

# INTERNATIONAL STANDARD



Electronic paper displays –  
Part 4-2: Environmental test methods

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRONIC PAPER DISPLAYS –**

**Part 4-2: Environmental test methods**

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International Standard IEC 62679-4-2 has been prepared by IEC technical committee 110: Electronic display devices.

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

CDV	Report on voting
110/730/CDV	110/773A/RVC

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.

A list of all parts in the IEC 62679 series, published under the general title *Electronic paper displays*, can be found on the IEC website.

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

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# ELECTRONIC PAPER DISPLAYS –

## Part 4-2: Environmental test methods

### 1 Scope

This part of IEC 62679 specifies the environmental conditions to determine the environmental reliability of electronic paper display (EPD) panels and/or modules for storage under the assumed usage environment. The scope of this document is restricted to EPDs using either segment, passive, or active matrix with either monochromatic or colour type displays. The measuring methods are intended for EPDs operated in a reflective mode.

### 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 62679-1-1, *Electronic paper displays – Part 1-1: Terminology*

IEC 62679-3-1, *Electronic paper displays – Part 3-1: Optical measuring methods*

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

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IEC 60068-2-38:2009, *Environmental testing – Part 2: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

CIE 085-1989, *Solar spectral irradiance*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62679-1-1, IEC 60068-1 and the following apply.

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

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

#### 3.1

##### air mass

path length that light from a celestial object takes through the earth's atmosphere relative to the length at the zenith where air mass = 1

Note 1 to entry: The air mass is  $1/\sin(\gamma)$ , where  $\gamma$  is the elevation angle of the sun.

#### 3.2

##### black standard temperature

temperature of an insulated stainless-steel plate, having a black coating



Note 1 to entry: The black standard temperature represents the maximum surface temperature of specimens exposed to radiation.

Note 2 to entry: The black coated surface absorbs at least 90 % of the incident radiation flux below  $\lambda = 2\,500$  nm.

Note 3 to entry: The plate is attached to a 5 mm thick baseplate made of a weather resistant polymer for the insulation.

### 3.3

#### black panel temperature

temperature of an un-insulated stainless-steel plate, having a black coating

Note 1 to entry: The back of the metal plate is open to the atmosphere.

### 3.4

#### solar constant

$E_0$

irradiance by the sunlight on a plane perpendicular to the incident radiation outside the earth's atmosphere at the mean earth-sun distance

Note 1 to entry: The value of the solar constant is  $E_0 = 1\,367$  W/m<sup>2</sup>.

### 3.5

#### optical depth

measure of how much light is absorbed when travelling through a medium

Note 1 to entry: A completely transparent medium has an optical depth of zero.

## 4 Measuring conditions (standards.iteh.ai)

### 4.1 Standard measuring environmental conditions

Measurements shall be carried out under the standard environmental conditions:

- temperature: 25 °C ± 3 °C,
- relative humidity: 25 %RH to 85 %RH,
- atmospheric pressure: 86 kPa to 106 kPa.

When different environmental conditions are used, they shall be noted in the measurement report.

### 4.2 Standard atmospheric conditions for reference measurements and tests

If the parameters to be measured depend on temperature, pressure and humidity and their dependence on temperature, pressure and humidity is unknown, the atmospheres to be specified shall be selected from the following values, as shown in Table 1. The selected values shall be noted in the relevant specifications.

**Table 1 – Standard conditions for reference measurements and tests**

Temperature <sup>a</sup> °C	Relative humidity <sup>a, b</sup> % RH	Air pressure <sup>a</sup> kPa
20, 25, 30, and 35 ± 3	45 to 75	86 to 106
<sup>a</sup> Including extreme values. <sup>b</sup> Absolute humidity ≤ 22 g/m <sup>3</sup> .		

## 4.3 Recovery conditions

### 4.3.1 General

After the conditioning period and before making the final measurements, the specimens should be allowed to stabilize at the ambient temperature, i.e. the temperature at which the measurements are to be made.

The controlled recovery conditions (see 4.3.2) shall be applied if the electrical parameters to be measured are affected by the absorbed humidity or surface conditions of the specimens and change rapidly, for example if the insulation resistance rises considerably within approximately 2 h after removal of the specimens from a humidity chamber.

If the electrical parameters of the specimens affected by the absorbed humidity or surface conditions do not vary rapidly, recovery may be carried out in the conditions of 4.2.

If recovery and measurements are performed in separate chambers, the combination of temperature and humidity conditions shall be such that condensation on the surface of the specimens does not occur when the specimen is transferred to the measurement chamber.

Most test procedures give the appropriate recovery conditions and duration. These conditions apply unless otherwise prescribed by the relevant specification.

### 4.3.2 Controlled recovery conditions

The controlled recovery conditions are as follows:

- Temperature: actual laboratory temperature  $\pm 1$  °C provided that it is within the limits fixed in 4.2, that is, between + 15 °C and + 35 °C.
- Relative humidity: between 45 % and 75 %.
- Air pressure: between 86 kPa and 106 kPa.
- Recovery period: to be stated in the relevant specification if different from that given in the appropriate method of test.

If, for specific cases, different recovery conditions are necessary, they shall be prescribed by the relevant specification.

### 4.3.3 Recovery procedure

The specimen shall be placed in the recovery chamber within 10 min of removal from the conditioning environment. Where the relevant specification requires measurements to be made immediately after the recovery period, these measurements shall be completed within 30 min of removal from the recovery chamber. Those characteristics which are expected to change most rapidly after the specimen is removed from the recovery atmosphere shall be measured first.

