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INTERNATIONAL STANDARD

Flexible display devices –
Part 6-2: Environmental testing methods

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FLEXIBLE DISPLAY DEVICES –

Part 6-2: Environmental testing methods

FOREWORD

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International Standard IEC 62715-6-2 has been prepared by IEC technical committee 110: Electronic display devices.

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

FDIS	Report on voting
110/860/FDIS	110/871/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.

A list of all parts in the IEC 62715 series, published under the general title *Flexible display devices*, 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

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

FLEXIBLE DISPLAY DEVICES –

Part 6-2: Environmental testing methods

1 Scope

This part of IEC 62715 specifies testing methods for evaluating the environmental endurance of flexible display panels and modules for use, storage and transport under assumed usage environment. This part of IEC 62715 is applicable to flexible display panels and modules such as liquid crystal display devices (LCDs), electric paper display devices (EPDs), and organic light emitting diode display devices (OLEDs). This part of IEC 62715 will also be suitable for flexible panel or module with mechanical operation.

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 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 62341-6-2, *Organic light emitting diode (OLED) displays – Part 6-2: Measuring methods of visual quality and ambient performance*

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

IEC 62715-1-1, *Flexible display devices – Part 1-1: Terminology and letter symbols*

IEC 62715-5-1 [1], *Flexible display devices – Part 5-1: Measuring methods of optical performance*

IEC 62715-5-3[2], *Flexible display devices – Part 5-3: Visual assessment*

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1 Under preparation. Stage at the time of publication: IEC/FDIS IEC 62715-5-1:2017.

2 Under preparation. Stage at the time of publication: IEC/FDIS IEC 62715-5-3:2017.

IEC 62715-6-1, *Flexible display devices – Part 6-1: Mechanical stress test methods*

IEC 62679-3-2, *Electronic paper display – Part 3-2: Measuring method – Electro-optical*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62715-1-1 and IEC 60068-1 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

4 Structure of measuring equipment

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

5 Standard conditions

5.1 Standard reference atmosphere

The following conditions are applied:

– temperature: 25 °C

– air pressure: 101,3 kPa

NOTE No requirement for relative humidity is given because correction by calculation is generally not possible.

If the parameters to be measured depend on temperature and/or pressure, and their dependence on temperature and pressure is known, the parameter values can be measured under the conditions specified in 5.3 and corrected by calculation to the standard reference atmosphere above.

5.2 Standard atmospheric conditions for referee 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 referee measurements and tests

Temperature [a] °C	Relative humidity [b] % RH	Air pressure [b] kPa
20 ±2 / ±1 25 ±2 / ±1 30 ±2 / ±1 35 ±2 / ±1	45 to 75	86 to 106
[a] The close tolerances may be used for the referee measurements. The wider tolerances may be used only when allowed by the relevant specification. [b] Inclusive values.		

5.3 Standard atmospheric conditions for measurements and tests

Unless otherwise specified, all tests and measurements shall be carried out under standard atmospheric conditions:

– temperature: 15 °C to 35 °C
– relative humidity: 25 % to 85 %, where appropriate
– air pressure: 86 kPa to 106 kPa

5.4 Recovery conditions

The recovery conditions specified in IEC 60068-1:2013, 4.4, shall be applied.

The flexible panel or module shall be subjected to the recovery procedure in the chamber or otherwise as appropriate.

The flexible panel or module shall then remain under standard atmospheric conditions for recovery for a period adequate for the attainment of temperature stability, with a minimum of 1 h.

If required by the relevant specification, the panel or module shall be switched on or loaded and measured continuously during the recovery period.

If the standard conditions given above are not appropriate for the device to be tested, the relevant specification may call for other recovery conditions.

5.5 Standard atmospheric conditions for assisted drying

The conditions specified in IEC 60068-1:2013, 4.5, shall be applied.

Where assisted drying is required before commencing a series of measurements, the following conditions (see Table 2) shall be used for 6 h, unless otherwise prescribed by the relevant specification.

Table 2 – Assisted drying condition

Temperature	Relative humidity	Air pressure [a]
55℃ ± 2 ℃	Not exceeding 20 %	86 kPa to 106 kPa
[a] Inclusive values.		

If it is impracticable to carry out assisted drying under the standard conditions for assisted drying, a note, stating the actual conditions, shall be added to the test report. When the specified temperature for the dry heat test is lower than 55 °C, the assisted drying shall be carried out at that lower temperature.

