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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Plasma display panels –
Part 4-2: Environmental testing methods – Panel strength

Panneaux d'affichage à plasma –
Partie 4-2: Méthodes d'essais d'environnement – Résistance des panneaux

IEC 61988-4-2:2012

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CONTENTS

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PLASMA DISPLAY PANELS –

Part 4-2: Environmental testing methods – Panel strength

FOREWORD

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International Standard IEC 61988-4-2 has been prepared by IEC technical committee 110: Electronic display devices.

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

FDIS	Report on voting
110/354/FDIS	110/369/RVD

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

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

A list of all the parts in the IEC 61988 series, published under the general title *Plasma display panels*, can be found on the IEC website.

Future Part 4-x standards in this series will include the new title component: *Environmental testing methods*, as cited above. Titles of existing Part 4-x standards in this series will be updated accordingly at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

PLASMA DISPLAY PANELS –

Part 4-2: Environmental testing methods – Panel strength

1 Scope

This part of IEC 61988 defines testing methods for evaluating mechanical characteristics of plasma display modules (PDP modules) in the following areas:

a) Ball drop breaking strength of panels;

b) Partial heating strength of panels.

2 Normative references

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.

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

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

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

IEC 61988-4, *Plasma display panels – Part 4: Climatic and mechanical testing methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-1 and IEC 61988-1 and the following apply.

3.1
ball drop breaking strength
breaking strength against a ball drop impact measured as a breaking drop height using a ball whose weight and material are previously determined

3.2
rubber heater
soft and flexible sheet (generally made from thermally conductive rubber) in which electric heating element is molded

Note 1 to entry: Temperature uniformity of rubber heater is obtained by the layout of heating wire in the sheet and its material.

3.3
partial heating strength
mechanical strength under a thermal stress caused by heating a limited area of panel

Note 1 to entry: Still images including bright small part(s) located near screen edge surrounded by dark background emulate significant partial heating at the bright part(s). In some cases, the thermal stress breaks the panel. Luminous efficacy and heat radiation design affect the thermal stress.

4 Structure of measuring equipment

The system diagrams and/or driving conditions of the measuring equipment shall comply with the structure specified in each item.

5 Standard measuring conditions

Measurements shall be carried out under the standard environmental conditions defined in IEC 61988-2-1, i.e. at a temperature of 25 °C ± 3 °C, a relative humidity of 25 % to 85 % and a pressure of 86 kPa to 106 kPa. PDP modules and PDP panels to be measured shall be kept in off-state and in the environmental conditions until they reach the stable temperature. When different conditions are used, these shall be noted on the report.

The standard reference atmosphere defined in IEC 61988-4, i.e. 25 °C and 101,3 kPa, is applied.

6 Measuring methods

6.1 Ball drop strength

6.1.1 Purpose

The purpose of this method is to measure the impact strength of screen of a PDP module using ball drop.

6.1.2 Measuring equipment

The following equipment shall be used:

a) ball;

NOTE 1 Three kinds of smooth steel balls with the weights of 5,6 g, 8,3 g and 533 g are used.

b) height scale; and

c) others when used.

NOTE 2 For example a drop guide, which is a straight plastic pipe, whose inner radius is larger than the radius of ball, and has side holes at the drop heights, can be used.

6.1.3 Applicability

This measurement can be applied to PDP module and PDP panel. In the case that modules use directly laminated filter, the modules should be measured with the directly laminated filter.

6.1.4 Measurement layout

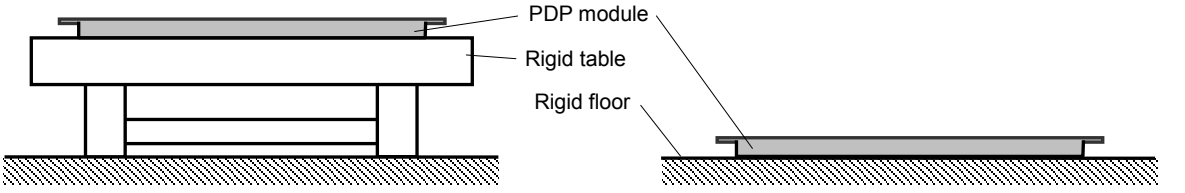
The PDP module shall be set on a rigid table or a rigid floor with the screen upward and horizontal avoiding free movement and vibration as shown in Figure 1, or Figure 2 by using rigid spacers.

