

SEMI P1-0708

SPECIFICATION FOR HARD SURFACE PHOTOMASK SUBSTRATES

This standard was technically approved by the global Micropatterning Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 13, 2008. It was available at www.semi.org in June 2008. Originally published in 1981; previously published November 2001.

NOTICE: This document was completely rewritten in 2008.

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.

2.2 This document also gives specifications for the following materials:

- High Thermal Expansion (HTE),
- Medium Thermal Expansion (MTE),
- Low Thermal Expansion (LTE),
- Synthetic Fused Silica (SFS),¹
- Durable Synthetic Fused Silica (DSFS) glass for 193 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 *ASTM Standard*²

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

3.2 *ANSI/ASQC Standard*³

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

3.3 *ISO Standard*⁴

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

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

4 Terminology

4.1 *Definition*

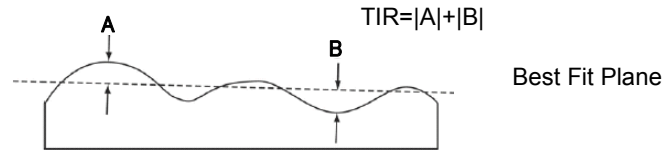
4.1.1 *total indicated reading* — the difference between the highest point above and the lowest point below the best fit plane. Also referred to as “TIR” for short.

¹ Historically this was known as Ultra Low Thermal Expansion (ULTE).

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>

³ 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>

⁴ 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>



A – Maximum distance above the best fit plane
B – Maximum distance below the best fit plane

Figure 1
Total Indicated Reading

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 specification (see § 9 and § 10); and
- 5.1.5 Lot acceptance criteria (see § 11).

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 2 and a fixture for measuring the diagonal dimensions is shown in Figure 3.

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 4 and 5.

7 Material Specifications

7.1 Substrate materials shall be specified as high thermal expansion (HTE), medium thermal expansion (MTE), low thermal expansion (LTE), Synthetic fused silica (SFS), durable synthetic fused silica (DSFS). 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 SFS, DSFS are quartz (silica).

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

7.3 DSFS materials shall conform to irradiation durability within 0.3% transmittance change against accumulated dosage of 100 kJ/cm² of 193 nm wavelength irradiation.

7.4 Selected physical properties of HTE, MTE, LTE, SFS and DSFS materials are provided for information only in Appendix 1.

7.5 Substrates shall be supplied with a Birefringence (BF) of 1 nm/cm, 2 nm/cm or 5 nm/cm over 132 mm square area or no specification on Birefringence.

8 Flatness Specifications

8.1 Substrates shall be supplied with one side having a specified flatness (TIR) over a circular or square quality flatness area as defined in Figures 6 and 7. Typical values for the flatness specification would be 0.25, 0.5, 1, 2, 5, 10 or 20 µm.

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 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 8a). Borosilica and Aluminosilicate (MTE) glasses are marked with three corner notches (Figure 8b). Aluminosilica (LTE) glass is marked with two adjacent corner notches (Figure 8c). Quartz (SFS) is marked with two diagonal corner notches (Figure 8d). Quartz (DSFS) is marked with one corner notch (Figure 8e), that is the same as specified for HTE. Dimensions of notches shall be as specified in Figure 9. If desired, and so specified in the contract or order, notches are positioned to identify the squareness origin corner.

10 Defects

10.1 Specific defects of glass substrate are internal defects (inclusion etc.), frontside and backside surface defects (scratch etc.).

10.2 Specification of glass substrate defect shall be agreed upon by the supplier and user.

10.3 Typical value for the defect specification would be zero defects equal to or greater than 1, 2, 3, 5 or 10 μm in size.

11 Sampling

11.1 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.

12 Test Methods

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

12.2 *Transmittance* — To be agreed upon between user and supplier.

12.3 *Irradiation Durability* — To be agreed upon between user and supplier.

12.4 *Birefringence* — To be agreed up between user and supplier.

12.5 *Flatness* — To be agreed up between user and supplier.

12.6 *Visual* — To be agreed upon between user and supplier.

13 Handling

13.1 Substrates are to be handled on the edges only.

14 Certification

14.1 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.

15 Packing and Marking

15.1 Substrates shall be packed in a cleanroom environment as defined by ISO 14644-1. Specification of Classification of Air Cleanliness should be agreed upon by the supplier and user. Shipping containers should be agreed upon by the supplier and user. Packaging shall comply with the applicable internal, national, state, and local laws and regulations required for shipping.

15.2 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.