

INTERNATIONAL STANDARD



**Flexible display devices –
Part 6-22: Crease and waviness measurement methods**

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FLEXIBLE DISPLAY DEVICES –

Part 6-22: Crease and waviness measurement methods

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

Draft	Report on voting
110/1491/FDIS	110/1503/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 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- withdrawn,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
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INTRODUCTION

The market for foldable display devices is growing rapidly, as shown in the new form factors for portable devices. It is expected that various foldable display devices will be released in the near future.

Typically, the cover for rigid displays is made of glass. A rigid glass cover protects the display panel from external shock and produces a surface uniformity without visual distortion. In order to utilize a foldable display, a thin and flexible cover is preferred rather than the thick general rigid cover. Although cover materials like thin films or plastics can be flexible, their surface is rougher and can crease more easily. Based on this expectation, there is an anticipation to standardize the measurement of surface creasing and waviness due to folding in order to evaluate the surface quality of foldable displays.

There is a wide variety of ways to analyse the surface of an object, and many of them are already standardized, [1] to [9]¹. In this document, two of the non-contact methods and one contact method using a probe are described, and the manner in which to report the values of crease and waviness of foldable displays from the measured data is specified.

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¹ Numbers in square brackets refer to the Bibliography.

FLEXIBLE DISPLAY DEVICES –

Part 6-22: Crease and waviness measurement methods

1 Scope

This part of IEC 62715 specifies the standard measurement conditions and methods for determining the surface crease and waviness for the evaluation of foldable displays. The measurement methods are used to specify the extent of geometrical distortions in foldable display surfaces. This document applies to foldable display panels and modules (e.g. in-folding and out-folding) with one axis.

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 (IEV) – Part 845: Lighting* (available at <<http://www.electropedia.org>>)

IEC 62341-1-2, *Organic light emitting diode (OLED) displays – Part 1-2: Terminology and letter symbols*

IEC 62341-6-2:2015, *Organic light emitting diode (OLED) displays – Part 6-2: Measuring methods of visual quality and ambient performance*

IEC 62715-5-3, *Flexible display devices – Part 5-3: Visual assessment of image quality and defects*

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

ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

ISO 16610-21, *Geometrical product specifications (GPS) – Filtration – Part 21: Linear profile filters: Gaussian filters*

ASME B46.1-2019, *Surface Texture (Surface Roughness, Waviness, and Lay)*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62341-1-2 and IEC 60050-845 and the following apply.

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

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

3.1.1

crease

permanent or temporary linear visual distortion or deformation in the screen due to folding

3.1.2

waviness

long wavelength variation in a surface away from its basic form

Note 1 to entry: Within small areas of the display, distortions can occur in what should be nominally straight features in images, characters, and symbols. This measurement characterizes the deviations from straightness.

3.1.3

folding area

curved section of the panel due to folding

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CCD	charge-coupled device
CMM	coordinate measuring machine
CMOS	complementary metal-oxide semiconductor
DUT	devices under test
LIDAR	light detection and ranging
PMD	phase measuring deflectometry
PSD	position sensitive detector

4 Standard atmospheric conditions

The standard atmospheric conditions specified in IEC 62715-6-1 shall apply as follows, unless otherwise specifically agreed between customer and supplier:

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

The temperature and humidity conditions shall be reported.

5 Preparation of specimen for measurement

5.1 General

In this document, the measurement object is called specimen, and the specimen consists of foldable panel, modules, adhesive, base plate and jig. The description of the specimen's components and how to configure them is specified in 5.3. All measurements shall be performed under non-operating conditions.

5.2 Visual examination

The foldable display panel is subjected to visual and dimensional checks under non-operating conditions and a functional check under operating conditions specified as follows:

- a) non-operating conditions: visual damage on the surface of the specimen shall be checked;
- b) operating conditions: visual assessment shall be done by the methods specified in IEC 62715-5-3.

Unless otherwise specified, visual examination shall be performed under the conditions and methods specified in IEC 62341-6-2:2015, 5.2.2.1.

NOTE The purpose of 5.2 is to check the surface damage or failure of the DUT before performing the measurement.

5.3 Specimen preparation

The conditions for the preparation of the specimen (e.g. plate, jig, number of cyclic folding tests, folding duration time) and its size shall be determined between the supplier and customer.

If a mechanical test (e.g. cyclic folding test) is performed in the process of preparing the specimen, the mechanical test method and condition shall be determined between the supplier and customer before the preparation of the specimen. This mechanical test specified in IEC 62715-6-1 and the test method and condition shall be reported.

NOTE 1 If the mechanical test is not performed in the process of preparing the specimen, the corresponding content in Table 1 will be empty.

The temperature, humidity, storage time prior to testing, and the delayed time between the specimen preparation and measurement can affect the crease and waviness, so the specimen preparation condition and delayed time shall be controlled and reported.

NOTE 2 If the foldable display panel is unfolded and the time is delayed, the measurement result of the crease and waviness can be smaller or alleviated due to the resilience of the panel. Therefore, the delayed time will be reported as illustrated in Table 1.

The order and process of preparing the specimen are described as illustrated in Figure 1, Figure 2, Figure 3, and Figure 4.

