

# SEMI D50-0822

## TEST METHOD FOR SURFACE HARDNESS OF FLAT PANEL DISPLAY (FPD) COMPONENTS

This Standard was technically approved by the Flat Panel Display – Materials & Components Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on January 4, 2022. Available at [www.semiviews.org](http://www.semiviews.org) and [www.semi.org](http://www.semi.org) in August 2022; originally published July 2007; previously published March 2016.

**NOTICE:** The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (§§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§§) the symbols are used to reference more than one section or paragraph, respectively.

**NOTICE:** Paragraphs entitled ‘NOTE:’ are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

### 1 Purpose

- 1.1 This Test Method defines the procedural guideline for measuring the surface hardness of a film and other components for Flat Panel Display (FPD) excluding glass. These procedures are applicable to manufacturing, quality control, and development work.
- 1.2 This Test Method clarifies the differences when evaluating films and other components and its materials, using ISO 15184, the specification defined for determining the hardness of coating film. It specifically clarifies the load in the test method and evaluation items in the evaluation method.

### 2 Scope

- 2.1 This Test Method defines the measurement method of surface hardness of FPD components excluding glass. This Test Method is applied for, for example, polarizing film, color filter, plastic substrates, touch panel, and other components of FPD applications.

**NOTICE:** SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

### 3 Referenced Standards and Documents

#### 3.1 ISO® Standards<sup>1</sup>

ISO 15184 — Paints and Varnishes – Determination of Film Hardness by Pencil Test

**NOTICE:** Unless otherwise indicated, all documents cited shall be the latest published versions.

### 4 Summary of Test Method

- 4.1 *Equipment and Instruments* — For the test equipment, pencil, pencil sharpener, abrasive paper, and sampling method, those specified in ISO 15184 are to be employed. Test equipment can be of another shape as long as it is based on the same principles as in ISO 15184. However, if equipment other than the kind specified in ISO 15184 is used, types of test equipment used shall be recorded in the test result report and any other such documents. Also, the load applied in the test shall be changed to  $4.9 \text{ N} \pm 0.1 \text{ N}$ . However, the load of  $7.35 \text{ N} \pm 0.15 \text{ N}$ , which is stipulated in ISO 15184, can be also applied for other materials. The test load used shall be reported. The inclined angle of the pencil to the film shall be  $45^\circ \pm 1^\circ$ .

<sup>1</sup> International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, <http://www.iso.org>. ISO trademark is owned by International Organization for Standardization.

NOTE 1: This Test Method is especially useful in developmental work in a single laboratory. It should be recognized that the results obtained may vary between different laboratories.

4.2 *Test Plate* — Test piece is prepared by cutting the target components into the shape and size suitable for the test, if necessary. It is recommended to prepare two pieces mutually-perpendicular.

4.3 *Pencils* — Pencils made by various manufacturers may be used by agreement between the interested parties, provided they give similar relative rating results.

NOTE 2: Some examples of pencil makes and manufacturers which have been found suitable are as follows:

- Cleos Fine Art 160, manufactured by Cretacolor;
- Graphic, manufactured by Derwent;
- Turquoise T-2375, manufactured by Sanford;
- KOH-I-NOOR 1500, manufactured by Hardtmuth AG;
- Uni, manufactured by Mitsubishi Pencil Co.;
- Chunghwa, manufactured by China First Pencil Co., Ltd.

4.3.1 For comparative testing, it is recommended that pencils from the same manufacturer be used. Variations might be found between manufacturers and between batches from the same manufacturer.

4.3.2 Pencil leads in mechanical holders (propelling/mechanical pencils) may be used provided they give the same results as wooden pencils.

4.3.3 For wood pencils, remove approximately 5 to 6 mm of wood from the point of each pencil, being careful to leave an undisturbed, unmarked, smooth cylinder of lead. Holding the pencil at an angle of 90° to the abrasive paper, rub the lead against the paper maintaining an exact angle of 90° to the abrasive paper until flat, smooth and circular cross section is obtained, free of chips or nicks in the edge of the cross section.

#### 4.4 *Environmental Conditions*

4.4.1 Carry out the test at a temperature of 23°C ± 2°C and a relative humidity of 50% ± 5%, unless otherwise agreed. The sample should be equilibrated at the atmosphere at least one hour before carrying out the test.

### 5 Procedure

5.1 *Running the Test* — Methods and conditions specified in ISO 15184 shall be used for the test environment, conditioning of the pencil, mounting of the sample, and use of test equipment. However, the speed of the test equipment shall be 0.5 mm/s and the scratch length shall be from 5 to 10 mm. Other conditions can be used, but the condition different from the standard test condition shall be reported.

5.2 *Evaluation* — Visual inspection can be performed immediately after the measurement. If there is dent, a check shall be made if the dent recovers after 1 hour. For the evaluation of scratches, the reflective test shall be performed on a blackboard using fluorescent light. Other evaluations shall be conducted in accordance with the methods specified in ISO 15184. The damage can be assessed more easily after cleaning all fragments of pencil lead from the surface, using a soft cloth or swab of cotton wool. If necessary, an inert solvent can be used for the cleaning. If this is done, take care that the solvent does not affect the hardness of the coating in the test area.

#### 5.3 *Evaluation Items*

5.3.1 *Scratch* — Irrecoverable visual change on the surface of the film.

5.3.2 *Dent* — Visual change caused on the surface of the film that recovers with time. Dent that recovers within an hour is out of the scope of this Test Method. If there are other specific evaluation items, they shall be described separately in the test items.

5.4 *Accuracy* — All the measurements shall conform to the accuracy specified in ISO 15184.

### 6 Calculations

6.1 No calculation is needed in this Standard.