SEMI P1-92 (Reapproved 0299)
SPECIFICATION FOR HARD SURFACE PHOTOMASK SUBSTRATES

This specification was technically reapproved by the Mask & Mask Equipment Committee and is the direct responsibility of the North American Microlithography Committee. Current edition approved by the North American Regional Standards Committee in October 1998. Initially available on SEMI OnLine February 1999; to be published February 1999. Originally published 1981; previous published revision 1996.

Editorial changes were made to the following: Sections 1.1, 2.3, 5.2, and 7.1, Tables 2 and 4, and Figure 3.

General Requirements

1 Preface

1.1 This specification covers the general requirements of the glass substrate for hard surface photomasks. 230 mm substrates are excluded from this standard and can be found in SEMI P33.

2 Applicable Documents

2.1 *ASTM Standard*[1]

ASTM E228 — Test for Linear Thermal Expansion of Rigid Solids with a Vitreous Silical Dilatometer

2.2 ISO Standard[2]

ISO 14644-1 — Cleanrooms and Associated Controlled Environments Part 1: Classification of Air Cleanliness

3 Definitions

3.1 Selected terms relating to photomasking are given for information only in Terms and Definitions Relating to the Microlithography Industry found at the end of this volume. Definitions may be found in what was ASTM F127.

4 Ordering Information

4.1 Purchase orders for hard surface photomask substrates furnished to this specification shall include the following:

4.1.1 Nominal edge length, nominal thickness dimension, and edge criteria (see § 5);

4.1.2 Material (see § 6);

4.1.3 Flatness quality area and flatness (Total Indicated Reading [TIR] see § 7);

4.1.4 Visual quality area and defect limits (see § 8); and

4.1.5 Lot acceptance criteria (see § 9).

5 Dimensions and Permissible Variations

5.1 The square substrates shall conform to the dimensional tolerances appropriate to the nominal edge length and thickness as listed in Table 1. Dimensions are illustrated in Figure 1 and a fixture for measuring the diagonal dimensions is shown in Figure 2.

5.2 Substrates shall have chamfered or rounded edges. The edges shall conform to the dimensional tolerances appropriate to the nominal thickness listed in Table 2. Dimensions are illustrated in Figures 3 and 4.

6 Material Specifications

6.1 Substrate materials shall be specified as high thermal expansion (HTE), medium thermal expansion (MTE), low thermal expansion (LTE), or ultra low thermal expansion (ULTE). Examples of HTE materials are white crown and

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[2] International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, http://www.iso.org

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soda lime glasses, of MTE materials are borosilicate and aluminosilicate glasses, of LTE materials are aluminosiliate glasses, and of ULTE materials is quartz (silica).

6.2 Substrate materials shall conform to thermal expansion and optical transmittance characteristics specified in Table 3.

6.3 Selected physical properties of HTE, MTE, LTE, and ULTE materials are provided for information only in Appendix 1.

7 Flatness Specifications

7.1 Substrates shall be supplied with one side having a flatness (TIR of 0.5, 1, 2, 5, 10, or 20 µm) over a circular or square quality flatness area as defined in Figures 5 and 6.

8 Visual Criteria

8.1 A visual quality area, which may or may not correspond with the flatness area, shall be agreed upon between the user and supplier.

8.2 Each plate shall not have more defects than listed in Table 4. This table includes limits for the following types of defects:

8.2.1 Internal defects in the quality area,

8.2.2 Frontside surface defects,

8.2.3 Backside surface defects, and

8.2.4 Defects outside the quality area.

8.3 Glass substrates shall be identified with notches as shown in Figure 7. Soda lime and white crown (HTE) glass are marked with one corner notch (Figure 7a). Borosilica and Aluminosilicate (MTE) glass is marked with three adjacent corner notches (Figure 7b). Aluminosilica (LTE) glass is marked with two adjacent corner notches (Figure 7c). Quartz (ULTE) is marked with two diagonal corner notches (Figure 7d). Dimensions of notches shall be as specified in Figure 8.

9 Sampling

9.1 Unless otherwise specified, appropriate sample sizes shall be selected from each lot in accordance with MIL-STD-105D. Each quality characteristic shall be assigned an acceptable quality level (AQL) in accordance with MIL-STD-105D definitions for critical, major, and minor classifications. If desired, and so specified in the contract or order, each of these classifications may alternatively be assigned cumulative AQL values. Inspection levels shall be agreed upon between user and supplier.

10 Test Methods

10.1 *Thermal Expansion* — Determine in accordance with ASTM E 228.

10.2 Transmission (to be agreed upon between user and supplier).

10.3 Flatness (to be agreed up between user and supplier).

10.4 Visual (to be agreed upon between user and supplier).

11 Handling

11.1 Substrates are to be handled on the edges only. Substrates are to be handled with gloves approved for cleanroom use.

12 Certification

12.1 Upon request of the purchaser in the contract or order, a manufacturer's or supplier's certification that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.

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13 Packing and Marking

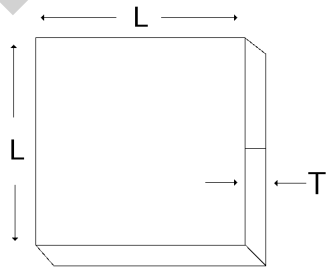
13.1 Substrates shall be packed in a class 100 environment as defined by Federal Standard 209. Containers shall be designed to prevent glass-to-glass contact, and to protect the substrates from contamination in handling and transit. Substrates shall be shipped with the acceptable flatness side toward the front of the box. This orientation shall be indicated on each container. Packaging shall comply with the applicable internal, national, state, and local laws and regulations required for shipping.

13.2 Containers shall be labeled "Warning: Open and Handle Under Cleanroom Conditions Only" as well as identified by user purchase order number (if applicable), drawing number (if applicable), quantity, supplier lot number, and material identification.

Table 1 Specifications for Edge Length, Squareness, and Thickness for Square Substrates

Nominal Edge Length	*Edge Length Min.*	*Edge Length Max.*	*Squareness*	*Thickness Min.*	*Thickness Max.*	*Units*
2 ½ in. sq.	62.7	63.50	0.05/25.40	1.40	1.60	mm
3 in. sq.	75.4	76.2	0.05/25.40	1.40	1.60	mm
3 ½ in. sq.	88.1	88.9	0.05/25.40	1.40	1.60	mm
4 in. sq.	100.80	101.6	0.05/25.40	1.40	1.60	mm
				2.20	2.40	mm
5 in. sq.	126.2	127.0	0.05/25.40	2.20	2.40	mm
				3.70	3.90	mm
				6.25	6.45	mm
6 in. sq.	151.6	152.4	0.05/25.40	2.20	2.40	mm
				2.95	3.15	mm
				3.70	3.90	mm
				6.25	6.45	mm
7 in. sq.	177.0	177.8	0.05/25.40	2.95	3.15	mm
				3.70	3.90	mm
				6.25	6.45	mm

NOTE: HTE is 0.08/25.40.



Note: L = Edge Length
T = Thickness

Figure 1
Square Hard Surface Photomask Substrate

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