5.6 Operating conditions

Apply a white level (100 % grey level) to the full screen of the flexible display panels or modules.

5.7 Standard flexible display test configuration

Unless otherwise specified, the flexible display panels or modules shall be tested in a state that is ready for normal operation without any protective elements added, nor voltage applied.

6 Measurements and analysis

The following items shall be evaluated at the beginning, after the cyclic bending test and after the final environment test:

a) Visual inspection

Visual inspection shall be performed according to IEC 62715-5-3.

b) Optical performance

Optical performance measurement shall refer to IEC 62715-5-1.

c) Image quality

Image quality measurement shall refer to IEC 62341-6-2 and IEC 62341-6-3. EPD measuring conditions refer to IEC 62679-3-2.

Depending on the purpose of the test, only one, some or all of the methods shall be used. The measuring frequency and evaluation criteria shall be specified in the detailed specifications.

7 Environmental testing methods

7.1 General

For the flexible panel or module, the mechanical cycling test should be done before the temperature and humidity test.

First and foremost, the flexible panel or module shall endure the cyclic bending tests. The bending radius and bending times are according to the product detail specification. The detailed cyclic bending test refers to IEC 62715-6-1.

After the bending test, the flexible panel or module shall be tested with the temperature and humidity. The temperature and humidity testing method is often used as one of several endurance testing methods. When the testing method defined in this document is used as one of these endurance testing methods, review the testing period and/or conditions appropriately as specified in the relevant specification. If the product is curved, it can go through the temperature and humidity test directly.

For the test of electrical operation, the operating conditions shall refer to 5.6.

Before the final measurements, the recovery procedure referred to in 5.4 should be completed.

The effect of simultaneous stress combination between the mechanical cycling test and the other tests shall be evaluated if necessary according to the specifications.

7.2 Storage at high temperature

7.2.1 Purpose

The purpose of this test is to check the performance of the flexible display panel and module after high temperature storage. The test procedure of IEC 60068-2-2 shall be applied.

7.2.2 Test conditions

Test Bb of IEC 60068-2-2 shall be applied with the following specific conditions.

Test Bb: Dry heat for non heat-dissipating specimens with gradual change of temperature.

a) Temperature

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

b) Duration time

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

The temperature and duration used shall be noted in the report.

7.3 Storage at low temperature

7.3.1 Purpose

The purpose of this test is to check the performance of the flexible display panel and module after low temperature storage. The test procedure of IEC 60068-2-1 shall be applied.

7.3.2 Test conditions

Test Ab of IEC 60068-2-1 shall be applied with the following specific conditions.

Test Ab: Cold for non heat-dissipating specimens with gradual change of temperature.

a) Temperature

(-50, -45, -40, -35, -30, -25, -20, -15, -10, -5, 0) °C ± 3 °C

b) Duration time

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

The temperature and duration used shall be noted in the report.

7.4 Temperature change, storage

7.4.1 Purpose

The purpose of this test is to check the ability of the flexible display panel and module to withstand either rapid change of temperature or specific change rate of temperature while the flexible display module is turned off. Test Na of IEC 60068-2-14 shall be applied to rapid change of temperature and Test Nb to the specified rate of temperature. The temperature and duration should be chosen based on specifications.

7.4.2 Rapid change of temperature

a) High temperature

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

b) Low temperature

(-50, -45, -40, -35, -30, -25, -20, -15, -10, -5, 0) °C ± 3 °C

c) Duration time

2 h, 1 h, 30 min, 10 min

d) Transition time

Less than 3 min

e) Cycle

5, 10, 20, or 30

7.4.3 Specified change rate of temperature

a) High temperature

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

b) Low temperature

(-50, -45, -40, -35, -30, -25, -20, -15, -10, -5, 0) °C ± 3 °C

c) Duration time

2 h, 1 h, 30 min, 10 min

d) Change rate of temperature

(1 ± 0,2) °C/min, (3 ± 0,6) °C/min or (5 ± 1) °C/min

e) Cycle

2, 5, 10, 20 or 30

7.5 Damp heat, steady state, storage

7.5.1 Purpose

The purpose of this test is to check the performance of the flexible display panel or module after temperature and humidity storage. The test procedure of IEC 60068-2-78 shall be applied.

