v' can be calculated from those of x and y using following equations:

$$u' = 4x / (3 - 2x + 12y);$$
$$v' = 9y / (3 - 2x + 12y);$$

where x and y are CIE 1931 chromaticity coordinates.

The measuring result should be summarized in a table. Table 3 shows an example.

When the initial chromatic non-uniformity among these points is large compared to the chromatic difference, then the chromatic change at the measuring point P_0 shall be noted on the report.

See IEC 61988-2-1 for optical measurement for calculating chromatic uniformity.

NOTE The measuring method of spatial non-uniformity in IEC 61966-5 can be referred.

Table 3 – Example of image sticking coefficient measurement (full screen red)

	P_0	P_1	P_2	P_3	P_4
$L_{R,P0}(t_0)$ cd/m^2					
$L_{R,P0}(t)$ cd/m^2					
$L_{R,av}(t_0)$ cd/m^2					
$L_{R,av}(t)$ cd/m^2					
$IS_R(t)$ %					
$(x(t_0),y(t_0))_R$					
$(x(t),y(t))_R$					
$(u'(t_0),v'(t_0))_R$					
$(u'(t),v'(t))_R$					
Initial chromatic non-uniformity (Compare with P_0)	------------				
$(\Delta u'(t), \Delta v'(t))_R$		--			

5.3 Luminance lifetime

5.3.1 Purpose

The purpose of this method is to measure the luminance lifetime of the PDP modules.

NOTE During life time measurement the colour of the PDP modules may change, no adjustment needed.

5.3.2 Measuring equipment

The following equipment shall be used:

a) driving power source;

b) driving signal equipment;

c) light measuring device.

5.3.3 Measuring procedure

The PDP module shall be set in the standard measuring conditions. The dark-room conditions shall be applied when the luminance is measured. The layout diagram is shown in Figure 1.

Apply full screen input signal set at 15 % of white level without gamma correction or equivalent input level when gamma correction is used. Operate the module one day under these conditions for stabilization (see Figure 9). Measure the initial luminance for time zero at the point P_0 as shown in Figure 8. Keep the above operating conditions and measure the luminance of point P_0 at specified time. The specified time may be 1, 2, 5, 10, 20, 50, 100, 200, 500, 1 000 and 2 000 days.

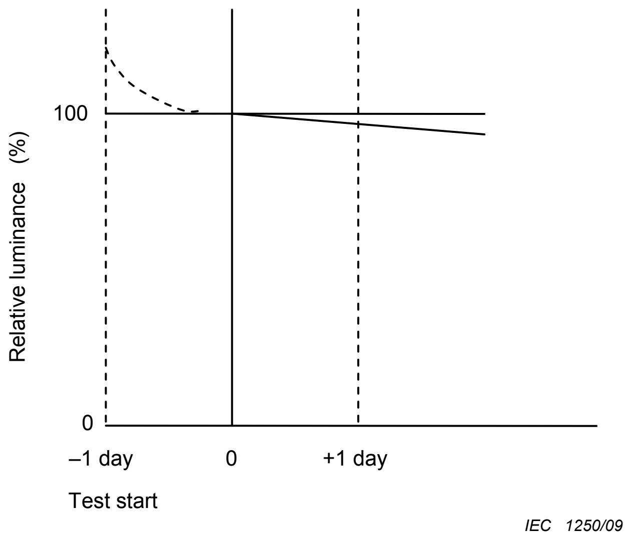
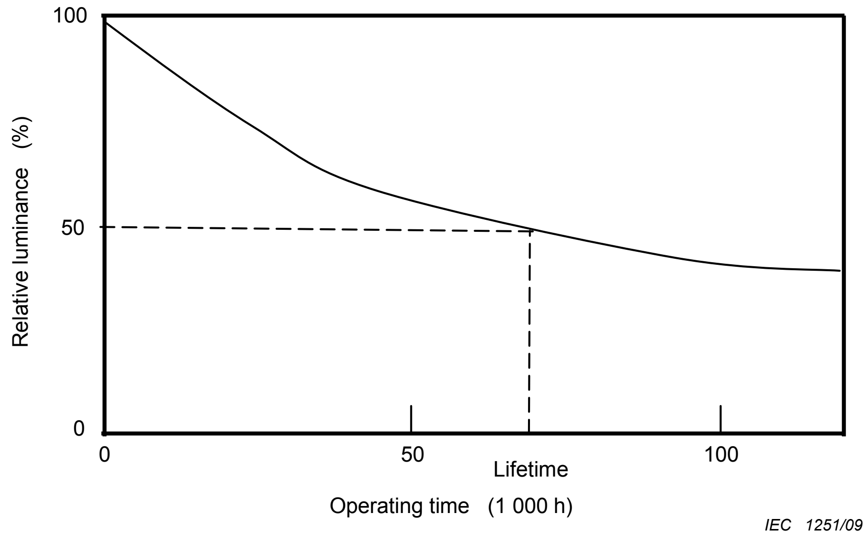


