

SEMI P7-1111

TEST METHOD FOR VISCOSITY DETERMINATION, METHOD A — KINEMATIC VISCOSITY

This Standard was technically approved by the Micropatterning Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on September 12, 2011. Available at www.semiviews.org and www.semi.org in November 2011; originally published in 1982; previously published November 2003.

NOTICE: This Standard or Safety Guideline has an Inactive Status because the conditions to maintain Current Status have not been met. Inactive Standards or Safety Guidelines are available from SEMI and continue to be valid for use.

1 Purpose

1.1 This procedure describes a method for determining the kinematic viscosity of photoresists.

2 Scope

2.1 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.

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 *ASTM Standards*¹

ASTM D445 — Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

ASTM F66 — Test Methods for Testing Photoresist Used in Microelectronic Fabrications [Withdrawn]

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

4 Apparatus

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

4.2 *Constant Temperature Bath* — Equilibrated to $25.0 \pm 0.1^\circ\text{C}$.

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

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

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

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

5 Procedure

5.1 Confirm that the constant temperature bath is equilibrated to $25.0 \pm 0.1^\circ\text{C}$.

¹ 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>

5.2 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.

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

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

5.5 Allow 15 minutes for the sample temperature to equilibrate.

5.6 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.

5.7 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.

5.8 Repeat the steps in §§ 5.6 and 5.7. (For reverse flow viscometers, use the same or another viscometer and begin with the step in § 4.3 for the second measurement.)

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

5.10 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).

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

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

6 Calculations

6.1 Average the flow measurements.

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

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

7 Report

7.1 The report should include:

7.1.1 Identification of the test specimens, if any;

7.1.2 The location where the procedure was performed and the operator who carried it out;

7.1.3 Description of the specific equipment used to carry out the procedure, including software version, if applicable;

7.1.4 Any optional portions of the procedure or choices exercised in carrying out the procedure; and

7.1.5 Results of carrying out the procedure.

8 Summary of Test Method

8.1 None.

NOTICE: SEMI makes no warranties or representations as to the suitability of the Standards and Safety Guidelines set forth herein for any particular application. The determination of the suitability of the Standard or Safety Guideline is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature, respecting any materials or equipment mentioned herein. Standards and Safety Guidelines are subject to change without notice.

By publication of this Standard or Safety Guideline, SEMI takes no position respecting the validity of any patent rights or copyrights asserted in connection with any items mentioned in this Standard or Safety Guideline. Users of this Standard or Safety Guideline are expressly advised that determination of any such patent rights or copyrights and the risk of infringement of such rights are entirely their own responsibility.