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INTERNATIONAL STANDARD

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Liquid crystal display devices –
Part 40-6: Mechanical testing of display cover glass for mobile devices – Retained biaxial flexural strength (abraded ring-on-ring)

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International Standard IEC 61747-40-6 has been prepared by technical committee 110: Electronic display devices.

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

CDV	Report on voting
110/882/CDV	110/929A/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 61747 series, published under the general title *Liquid crystal 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Mobile electronic devices have become increasingly sophisticated and often incorporate displays for the purposes of user interface and viewing. Such displays commonly incorporate a transparent cover glass which aids in protecting the display against the introduction of damage through routine device transport and use, as well as occasional or accidental misuse.

The purpose of this document is to provide mechanical testing procedures for cover glasses utilized in such applications. Such glasses can be strengthened, for example via an ion-exchange process, which acts to increase mechanical strength through the introduction of a surface compressive layer.

LIQUID CRYSTAL DISPLAY DEVICES –

Part 40-6: Mechanical testing of display cover glass for mobile devices – Retained biaxial flexural strength (abraded ring-on-ring)

1 Scope

This part of IEC 61747 is a mechanical performance testing procedure for cover glass used in electronic flat panel displays in mobile devices. This document focuses on the measurement of surface fracture load after flaw introduction via grit particle abrasion. After abrasion, the retained surface fracture load is measured with the method documented in IEC 61747-40-4.

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 61747-40-1, *Liquid crystal display devices – Part 40-1: Mechanical testing of display cover glass for mobile devices – Guidelines*

IEC 61747-40-4, *Liquid crystal display devices – Part 40-4: Mechanical testing of display cover glass for mobile devices – Biaxial flexural strength (ring-on-ring)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
specimen
individual piece of glass to be abraded and then tested for retained fracture load

3.2
sample
group of specimens that share a common pedigree (such as manufacturing process and period of production), for which failure statistics can be generated and reported

3.3
sample size
number of specimens in a sample

3.4
specimen holder
two-part fixture that consists of a recessed cutout for the specimen and a backing plate to hold the specimen in place when testing

3.5
go/no go gauge
gauge used to ensure the specimen holder hole is within specified tolerances

4 General

This test is performed in two steps:

1) controlled abrasion of the surface of a number of specimens in the sample;
2) retained failure load testing of the abraded specimens using the ring-on-ring test described in IEC 61747-40-4, with the abrasion damage placed in tension during the test.

This document describes the apparatus and procedures for doing the controlled abrasions. It describes the retained failure load testing referenced in IEC 61747-40-4.

The specimens to be tested are typically 50 mm in width and 50 mm in length, with thickness ranging from 0,55 mm to 2,0 mm. The sample size is 30, as an example. The Weibull statistics [1][1] of fracture loads, after abrasion, are reported.

The abrasion process introduces flaws to the glass surface by fine particle grit abrasion. Before abrasion, a specified amount of abrasion material is prepared. The specimen is then placed in the specimen holder, with the desired abrasion surface oriented towards the particle containment tube of the device, and inserted under the containment tube. The compressed air is turned on for the device, and the abrasion material is quickly loaded into the abrasion device to abrade the specimen. After the specified abrasion time, the specimen holder is removed from the device and the residual abrasion material is removed from the specimen, using pressurized air, before storage for the allotted inspection time to ensure no premature failures occur to the specimens.

Abrasion pressures are generally 34,5 kPa to 310,3 kPa, more typically 34,5 kPa to 103,4 kPa, and rarely exceed 413,7 kPa. However, selected pressure will vary depending on the damage resistance and thickness of the glass specimens under test. An iterative process, in which a small sample set (10 specimens) is tested at an initial abrasion pressure, and check (i.e. flaw) depths are measured via fractography, may need to be employed to determine the appropriate abrasion pressure that generates check depths similar to those experienced in the field for a given glass composition or condition. Information on the measurement of check depths is described in Annex A. Once an appropriate abrasion pressure is determined for a glass, that pressure may then be used to generate a relative comparison with the performance of other glass compositions/candidates at the same pressure. The general requirements of the abrasion apparatus are given in Clause 5. Apparatus dimensions can be affected by specimen dimensions.

Abrasion testing procedures are given in Clause 6, while retained failure load testing procedures are given in Clause 7 via reference to IEC 61747-40-4.