Figure 9 – Stabilization of luminance lifetime measurement

The luminance lifetime is the time when the luminance of the PDP module becomes 50 % of its initial value at time zero, as shown in Figure 10.



NOTE 1 Input signal of 15 % full white is estimated as the average input signal level of TV program.

NOTE 2 Chromaticity should be measured as a reference.

Figure 10 – Example of luminance lifetime measurement

In the measuring of luminance lifetime, some acceleration method may be acceptable. If any acceleration method is applied, the acceleration condition, the acceleration ratio and the theoretical basis of the method shall be reported.

Annex A
(informative)

Luminance lifetime estimation

A.1 General

The measurement of luminance lifetime needs very long time for the reason that the luminance lifetime usually exceeds several ten thousand hours. Acceleration method and extrapolation method are applied to shorten the measuring period. Luminance lifetime is a degradation phenomenon on light emitting mechanism of a PDP. Acceleration method is applied to accelerate the degradation phenomenon under accelerating conditions. Extrapolation method is applied to estimate the lifetime by using a degradation time formula. Both methods are based on the knowledge of the phenomenon.

A.2 Acceleration method

Acceleration method of luminance lifetime is explained by using an example, where the accelerating conditions of the luminance degradation of PDPs are experimentally determined as follows:

a) luminance input level is in proportion to the speed of luminance degradation as shown in Figure A.1 and A.2;

b) average temperature of the PDP has little affect on the degradation;

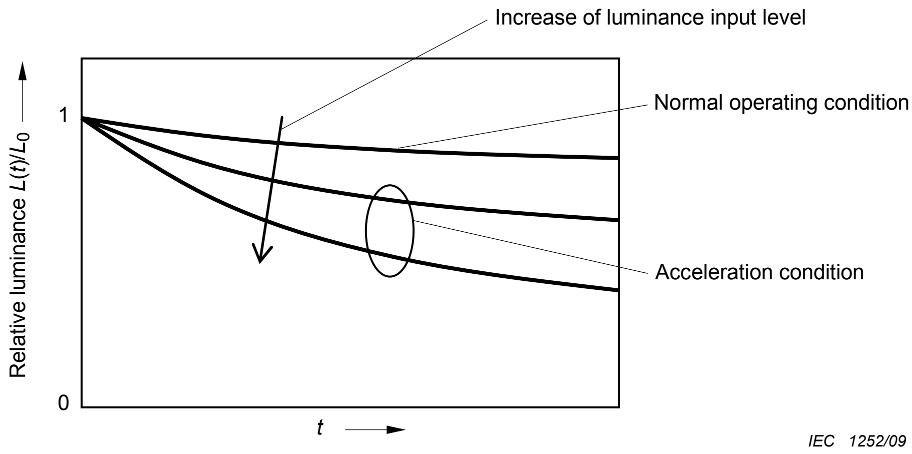
c) partial heating of the panel have an affect on the degradation, but the affect is very complex and difficult to be simplified; and

d) other conditions have only a little affect on the degradation.

NOTE Accelerating conditions of each PDP module may be different, as the panel design, panel materials and driving method are different in the module.

In this case, the acceleration may be carried under high luminance condition. Luminance lifetime is defined as an operating time when the luminance of the PDP module reaches to the half value of its initial value under an operating condition with a signal input of full screen 15 % white level without gamma correction and auto power control, i.e. normal operating condition. When a signal input of full screen 60 % white level is applied without auto power control, the luminance input level is five times larger and the luminance degradation speed is five times faster. The measuring period of the luminance lifetime becomes one fifth of the time under the normal operating condition.

