SEMI MF671-0312 (Reapproved 0718)
TEST METHOD FOR MEASURING FLAT LENGTH ON WAFERS OF SILICON AND OTHER ELECTRONIC MATERIALS

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1 Purpose

1.1 The length of fiducial flats is an important materials characteristic for determining the suitability of material for use in semiconductor processing.

1.2 Automatic wafer handling equipment widely used in semiconductor device manufacturing processes relies on identification and orientation of the primary flat to obtain correct alignment.

1.3 This Test Method is suitable for use in research, development, process control, quality assurance, and materials acceptance applications.

2 Scope

2.1 This Test Method covers techniques for determination of the length of the flatted portion of a wafer periphery.

2.2 This Test Method is intended primarily for use on electronic materials in the form of nominally circular edge-contoured wafers with flat lengths up to 65 mm. The precision of this Test Method has been established directly only for silicon wafers, but it is not expected to be material dependent.

2.3 This Test Method is suitable for referee measurement purposes and may be used for routine acceptance measurements when specified limits require test precision greater than can be obtained with hand held scale and unaided eye.

2.4 This Test Method is independent of surface finish.

2.5 For application to wafers of diameter 3 inch or smaller, the values stated in inch-pound units are to be regarded as the standard whether or not they appear in parentheses; the values stated in acceptable metric units are for information only. For application to wafers of diameter larger than 3 inch, the values stated in acceptable metric units are to be regarded as the standard; the values stated in inch-pound units are for information only.

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 Limitations

3.1 Some operations performed after slicing, such as mechanical edge grinding and chemical etching, may reduce profile definition at the ends of the flatted area.

3.2 Backlash in the micrometer head assemblies may result in erroneous readings.

3.3 Failure to maintain sharp focus on the sample comparator screen image during measurement can introduce errors.

3.4 Comparator optics may sometimes incorporate image-reversal elements, which result in image conditions opposite to those described by this Test Method.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI M1 — Specification for Polished Single Crystal Silicon Wafers

SEMI M59 — Terminology for Silicon Technology

Documents Document Sharing Hub

Full document details: SEMI MF671-0312-0718R

4.2 *ANSI Standard*[1]

ANSI/ASQ Z1.4 — Sampling Procedures and Tables for Inspection by Attributes

4.3 *ASTM Standard*[2]

ASTM E122 — Standard Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process

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

5 Terminology

5.1 Terms relating to silicon and other semiconductor technology are defined in SEMI M59.

6 Summary of Test Method

6.1 The specimen is aligned on an optical comparator. One end of the projected image of the flat is positioned on a reference point on the viewing screen. The micrometer reading is recorded, and the stage is manipulated to scan to the opposite end of the flat where the micrometer reading is again recorded. Flat length is the difference between the first and second readings.

7 Apparatus

7.1 *Shadowgraph Comparator* — Equipped as follows:

7.1.1 20× Optical System,

7.1.2 *Viewing Screen* — With minimum diameter of 254 mm (10 in.), and

7.1.3 *Sample Stage* — Capable of minimum micrometer travel of 50 mm or 2 in. in the *x* direction and goniometer rotation in the *x*-*y* plane.

7.1.3.1 Stage travel in the *x* direction shall move the projected image horizontally on the viewing screen. Travel in the *y* direction shall move the projected image vertically on the viewing screen.

7.1.3.2 The *x* micrometer shall have graduations of 25 µm (0.001 in.) or smaller.

7.1.3.3 The *y* direction stage travel must be enough to show the flatted regions of the largest wafer to be tested, or about three-fifths of the nominal diameter of the largest wafer to be tested.

7.2 An overlay, with reference lines perpendicular to each other intersecting at the center, and ten calibrated divisions on the vertical reference line above and below center, corresponding to 50 µm (0.002 in.) per division at the sample location (see Figure 1).

NOTE 1: For a 20× overlay, the calibration divisions on the overlay itself are 1 mm apart.

[1] American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: +1.212.642.4900, Fax: +1.212.398.0023, http://www.ansi.org

[2] ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: +1.610.832.9585, Fax: +1.610.832.9555, http://www.astm.org

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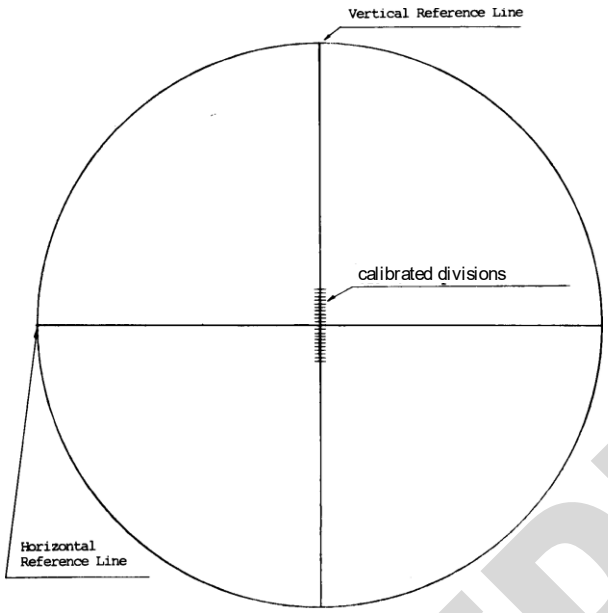

Figure 1
Overlay

7.3 *Microscope Stage Micrometer* — On clear glass or plastic, the scale to be at least 1.3 mm (0.05 in.) long with 25 µm (0.001 in.) divisions.

7.4 *Machinists' Steel Scale* — 150 mm (or 6 in.) minimum length, graduated in 0.50 mm (0.02 in.) or 0.25 mm (0.01 in.).

8 Sampling

8.1 Unless otherwise specified, ASTM E122 shall be used. When so specified, appropriate sample sizes shall be selected from each lot in accordance with ANSI/ASQ Z1.4-1993. Inspection levels shall be agreed upon between the supplier and purchaser.

9 Calibration

9.1 *Comparator Optical Magnification*

9.1.1 Place the microscope stage micrometer on the comparator sample stage so that its projected image is at the center of the viewing screen.

9.1.2 With a steel scale on the viewing screen, count the number of 25 µm (0.001 in.) lines projected over a 25 mm (or 1 in.) distance. Divide the number into 1000 to obtain the actual magnification.

9.1.3 Magnification must be between 19.8 and 20.2 to be usable for this method.

9.2 *Comparator Micrometer Travel — x Direction*

9.2.1 Set the *x*-travel micrometer to zero.

9.2.2 Align the projected image of the microscope stage micrometer such that the array of scale division lines is horizontal and the right most lines are all to one side of the vertical reference line on the viewing screen as in Figure 2.

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