In order to prevent moisture being absorbed or lost by the specimen when removed from the recovery chamber, the temperature of the recovery chamber shall not deviate from the laboratory ambient temperature by more than 1 °C. This necessitates the use of a chamber having good thermal conductivity in which the relative humidity can be closely controlled.

## 5 Measuring methods of environmental properties

### 5.1 High temperature storage test

#### 5.1.1 Purpose

The purpose of this non-operational test is to measure the ability of EPD panels and modules to withstand high temperature in storage.

#### 5.1.2 Storage conditions

Standard measuring is implemented under the standard environmental conditions.

Temperature and duration time are as follows:

##### a) Temperature

The temperature shall be selected from the values given below depending on application. The temperature used shall be noted in the report.

(100, 95, 90, 85, 80, 75, 70, 65, 60, 55, 50, 45, 40, 35,  $30 \pm 3$ ) °C

##### b) Duration time

The duration shall be selected from the values given below depending on application. The duration used shall be noted in the report.

2 h, 16 h, 24 h, 48 h, 72 h, 96 h, 120 h, 168 h, 192 h, 240 h, 300 h, 500 h and 1 000 h

### 5.2 Low temperature storage test

#### 5.2.1 Purpose

The purpose of this non-operational test is to measure the ability of EPD panels and modules to withstand low temperature in storage.

#### 5.2.2 Storage conditions

Standard measuring is implemented under the standard environmental conditions.

Temperature and duration time are as follows:

##### a) Temperature

The temperature shall be selected from the values given below depending on application. The temperature used shall be noted in the report.

(–50, –45, –40, –35, –30, –25, –20, –15, –10, –5,  $0 \pm 3$ ) °C

##### b) Duration time

The duration shall be selected from the values given below depending on application. The duration used shall be noted in the report.

2 h, 16 h, 24 h, 48 h, 72 h, 96 h, 120 h, 168 h, 192 h, 240 h, 300 h, 500 h and 1 000 h

### 5.3 Temperature shock test – Two chambers

#### 5.3.1 Purpose

The purpose of this non-operational test is to measure the ability of EPD panels and modules to withstand rapid changes of ambient temperature.

#### 5.3.2 Storage conditions

Standard measuring is implemented under the standard environmental conditions.

The schematic diagram of temperature profile is shown in Figure 1.

Temperature, duration time, transition time and number of cycles are as follows:

a) High temperature

The temperature shall be selected from the values given below depending on application.

(100, 95, 90, 85, 80, 75, 70, 65, 60, 55, 50, 45, 40, 35,  $30 \pm 3$ ) °C

The temperature used shall be noted in the report.

b) Low temperature

The temperature shall be selected from the values given below depending on application.

(–50, –45, –40, –35, –30, –25, –20, –15, –10, –5,  $0 \pm 3$ ) °C

The temperature used shall be noted in the report.

c) Duration time

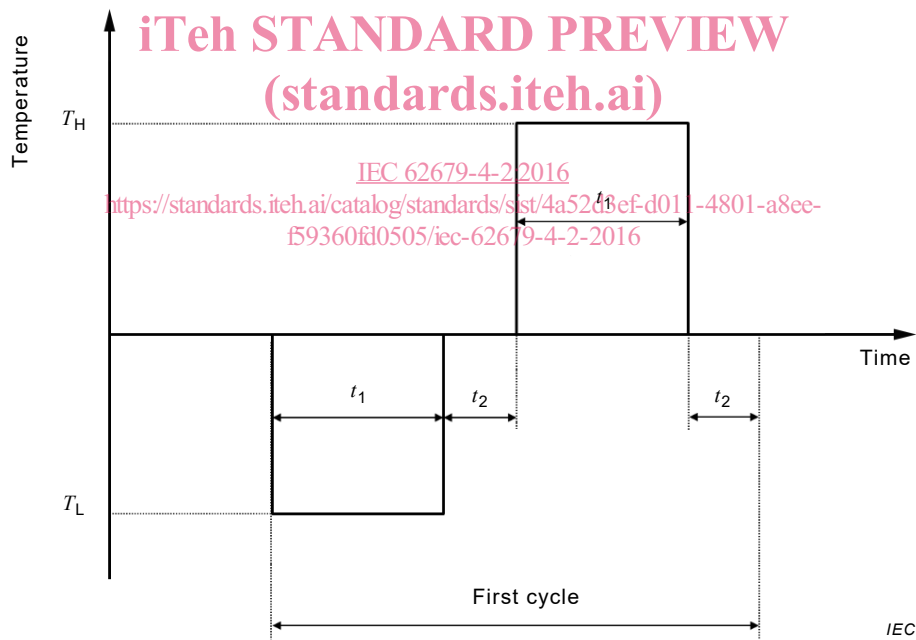
3 h, 2 h, 1 h, 30 min, 10 min

d) Transition time

2 min to 3 min, 20 s to 30 s, less than 10 s

e) Number of cycles

5 or 10



$T_H$  High temperature

$T_L$  Low temperature

$t_1$  Duration time

$t_2$  Transition time

Figure 1 – Temperature profile

5.4 Specified change rate test of temperature – One chamber

5.4.1 Purpose

The purpose of this non-operational test is to measure the ability of EPD panels and modules to withstand specified change rate of ambient temperature.