NOTE When the affect of partial heating is clarified, window acceleration (using higher luminance window pattern, i.e. higher acceleration condition) may be applied.



Key

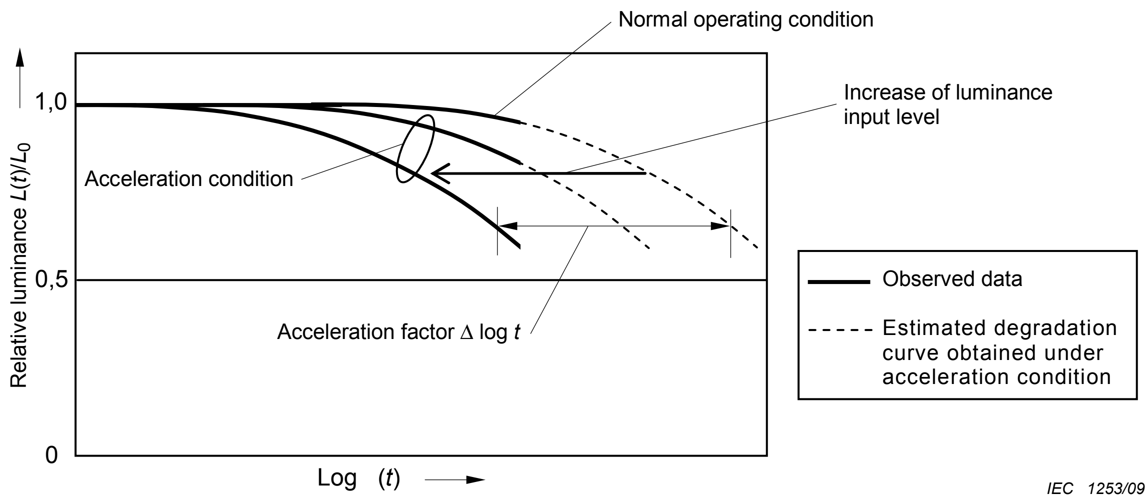
t operating time

L(*t*) luminance at *t*

L_0 initial luminance

The speed of luminance degradation increases by luminance input levels.

Figure A.1 – An example of luminance degradation under different luminance conditions



Key

t operating time

L(*t*) luminance at *t*

L_0 initial luminance

The shape of luminance degradation curve under each luminance input level keeps same and moves to shorter time region by the increase of luminance input level. Acceleration factor $10^{(\Delta \log t)}$ is in proportion to the ratio of luminance input level.

Figure A.2 – Luminance degradation on log *t* axis

Acceleration ratio is limited by the limit of applicable luminance input level. When an acceleration ratio of 10 times is applied, the test period of several ten thousand hours under normal conditions is reduced to several thousand hours. Even then the test period is too long. An extrapolation method may be applied.

A.3 Extrapolation method

Extrapolation method may be applied, when the degradation formula is determined. Usually degradation phenomena show exponential degradation as following:

$$A(t) = A_0 \exp -(t/\tau)$$

In which

t is the operating time,

$A(t)$ is the physical value of the degradation phenomena at time t,

A_0 is the initial value of A(t), and

τ is the constant (relaxation time).

But in the case of luminance degradation of PDPs, this formula does not coincide with the observed result. Other formula should be chosen to apply. W. Lehman (J. Electrochem. Soc.,130,426 ,1983) introduced following formula to the luminance degradation of fluorescent lamps and in some cases this formula coincides with the luminance degradation of PDPs.