In the case of a PDP panel, the panel shall be set on a measurement base with the screen upward and horizontal as shown in Figure 3, avoiding free movement and vibration. The measurement base and the cushion sheets should be the chassis and the bonding material(s)/adhesive sheets respectively, or well-defined ones. The details of the measurement base and the sheets shall be noted on the report. Non-adhesive sheets may be put on the adhesive sheets, avoiding free movement and vibration, when the sheets do not

affect the measurement result. In the case of a panel on which a directly laminated optical filter will be applied, the panel should be measured with the filter.

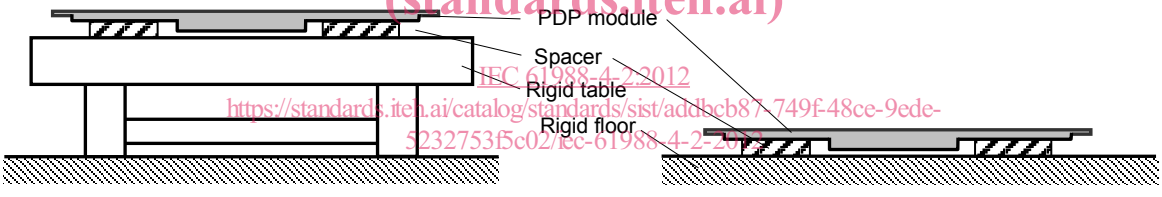
Hereafter in 6.1, the term “PDP module” means also PDP panel set on the measurement base as shown in Figure 3.

A height scale shall be set to measure the drop height as shown in Figure 4. The measuring layout applied shall be noted on the report with the details.



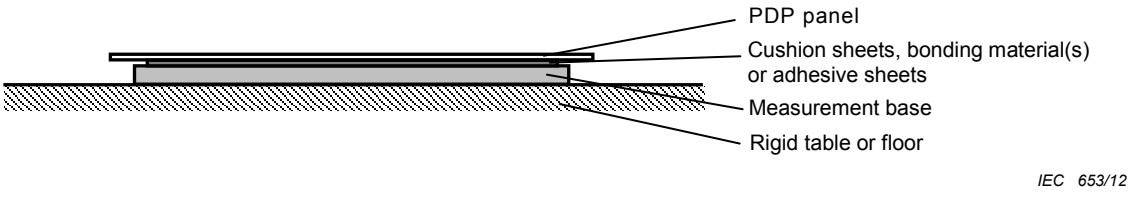
NOTE The screen of PDP module is set in a horizontal plane and upward. In the case using direct laminated optical filter, the module is measured with the filter.

Figure 1 – Setting of PDP module (side view)



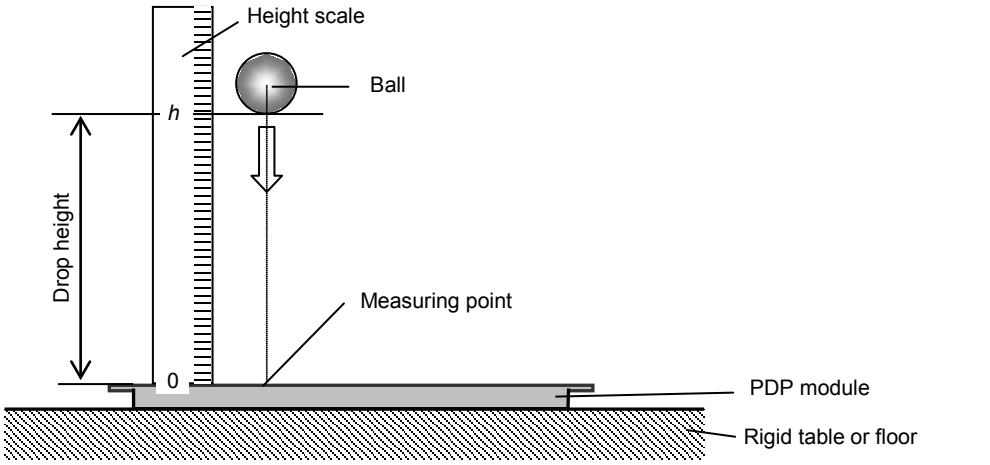
NOTE The screen of PDP module is set in a horizontal plane and upward.

