

SEMI P1-1101

SPECIFICATION FOR HARD SURFACE PHOTOMASK SUBSTRATES

This specification was technically approved by the Global Micropatterning Committee and is the direct responsibility of the North American Micropatterning Committee. Current edition approved by the Japanese Regional Standards Committee on August 3, 2001. Initially available at www.semi.org September 2001; to be published November 2001. Originally published in 1981; previously published February 1999.

1 Purpose

1.1 This specification covers the general requirements of the glass substrate for hard surface photomasks.

2 Scope

2.1 This document covers square photomasks up to 7 inches in length. 230 mm substrates are excluded from this standard and can be found in SEMI P33.

2.2 This document also gives specifications for the following materials:

- High Thermal Expansion (HTE),
- Medium Thermal Expansion (MTE),
- Low Thermal Expansion (LTE),
- Ultra Low Thermal Expansion (ULTE)
- Durable Fused Silica (DFS) glass for 193 nm wavelength
- Modified Fused Silica (MFS) glass for 157 nm wavelength.

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 SEMI Standards

SEMI P33 — Provisional Specification for Developmental 230 mm Square Hard Surface Photomask Substrates

3.2 ASTM Standard¹

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

3.3 ANSI/ASQC Standard²

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

3.4 ISO Standard³

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

4 Terminology

4.1 Selected terms relating to photomasking are given for information only in “Terms and Definitions Relating to the Microlithography Industry” found at the end of SEMI P33 “Related Information”. Definitions may be found in what was ASTM F127.

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>

² American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, USA; Telephone: +1.414.272.8575, Fax: +1.414.272.1734, <http://www.asq.org>

³ 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>

5 Ordering Information

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

5.1.1 Nominal edge length, nominal thickness dimension, and edge criteria (see § 6);

5.1.2 Material (see § 7);

5.1.3 Flatness quality area and flatness (Total Indicated Reading [TIR] see § 8);

5.1.4 Visual quality area and defect limits (see § 9); and

5.1.5 Lot acceptance criteria (see § 10).

6 Dimensions and Permissible Variations

6.1 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.

6.2 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.

7 Material Specifications

7.1 Substrate materials shall be specified as high thermal expansion (HTE), medium thermal expansion (MTE), low thermal expansion (LTE), ultra low thermal expansion (ULTE), durable fused silica (DFS), or modified fused silica (MFS). Examples of HTE materials are white crown and soda lime glasses, of MTE materials are borosilicate and aluminosilicate glasses, of LTE materials are aluminosilicate glasses, and of ULTE, DFS, and MFS materials are quartz (silica).

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

7.2.1 DFS shall maintain the transmittance given in Table 3 within 0.3% change at least accumulated dosage of 100 kJ/cm² of 193 nm wavelength irradiation.

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

8 Flatness Specifications

8.1 Substrates shall be supplied with one side having a flatness (TIR) of 0.25, 0.5, 1, 2, 5, 10, or 20 µm over a circular or square quality flatness area as defined in Figures 5 and 6.

9 Visual Criteria

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

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

9.2.1 Internal defects in the quality area,

9.2.2 Frontside surface defects,

9.2.3 Backside surface defects, and

9.2.4 Defects outside the quality area.

9.3 Glass substrates shall be identified with notches on the backside corner as shown in Figure 7. Soda lime and white crown (HTE) glasses are marked with one corner notch (Figure 7a). Borosilica and Aluminosilicate (MTE) glasses are marked with three corner notches (Figure 7b). Aluminosilicate (LTE) glass is marked with two adjacent corner notches (Figure 7c). Quartz (ULTE) is marked with two diagonal corner notches (Figure 7d). Quartz (DFS) is marked with one corner notch (Figure 7e), that is the same as specified for HTE. Quartz (MFS) is marked with one non-

isosceles triangle corner notch (Figure 7f). Dimensions of notches shall be as specified in Figure 8. If desired, and so specified in the contract or order, notches are positioned to identify the squareness origin corner.

10 Sampling

10.1 Unless otherwise specified, appropriate sample sizes shall be selected from each lot in accordance with ANSI/ASQC Z1.4. Each quality characteristic shall be assigned an acceptable quality level (AQL) in accordance with ANSI/ASQC Z1.4 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.

11 Test Methods

11.1 *Thermal Expansion* — Determine in accordance with ASTM E228.

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

11.3 Irradiation durability (to be agreed upon between user and supplier).

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

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

12 Handling

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

13 Certification

13.1 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.

14 Packing and Marking

14.1 Substrates shall be packed in a class 100 environment as defined by ISO 14644-1. 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.

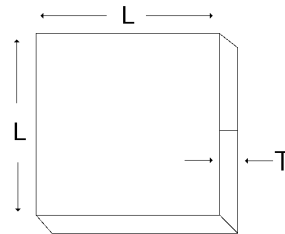
14.2 Containers shall be labeled "Warning: Open and Handle Under Cleanroom Conditions Only": as well as identified by user purchase order number (if applicable), drawing number (if applicable), quantity, supplier lot number, and material identification.

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

<i>Nominal Edge Length</i>	<i>Edge Length Min.</i>	<i>Edge Length Max.</i>	<i>Squareness</i>	<i>Thickness Min.</i>	<i>Thickness Max.</i>	<i>Units</i>
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

Nominal Edge Length	Edge Length Min.	Edge Length Max.	Squareness	Thickness Min.	Thickness Max.	Units
				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 squareness is 0.08/25.40.



Note: L = Edge Length
T = Thickness

Figure 1
Square Hard Surface Photomask Substrate

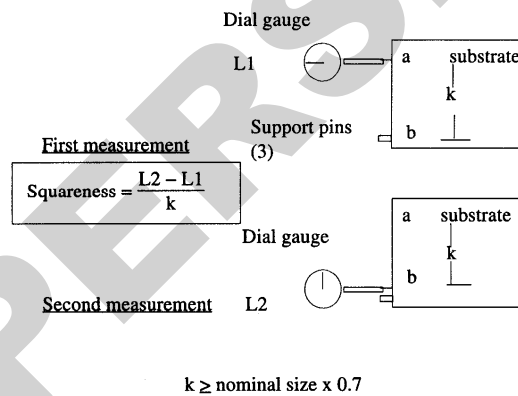


Figure 2
Measurements to Determine Substrate Squareness

Table 2 Specifications for Chamfered and Rounded Edge Dimensions

T	A	A	B	B	C	C	D	D	E	E	
Nominal	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Units
1.50	0.20	0.50	0.20	0.50	0.30	0.70	2.00	3.00	0.25	0.60	mm
2.30	0.20	0.60	0.20	0.60	0.30	0.70	2.00	3.00	0.25	0.60	mm
3.05	0.20	0.60	0.20	0.60	0.30	0.70	2.00	3.00	0.25	0.60	mm
3.80	0.20	0.60	0.20	0.60	0.30	0.70	2.00	3.00	0.25	0.60	mm
4.57	0.20	0.60	0.20	0.60	0.30	0.70	2.00	3.00	0.25	0.60	mm
6.35	0.20	0.60	0.20	0.60	0.30	0.70	2.00	3.00	0.25	0.60	mm