$$L(t) = L_0 \exp -(t/\tau)^{1/2}$$

In which

t is the operating time,

$L(t)$ is the physical value of the degradation phenomena at time t,

L_0 is the initial value of $L(t)$, and

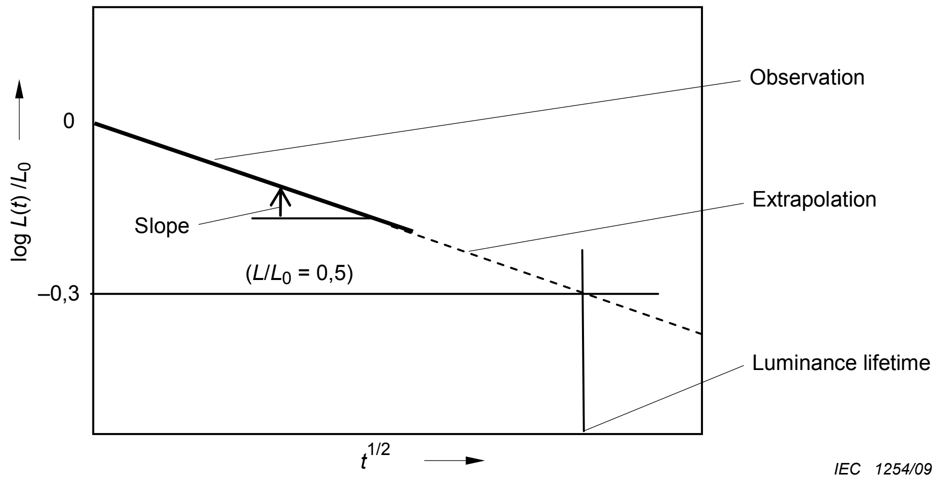
τ is the constant.

In this formula, there is a linear relation between log $L(t)$ and $t^{1/2}$ as follows;

$$\log L(t) = -(t/\tau)^{1/2} + \log L_0$$

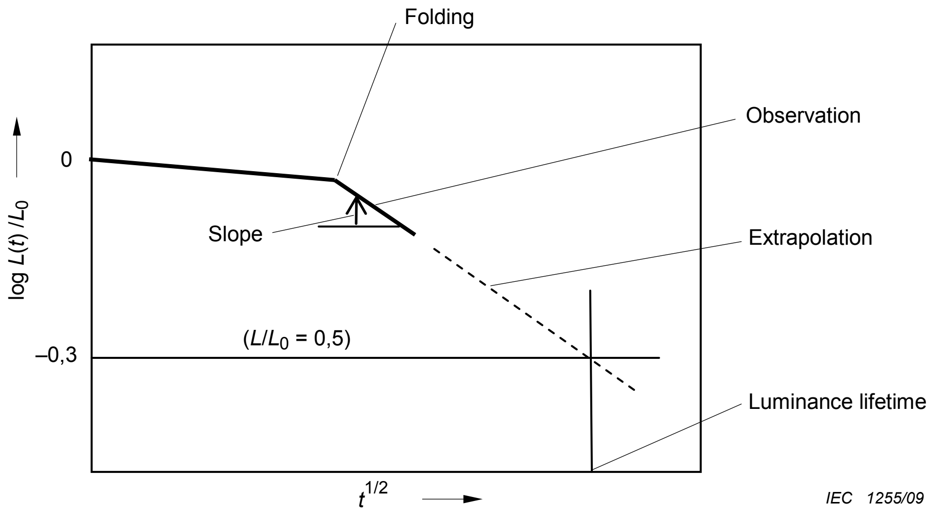
And the relation appears as a linear line on a log $L(t)$ vs. $t^{1/2}$ graph. Figure A.3 and Figure A.4 show examples of log $L(t)$ vs. $t^{1/2}$ graphs of luminance degradation of PDPs. The relation appears as a straight line or a snapped line on the graph. When the slope of the line on longer period and /or the position of the folding are observed, the estimation of the luminance lifetime is allowed.

Usually the time, when the luminance degradation shows the folding on the graph, is several thousand hours in the normal lifetime measuring method. It is also too long and the combination of acceleration method and extrapolation method are applied.



When the slope is determined, the lifetime estimation may be applied.

Figure A.3 – Luminance degradation on *L(t)* vs. $t^{1/2}$ axis (an example of straight line)

