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INTERNATIONAL STANDARD

colour inside

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

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CONTENTS

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FOREWORD

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

FDIS	Report on voting
110/844/FDIS	110/867/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- withdrawn,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
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INTRODUCTION

This part of IEC 62715 was developed in response to demands for the standardization of the general rules and detailed procedures that are used in the visual assessment of flexible display devices.

Visual assessment is an essential means for evaluating flexible display devices and is intended to complement objective display measurements [1] [1]. The advantages of visual assessment are as follows:

a) It is speedy, e.g. defects are instantly recognized by a human observer.
b) It allows the evaluation of various device shapes and allows evaluation from various directions and distances, which can lead to higher sensitivity for detecting defects.
c) It completely covers the area of even the largest display, allowing identification and selection of regions of interest for objective measurements.
d) It is sensitive, e.g. for some defects, visual assessment is the most sensitive means of detection.
e) It corresponds to the perception of humans.
f) It can detect unexpected changes or defects that can be overlooked by predetermined measurements with equipment.

Visual assessment is a necessary first step for specifying types of measurements and the regions of interest for measurements.

Evaluation results from visual assessment depend on the observer, region of interest for the assessment, lighting and geometrical conditions of the assessment, criteria in making judgments, and various other factors. Therefore, it is important to standardize the general rules, including the terms, conditions, criteria and reporting of results from visual assessments.

Regarding the procedures for visual assessment of electronic display devices, the following standards can be consulted: IEC 62341-6-2 [6] and IEC 61747-20-3 [7].

Visual assessment is usually performed by comparing a test sample with a limit sample or a set of grade samples. This document stipulates the framework and procedures to be used in the assessments; it also describes the preparation of a limit sample or a set of grade samples.

This document also applies when a limit sample or a set of grade samples are not available for the same type of defect. Concerning defects of flexible display devices, many kinds of defects can be observed. Even within the same category of defect, factors, such as the shape, size, luminance, colour, gradation of the edge, width of the edge, solitary or repetitive, position in the display area, can differ. Therefore, in most cases, it is practically impossible to prepare the same type of limit sample or comparison samples for visual assessment.

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1 Numbers in square brackets refer to the Bibliography.

FLEXIBLE DISPLAY DEVICES –

Part 5-3: Visual assessment of image quality and defects

1 Scope

This part of IEC 62715 provides the framework and procedures for performing the visual assessment of flexible display devices.

Visual assessment stipulated in this document is applicable to flexible display modules in the following states:

– initial states and ageing states under standard ambient conditions,
– mechanically or environmentally stressed conditions,
– states after mechanical endurance test(s), after environmental endurance test(s) and after a combination of mechanical and environmental endurance tests.

NOTE Visual assessment under the mechanical or environmental stress is usually difficult to do, but this document can be applied when it is possible.

Visual assessment is performed by comparing a test sample to a limit sample or to a set of grade samples. This document provides the framework and procedures for visual assessments that use a limit sample or a set of grade samples. This document describes the framework and procedure that are followed while preparing limit samples and a set of grade samples. This document also describes visual assessment when limit samples and grade samples are not available for the same type of defect.

This document provides sets of test patterns that can be used in visual assessments.

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 61747-30-1, *Liquid crystal display devices – Part 30-1: Measuring methods for liquid crystal display modules – Transmissive type*

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

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

IEC 62715-6-2[2], *Flexible display devices – Part 6-2: Environmental testing methods*

3 Terms and definitions

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

2 Under preparation. Stage at the time of publication: IEC/AFDIS 62715-6-2:2017.

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

NOTE In cases where the terms and definitions are duplicated between this document and IEC 62715-1-1, the definitions in this document take precedence.

3.1
visual assessment
process in which human visual observation is used to evaluate image quality by detecting and classifying defects or by recognizing any adverse changes in image quality

3.2
grade sample
sample that represents a specific level of defect or deterioration in image quality

Note 1 to entry: Grade samples are usually prepared as grades 1 to 3 or grades 1 to 5, ranging from best to poorest.

3.3
limit sample
sample that represents a specific type of defect or deterioration in image quality that corresponds to an acceptance limit for a certain product

Note 1 to entry: Limit samples are applicable to defects that can be tolerated to a certain extent (e.g. uniformity defects, point defects). They can be either one sample providing the maximum acceptable defect level or a set of samples providing variations in defect level. The variations should represent a classification range for the strength or number of the specific defect, thus providing a reference for an acceptable defect level.

3.4
ND filter
nutral density filter
optical filter that reduces the intensity of all wavelengths of light equally, giving no changes in hue of color rendition

3.5
paired comparison method
psychophysical method involving a choice between two simultaneously presented stimuli that exhibit greater or lesser image quality, or an attribute thereof, in accordance with a set of instructions given to the observer

3.6
single stimulus method
psychophysical evaluation method inspecting only the objective sample without comparison, in accordance with a set of instructions given to the observer

3.7
psychophysical method
method for examining something relating to the physical stimuli and sensory response

Note 1 to entry: ISO 20462-3:2012, 3.12 [3] defines the psychophysical method as an "experimental technique for subjective evaluation of image quality or attributes thereof".