7.5.2 Test conditions

IEC 60068-2-78 shall be applied with the following specific conditions.

a) Temperature

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

(60, 55, 50, 45, 40, 35, 30, 25, 20, 15, 10) °C ± 3 °C

b) Humidity

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

(10, 15, 20, 30, 80, 85, 90, 93) % RH ± 3 % RH

c) Duration time

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

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

The temperature, humidity and duration used shall be noted in the report (see Table 3).

Table 3 – Examples of the damp heat, steady state test conditions

	Temperature	Humidity	Duration	Note
H-L	55 ºC	30 % RH	168 h	Hot and dry
H-H	60 ºC	90 % RH	120 h	Hot and humid
L-H	10 ºC	80 % RH	120 h	Cold and humid
L-L	20 ºC	10 % RH	240 h	Cold and dry

7.6 Damp heat, cyclic, storage

7.6.1 Purpose

The purpose of this test is to check the performance of the flexible display module under conditions of high humidity, combined with cyclic temperature changes depending on application. The test procedure of IEC 60068-2-30 shall be applied.

7.6.2 Test conditions

IEC 60068-2-30 shall be applied with the following specific conditions.

a) High temperature

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

(60, 55, 50, 45, 40, 35) °C ± 3 °C

b) Low temperature

(25 ± 3) °C

c) Humidity

(93 ± 3) % RH

d) Cycle

The number of cycles shall be selected from the values given below depending on application.

1, 2, 5, 10, 20, 30 or 50

The temperature, humidity and cycle used shall be noted in the report.

7.7 Operation at high temperature

7.7.1 Purpose

The purpose of this test is to check the performance of the flexible display panel and module after operation at high temperature operating conditions. The test procedure of IEC 60068-2-2 shall be applied.

7.7.2 Test conditions

Test Bd or Be of IEC 60068-2-2 shall be applied with the following specific conditions.

The relevant specification shall define the test (Bd or Be) to be used.

Depending on the application, the combination of temperature and operating time should be considered.

Test Bd: Dry heat for heat-dissipating specimens with gradual change of temperature that are not powered during the conditioning period.

Test Be: Dry heat for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test.

a) Temperature

(80, 75, 70, 65, 60, 55, 50, 45, 40, 35, 30) °C ± 3 °C

b) Operating time

2 h, 4 h, 8 h, 12 h, 24 h, 48 h, 72 h and 96 h

c) Operating conditions

The operating conditions are specified in 5.6

The temperature and duration used shall be noted in the report.

7.8 Operation at low temperature

7.8.1 Purpose

The purpose of this test is to check the performance of the flexible display panel and module after operation at low temperature operating conditions. The test procedure of IEC 60068-2-1 shall be applied.

7.8.2 Test conditions

Test Ad or Ae of IEC 60068-2-1 shall be applied with the following specific conditions.

The relevant specification shall define the test (Ad or Ae) to be used.

Depending on application, the combination of temperature and operating time should be considered.

Test Ad: Cold for heat-dissipating specimens with gradual change of temperature that are powered after initial temperature stabilization.

Test Ae: Cold for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test.

a) Temperature

   (-30, -25, -20, -15, -10, -5, 0) °C ± 3 °C

b) Operation time

   2 h, 4 h, 8 h, 12 h, 24 h, 48 h, 72 h and 96 h

c) Operating conditions

   The operating conditions are specified in 5.6

The temperature and duration used shall be noted in the report.

7.9 Damp heat, steady state, operational

7.9.1 Purpose

The purpose of this test is to check the performance of the flexible display panel or module after operation at high temperature and high humidity operating conditions. The test procedure of IEC 60068-2-78 shall be applied

7.9.2 Test conditions

IEC 60068-2-78 shall be applied with the following specific conditions.

No condensation on the flexible display panel or module shall be generated.

IEC 60068-2-78 shall be applied with the following specific conditions.

Depending on application, the combination of temperature and operating time should be considered.

a) Temperature

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

   (60, 55, 50, 45, 40, 35, 30) °C ± 3 °C

b) Humidity

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

   (10, 15, 20, 30, 80, 85, 90, 93) % RH ± 3 % RH

c) Duration time

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

   2 h, 4 h, 8 h, 12 h, 24 h, 48 h, 72 h and 96 h

The temperature, humidity and duration used shall be noted in the report.

Bibliography

IEC 62341-6-1, *Organic light emitting diode (OLED) displays – Part 6-1: Measuring methods of optical and electro-optical parameters*

IEC 62679-4-2, *Electronic paper displays – Part 4-2: Environmental test methods*

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