This test measures the retained surface fracture load by forcing a ring through a specimen that is supported by another, larger ring. The two rings shall be parallel and concentric and the applied force shall be perpendicular to the surface formed by the top of the support ring. The loads at fracture are measured. These loads are not normalized to strength using factors such as specimen dimensions and material properties because significant non-linearities can exist that render the classical formulas inaccurate.

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1 Numbers in square brackets refer to the Bibliography.

The test is applied to a sample of several specimens. The sample statistics of the fracture load values are defined in IEC 61747-40-4. The statistical values to be reported or specified are given in IEC 61747-40-4.

The specimen is placed on the support ring so that it is centered on the ring. Before the specimen is placed on the support ring, the surface that will contact the load ring is covered with a layer of polymeric adhesive tape to preserve the fracture surface and reduce the scattering of glass fragments upon breakage. The support ring is also covered with PTFE film to minimize contact damage and friction.

It is assumed that all measurements are performed by personnel skilled in the general art of mechanical property measurements. Furthermore, it shall be assured that all equipment is suitably calibrated as is known to skilled personnel and that records of the calibration data and traceability are kept.

5 Apparatus

5.1 Testing environment and pre-conditioning

The standard testing environment is specified in IEC 61747-40-1. Specimens shall be stored in such an environment for at least 4 h before and 12 h after abrasion, as well as 24 h before failure load testing.

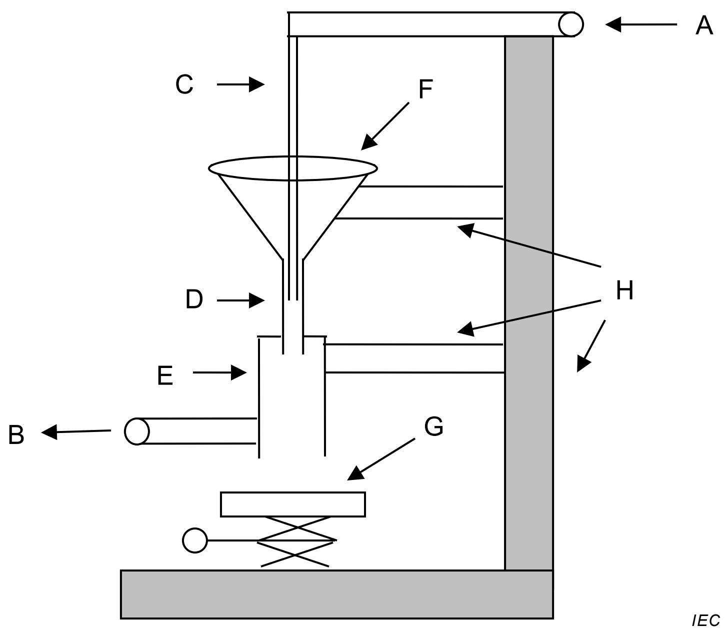
5.2 Abrasion device

The abrasion device is illustrated in Figure 1. The main elements include a funnel for the introduction of particulate into an air stream that impels the particulate onto the surface of the specimens. The air stream is defined in terms of an input air flow at a defined pressure together with three concentric tubes, in order:

1) pressurization tube
2) particulate acceleration tube
3) containment tube

The containment tube has an output exhaust tube to remove most of the particulate after impacting the specimen.

During the abrasion process, the specimen holder (Figure 2) is maintained flush with the bottom of the containment tube such that all air flows are defined within the apparatus. This will minimize the amount of particulate discharged into the laboratory environment. To further prevent air borne particulate, additional housing may optionally (not shown) be provided with a separate exhaust system.



Key

A Input pressurized air

B Output exhaust air

C Pressurization tube

D Acceleration tube

E Containment tube

F Funnel

G Specimen holder support and elevation mechanism (optional)

H Mechanical supports

Dimensions:

Pressurization tube inside diameter: 4,8 mm ± 0,025 mm

Acceleration tube inside diameter: 8 mm ± 0,025 mm

Containment tube inside diameter: 32 mm ± 0,025 mm

Funnel mouth diameter and height: 66 mm ± 0,025 mm and 51 mm ± 0,025 mm

Acceleration tube length: 51 mm ± 1 mm

Distance from bottom of acceleration tube to bottom of containment tube: 28 mm ± 1 mm

Distance from bottom of containment tube to top of sample: 2 mm ± 0,5 mm

Distance from bottom of acceleration tube to bottom of containment tube: 51 mm ± 1 mm

Input pressurized air: ≥ 34,5 kPa, ≤ 413,7 kPa ± 3,4 kPa

Output exhaust vacuum: 24,9 mbar ± 2,5 mbar

Figure 1 – Abrasion device