Figure 2 – Setting of PDP module using spacers (side view)



NOTE The screen of the PDP panel is set in a horizontal plane and upward. Non-adhesive sheets can be put on the adhesive layer when the sheets do not affect the measurement result.

Figure 3 – Setting of PDP panel (side view)



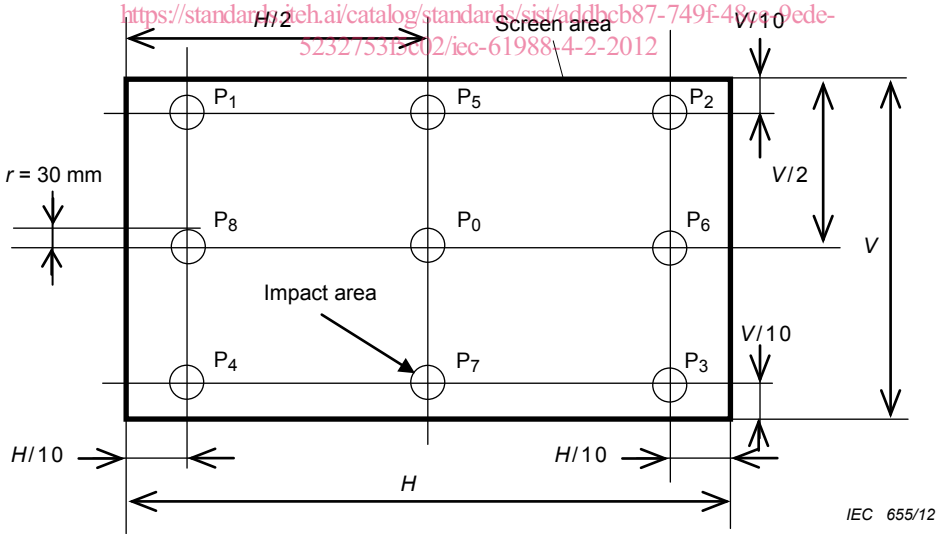
Key

h drop height at which the ball is released

Figure 4 – Measuring layout of ball drop strength (side view)

6.1.5 Measuring point

The measurement shall be carried out at the specified 9 points or 5 points P_i (where *i* is 0 to 8 or 0 to 4) on the screen area as shown in Figure 5. The ball drop impact shall be applied in the screen area and in the circle having a radius of 30 mm and a centre at each specified point. When other measuring points are measured, it shall be noted on the report.



NOTE P_0 to P_8 are measuring points. *H* and *V* are the horizontal and vertical width of the screen respectively.

Figure 5 – Measuring points

6.1.6 Ball and drop height

The weight of ball shall be selected from Table 1. The ball shall have a smooth and hard surface made of steel. The weight of applied ball shall be noted on the report. Drop heights for each ball are listed in Table 1.

The minimum drop height, at which no damage is expected, should be selected from the drop height list in Table 1. When other kinds of ball and drop heights are applied, it shall be noted

on the report. When the drop height exceeds 1 m, a drop guide may be used. The drop guide may be a straight plastic pipe, whose inner radius is larger than the radius of ball, and which has side holes at the drop heights listed in Table 1. Some special protections from the scattered broken glass pieces should be used especially near the maximum height.