3.8
reference stimulus
image provided to the observer for the purpose of anchoring or calibrating the perceptual assessments of test stimuli

Note 1 to entry: The plural is reference stimuli.

[SOURCE: ISO 20462-3:2012, 3,15, modified – last part of definition deleted] [3]

3.9
observer
individual performing the subjective evaluation task in a psychophysical method

[SOURCE: ISO 20462-3:2012, 3.9] [3]

4 Procedures of visual assessment [2][3]

4.1 General

Procedures for assessment of image quality are described in Clause 4. The following items are covered;

- image defects, such as subpixel defects, clustered defects, line defects, and mura,
- physical defects, such as scratch, abrasion, dent, and change in gross
- image quality, such as change in luminance, colour, or distortion.

Especially the changes of these items before and after the environmental and/or mechanical stress tests are described.

NOTE Classification of defects and the naming and definitions of defects are described in IEC 62341-6-2 [6] and IEC 61747-20-3 [7].

4.2 Setup of displays and driving conditions

Turn on the power supply and pattern generator and warm up for stabilization. Supply the driving voltage and pattern to the display module as specified for each assessment. The warm-up time of the device under test (DUT) and illumination shall be sufficiently long to obtain a stable signal, which is necessary for visual assessment. It is recommended that when the display is first turned on, it should be operated for at least 30 min.

4.3 Observers for visual assessment [4][5]

Observers shall be periodically trained for visual assessment by a qualified person using a document of specified procedures and grade samples. Qualified persons are certified by each organization based on their criteria. The criteria may be discussed by the customer(s) and the provider(s). To ensure effectiveness, grade samples shall be maintained by a qualified person.

Observers should adapt to lighting conditions for a period of 10 min or more before beginning an assessment session.

4.4 Ambient conditions for visual assessment

4.4.1 Standard environmental conditions

Visual assessment shall be carried out under standard environmental conditions: a temperature of 23 °C ± 3 °C, a relative humidity of 45 % to 75 % and a pressure of 86 kPa to 106 kPa. When other environmental conditions are used, they shall be noted in the report.

4.4.2 Standard lighting conditions

4.4.2.1 General

Dark room conditions shall be used for the visual assessment of the image quality of emissive-type displays in operational states. Controlled external lighting shall also be used for the visual assessment of the emissive- and reflective-type displays and for physical damage to both the display types.

4.4.2.2 Dark room conditions for emissive-type display modules

The luminance contribution from background illumination reflected off the test display shall be small enough for visual assessment. It is recommended that the luminance contribution from background illumination reflected off the test display be less than or equal to 0,01 cd/m² or less than 1/20 of the display's full screen black luminance.

It should be noted that, in case of mura defect in a black background, even low level of background illumination can hinder the detection of mura.

To avoid the emitted light from the display being reflected back onto the display, the clothes of the observer(s) and walls of the room shall be sufficiently dark.

4.4.2.3 Lighting conditions for reflective-type display modules

For reflective-type displays modules, visual assessment shall be carried out in a dark room, as described in 4.4.2.2, however the display shall be illuminated by higher than 500 lx of diffuse broadband illumination, such as hemispherical lighting.

Lighting conditions for visual assessment have several functions:

1) lighting is necessary for viewing reflective displays,
2) the spectral distribution, lighting geometry and display surround have to be specified so that viewing conditions for visual assessment are reproducible,
3) lighting geometry has to be designed carefully so that lighting does not interfere with the assessment of the display. For example, specular reflections of the light source by the display into the field of view should be avoided because they can create a glare that can hide defects that confound the observer.

4.4.2.4 Light conditions for assessment of physical damages

Physical damages shall be assessed using external lighting for both emissive-type display and reflective type display devices.

The average illuminance on the display area shall be between 500 lx and 1 000 lx, as measured at the display surface. The other illumination condition can be selected based on the requirement of the customers, but the illuminance on the display shall not be less than 100 lx. Care shall be taken to block direct viewing of the light source by the observer. Either a fluorescent light with the illuminant of FL1 illustrated in CIE 15 or other fluorescent lights can be used [8].

Physical defects and changes in the gloss of the surface of display modules should be inspected with oblique directional lighting while changing the incident and observation angles. Diffuse illumination can also be used when it is appropriate.

Diffuse illumination is best for inspection of electro-optical properties, and directional lighting from an oblique direction for mechanical defects.

4.5 Viewing geometry

4.5.1 General

In 4.4, the following geometries are defined on the basis of the purpose of the evaluation:

1) Designed viewing geometry: The position with the designed viewing distance and direction of the device as defined by the manufacturer.
2) Standard usage viewing geometry: The viewing positions defined in this document.

The conceptual image of the viewing geometry is shown in Figure 1.