SEMI P7-0997
METHOD OF VISCOSITY DETERMINATION, METHOD A — KINEMATIC VISCOSITY

1 Scope

1.1 This method, a simplified version of ASTM D445 and ASTM F66 is intended for determining the kinematic viscosity of photoresists by measuring the time for a volume of liquid to flow under gravity through a calibrated glass capillary at a fixed temperature. Efflux time is measured in seconds and multiplied by the calibration constant of the viscometer to obtain kinematic viscosity in units of centistokes (cSt). Optionally, kinematic viscosity may be multiplied by the density of the photoresist to obtain dynamic viscosity in units of centipoise (cP). Refer to ASTM D445 and ASTM F66 for additional information and definitions.

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2 Referenced Standards and Documents

2.1 *ASTM Standards*[1]

ASTM D445 — Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

ASTM F66 — Photoresist Used in Microelectronic Fabrications

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

3 Apparatus

3.1 *Calibrated Viscometer* — Of the glass capillary type. (A listing of such viscometers is given in Table 1, ASTM D445.)

3.2 *Constant Temperature Bath* — Equilibrated to 25.0 ± 0.1°C.

3.3 *Viscometer Clamp* — Adjustable to achieve vertical alignment.

3.4 *Thermometer* — Graduated in 0.1°C intervals and calibrated (see ASTM D445 and ASTM F66).

3.5 *Stopwatch* — Readable in 0.2 second intervals or better.

3.6 *Chemicals* — Acetone, chromic acid, methyl ethyl ketone, xylene.

4 Procedure

4.1 Confirm that the constant temperature bath is equilibrated to 25.0 ± 0.1°C.

4.2 Select a clean dry viscometer of appropriate viscosity range. Choose the proper tube size for the given viscosity so that the efflux time is greater than or equal to 200 seconds.

4.3 Charge the viscometer with photoresist in the manner dictated by the design of the viscometer and wipe clean.

4.4 Insert the viscometer into the clamp holder in the constant temperature bath. Vertical alignment of the viscometer is essential for proper flow measurement.

4.5 Allow 15 minutes for the sample temperature to equilibrate.

4.6 Use suction or pressure to adjust the level of the test sample to a position in the capillary arm about 5 mm ahead of the first timing mark.

[1] ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: 610.832.9585, Fax: 610.832.9555, http://www.astm.org

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4.7 With the sample flowing freely, measure the time for the meniscus to pass from the first timing mark to the second. Record the time in seconds.

4.8 Repeat the steps in Sections 4.6 and 4.7. (For reverse flow viscometers, use the same or another viscometer and begin with the step in Section 4.3 for the second measurement.)

4.9 The two measurements must agree within 0.5 seconds. If they do not agree, then reject the measurement results.

4.10 After the measurement, the viscometer should be flushed several times with a suitable solvent (methyl ethyl ketone or acetone for typical novolac positive resists or equivalent and xylene for rubber based negative resists or equivalent).

4.11 Dry the tube by blowing dry, filtered air through the viscometer for a few minutes.

4.12 The viscometer should periodically be cleaned with chromic acid to remove trace organic deposits.

5 Calculation

5.1 Average the flow measurements.

5.2 Kinematic viscosity in cTs = Viscometer constant × efflux time in seconds.

5.3 Dynamic viscosity in cP = Photoresist density at 25.0°C in g/mL × kinematic viscosity in cSt.

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