Table 1 – Ball and drop height

Weight g	Diameter ϕ mm	Drop height mm	Maximum height mm
5,58	11,1	100, 200, 300, 400, 500, 600, 700, 800, 900, 1 000, 1 100, 1 200, 1 300, 1 400 and 1 500	1 500
8,33	12,7	100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1 000, 1 100, 1 200, 1 300, 1 400 and 1 500	1 500
533	50,8	10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190 and 200	200

6.1.7 Measuring procedure

The PDP module shall be set in the standard measuring conditions. The measuring layout is shown in Figure 4. The measurement shall be done as follows:

a) Set the drop-ball at the selected minimum drop height over the measuring point P_0.

b) Drop the ball in the circle at P_0 from the drop height.

c) Catch the ball after the first impact, if possible, for preventing the second impact.

d) Observe the measuring point to find any damage by the impact.

   1) When no damage is observed, repeat the measurement from a) increasing the drop height until any damage is observed or the ball drop from the maximum height has been done. When no breakage is occurred at the maximum height, it shall be noted on the report e.g. “no breakage at maximum height 1 500 mm.”

   2) When panel breakage occurs, record the breaking height on the report. The size of broken area and the breakage shape should be recorded. Pictures of the broken area may be included in the report.

e) Change the measuring point and repeat the measurement from a) until measurements of all measuring points are finished. In the case that the size of broken area is large and/or the drop impact is large, the panel strength of neighbouring area is usually decreased. When the damage and/or the panel breakage affects the panel strength of next measuring point, change to a new module and continue the measurement from the next measuring point.

When another measuring procedure is applied, it shall be noted on the report.

6.2 Partial heating strength

6.2.1 Purpose

The purpose of this method is to measure the breaking thermal stress of a PDP panel by partial heating.

6.2.2 Measuring equipment

6.2.2.1 List of measuring equipment

The following equipment shall be used:

a) rubber heater;

b) temperature control unit (including heater power source);

c) thermometer;

d) thermal sensor (e.g. thermocouple); and

e) thermal insulators.

NOTE Paper cups are good thermal insulators for this measurement.

6.2.2.2 Rubber heater

A 200 mm × 200 mm sheet-type rubber heater is used for this measurement. The rubber heater shall have properties as follows:

a) a square shape with the size of 200 mm × 200 mm;

b) a thickness below 10 mm;

c) good temperature uniformity;

d) maximum temperature limit of over 150 °C;

e) light weight; and

f) soft.

NOTE The rubber heater is usually made of silicone rubber.

The detail of applied rubber heater shall be noted on the report.

6.2.2.3 Temperature control unit, thermometer and thermal sensor

The temperature rise of rubber heater is controlled by the temperature control unit. The temperature of the rubber heater shall be monitored by a built-in thermal sensor or a film-type thermal sensor set on the heater. The variables of temperature control unit shall be preset for smooth temperature rise in time of the heater.

The temperature of PDP panel should be measured using other film-type thermal sensor set on the screen near the centre of the heating area or in the uniform temperature area as shown in Figure 7. The connecting wire of the thermal sensor shall be thin enough not to affect the temperature uniformity of the heating area. Unnecessary vibration and deformation of the connecting wires shall be avoided for the stable measurement. As long as smooth temperature rise is established, the thermal sensor set on the screen can be used also as the temperature monitor of the control unit.

The accuracy of thermometer shall be checked before the measurement. The type of applied thermal sensor shall be noted on the report with its detailed specification especially the temperature accuracy.

6.2.3 Measuring environmental conditions

Standard measuring conditions shall be applied. Direct and/or fast air flow to the panel shall be avoided. When other conditions are applied, they shall be noted on the report.

6.2.4 Measuring layout

The PDP panel shall be set on the thermal insulators with the screen upward and horizontal as shown in Figure 6. The positions and the numbers of thermal insulators should be chosen to avoid any obvious bend of the panel. The rubber heater shall be set at a side edge centre of the screen of the panel, aligning the edge of the heater to the screen edge. One of the thermal sensor s shall be set at a measuring position using heatproof adhesive tape, if necessary, to fix the position of the thermal sensor for temperature measurement as shown in Figure 7. If a rubber heater having no built-in thermal sensor is used, an external thermal sensor should be mounted on the outer side of the heater for the temperature monitor of the heater, using heatproof adhesive tape as shown in Figure 7. The position of the external thermal sensor shall be determined to obtain smooth temperature rise. The connecting wire of