

# SEMI P4-92 (Withdrawn 0706) SPECIFICATION FOR ROUND QUARTZ PHOTOMASK SUBSTRATES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 16, 2006. It was available at [www.semi.org](http://www.semi.org) in June 2006. Originally published in 1983; previously published February 1999 (Reapproval).

Editorial changes were made to the following: § 2.2, 6.2, and 13.1, Tables 3, 4 and 5, and Figure 5 during the February 1999 reapproval.

**NOTICE:** This document was balloted and approved for withdrawal in 2006.

## General Requirements

### 1 Preface

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

### 2 Applicable Documents

#### 2.1 *ASTM Standards*<sup>1</sup>

ASTM E122 — Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process

ASTM E228 — Standard Test Method for Linear Thermal Expansion of Rigid Solids with a Vitreous Silica Dilatometer

#### 2.2 *ISO Standard*<sup>2</sup>

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

#### 2.3 *United States Military Specification*<sup>3</sup>

MIL-STD-105 — Sampling Procedure and Tables for Inspection and Attributes

### 3 Terminology

3.1 None.

### 4 Ordering Information

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

|                          |           |
|--------------------------|-----------|
| <i>Dimensions</i>        | (See § 5) |
| <i>Material</i>          | (See § 6) |
| <i>Flatness Criteria</i> | (See § 7) |
| <i>Visual Criteria</i>   | (See § 8) |
| <i>Lot Acceptance</i>    | (See § 9) |

### 5 Dimensions and Permissible Variations

5.1 The material shall conform to the dimensions and dimensional tolerances as specified in Tables 1 and 5, Dimensions for Round Quartz Photomask Substrates.

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

<sup>2</sup> 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>

<sup>3</sup> United States Military Standards, Available through the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, USA; Telephone: 215.697.3321.

## 6 Material Specifications (ULTE glass only)

### 6.1 Thermal Characteristics 0–300°C

6.1.1 100% Quartz Material — Coefficient of expansion  $5.5 \times 10^{-7}/^{\circ}\text{C}$ .

6.1.2 Less Pure Quartz — Coefficient of expansion less than  $7.5 \times 10^{-7}/^{\circ}\text{C}$ .

### 6.2 Transmission Characteristics<sup>4</sup>

| Wave Lengths | Minimum % @ 1.5 mm Thickness                 |
|--------------|----------------------------------------------|
| 200 nm       | To be agreed upon between user and supplier. |
| 230 nm       | To be agreed upon between user and supplier. |
| 254 nm       | To be agreed upon between user and supplier. |
| 365 nm       | To be agreed upon between user and supplier. |
| 405 nm       | To be agreed upon between user and supplier. |

6.3 Physical Properties — Information on the following properties is provided for information only (see Appendix 1).

6.3.1 Poisson's Ratio

6.3.2 Density

6.3.3 Young's Modulus

6.3.4 Modulus of Elasticity

6.3.5 Index of Refraction

6.3.6 Volume Resistivity

## 7 Flatness Area (for one side only)

### 7.1 Flatness Quality Area

7.1.1 Circular Flatness Quality Area — (See Tables 2 and 5).

## 8 Visual Criteria (one side only)

8.1 Quality Area — (See Tables 2 and 5).

| Plate Diameter | Quality Area (Diameter) |
|----------------|-------------------------|
| 125 mm         | 113 mm                  |
| 150 mm         | 138 mm                  |

8.2 Defect Limits — Defects and allowable number of each type are listed in Table 4.

8.2.1 Terminology for SEMI P4 — Unless otherwise noted, the SEMI Terms and Definitions Relating to the Microlithography Industry shall be used.

<sup>4</sup> After correction for surface reflection

8.2.2 *Minimal Conditions or Dimensions* — Minimal conditions or dimensions for defects are listed in Table 4 and shall be used for determining substrate acceptability unless other minimal limiters are agreed upon by the interested parties.

8.2.3 *Photomask Substrate Edge Criteria* — (See Table 3).

8.3 *Identification* — To be agreed upon between the user and supplier.

## 9 Sampling

9.1 Unless otherwise specified, ASTM E122 shall be used. When so specified, appropriate samples sizes shall be selected from each lot in accordance with MIL-STD-105D. Each quality characteristic shall be assigned an acceptable quality level (AQL) and lot total percent defective (LTPD) value in accordance with MIL-STD-105D. Definitions for critical, major and minor classifications may alternatively be assigned cumulative AQL and LTPD values. Inspection levels shall be agreed upon between the user and supplier.

## 10 Test Methods

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

10.2 *Transmission* — (To be agreed upon between the user and supplier).

10.3 *Flatness* — (To be agreed upon between the user and supplier).

10.4 *Visual* — (To be agreed upon between the user and supplier.)

10.5 *Roundness* — Two readings at 90° with appropriate tool such as Vernier Caliper or equivalent. Roundness values not specified at this time.

## 11 Handling

11.1 Substrates are to be handled on the edges only. Substrates are to be handled only with clean room approved gloves.

## 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.

## 13 Packing and Marking

13.1 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 international, national, state, and local laws and regulations required for shipping.

13.2 Containers shall be labeled "Warning: Open and Handle Under Clean Room Conditions Only." Each shipment shall be identified by user purchase order number, drawing number (if applicable), quantity, vendor lot number and material identification.

**Table 1 Dimensions for Round Quartz Photomask Substrates**

| PLATE SIZE             | ROUNDNESS<br>(T. B. A. Later Date) | PLATE THICKNESS |                |                |       |
|------------------------|------------------------------------|-----------------|----------------|----------------|-------|
| Dimension (D)          |                                    | Dimension       | Tolerance Min. | Tolerance Max. | Units |
| 125 Diameter 125 ± 0.3 | —                                  | 2.3             | 2.17           | 2.43           | mm    |
| 150 Diameter 150 ± 0.3 | —                                  | 2.3             | 2.17           | 2.43           | mm    |
|                        | —                                  | 3.0             | 2.87           | 3.13           | mm    |