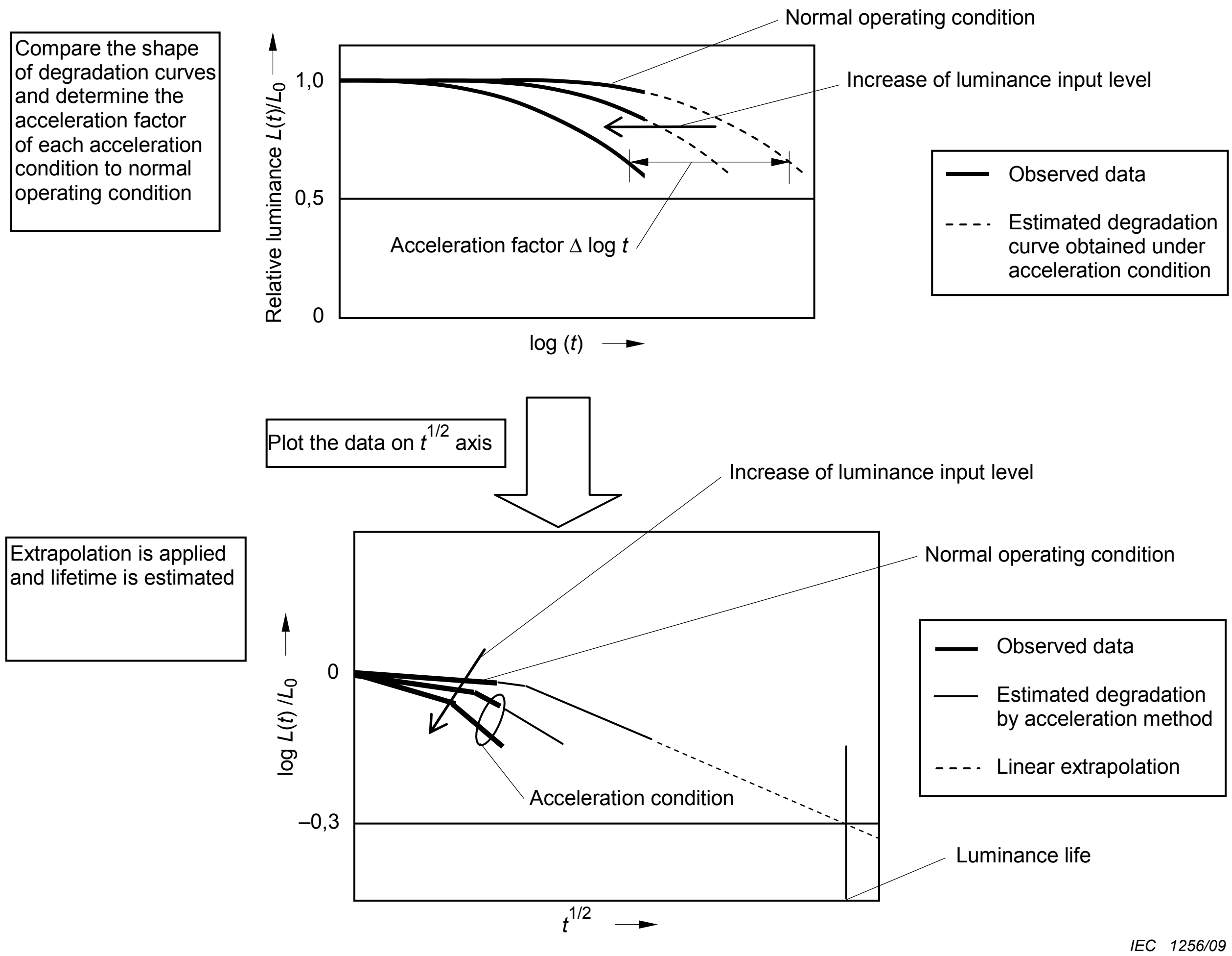


When the position of the folding and the slope are determined, the lifetime estimation may be applied.

Figure A.4 – Luminance degradation on *L*(*t*) vs. $t^{1/2}$ axis

A.4 Estimation of luminance lifetime

In this example, at first acceleration method is applied to measure the folding and the slope of the line on longer period. Then extrapolation is applied and the luminance lifetime is determined as shown in Figure A.5.



Key

t operating time

$L(t)$ luminance at *t*

L_0 initial luminance

Combination of acceleration method and extrapolation method.

Figure A.5 – Flow of luminance lifetime estimation

Bibliography

IEC 61966-5, *Multimedia systems and equipment – Colour measurement and management – Part 5: Equipment using plasma display panels*

IEC 61988-2-2:2003, *Plasma display panels – Part 2-2: Measuring methods – Optoelectrical*

W. Lehmann: J. Electrochem. Soc.,130, 426 (1983)

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