- a) Step 1: Preparing the components of the specimen: The foldable display panel should be unfolded after a specific duration time under the conditions which are reported in Table 1. The base plate shall be flat and bigger than the foldable display panel. The jig with a flat surface should be fixed to the base plate and have an adhesive on the top attached to the back of the panel. The panel holder is used to prepare the out-folding type panel. It is a tool to maintain the flatness of the panel while the jig is attached to the back of the panel in step 2 and step 3. The height of the panel holder should be high enough that the folding area does not touch the ground when the out-folding type panel is placed on it.

NOTE 3 Once the jig and the panel are attached, the panel holder is no longer necessary.

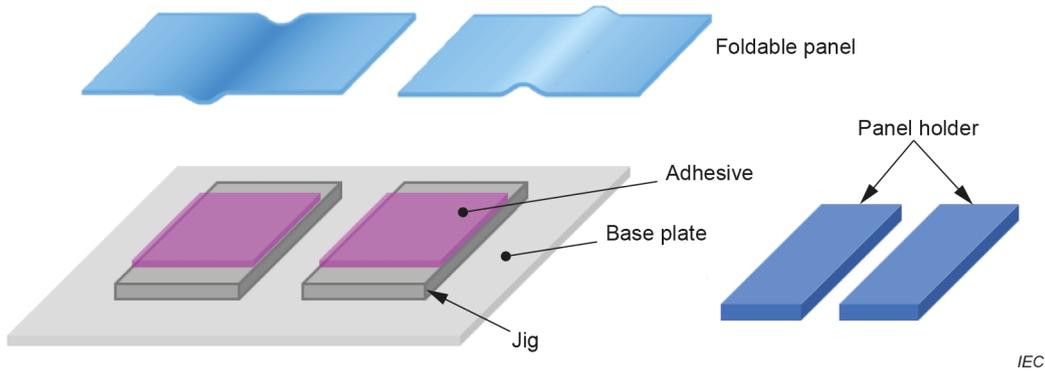


Figure 1 – Step 1: Preparing the components of the specimen

- b) Step 2: Turning the back of the panel to face upward: The method and location of the attachment should not affect the measurement. In order to eliminate the influence of tensile tension that can occur in the process of attaching the panel to the jig, the foldable panel shall be flipped so that the back of the panel faces upward. In other words, as shown in Figure 2, the light emitting surface of the panel is placed downward.

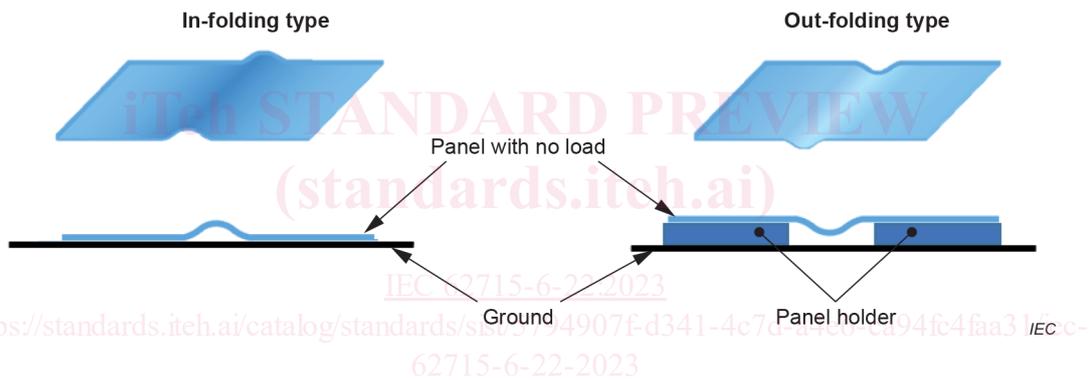


Figure 2 – Step 2: Turning the back of the panel to face upward

- c) Step 3: Turning over the base plate and attaching it to the back of the panel. The base plate shall also be flipped so that the adhesive surface faces downward. Then, lower the base plate from the top down and attach it to the back of the panel.

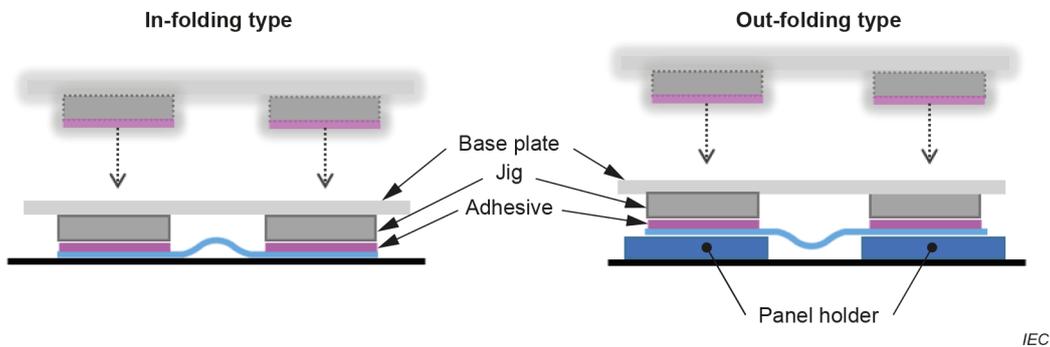


Figure 3 – Step 3: Turning over the base plate and attaching it to the back of the panel

- d) Step 4: Turning over the base plate with the panel attached. When the base plate with the foldable panel attached is turned over, the top of the panel to be measured faces upward and the specimen preparation is complete, as shown in Figure 4.