

SEMI M8-1296

SPECIFICATION FOR POLISHED MONOCRYSTALLINE SILICON TEST WAFERS

This Standard was technically approved by the Silicon Wafer Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee. Available at www.semi.org in December 1996; originally published in 1984; previously published in 1993.

1 Scope

1.1 This Specification covers requirements for virgin silicon test wafers to be used for testing and process monitoring in semiconductor manufacturing. Dimensional and crystallographic orientation characteristics and limits on surface defects are the only standardized properties included in this Specification.

1.2 A complete purchase specification requires that additional physical properties be defined. These properties are listed, together with test methods suitable for determining their magnitude.

1.3 This Specification is directed specifically to silicon wafers with one polished surface. Wafers polished on both sides, or unpolished, or with epitaxial deposits are not covered; however, purchasers of such wafers may find this Specification to be a useful guide in defining their requirements.

1.4 This Specification classifies test wafers according to surface condition defect levels and dimensional tolerances. Test wafer classifications are summarized in Table 1.

1.5 For referee purposes, U.S. customary units shall be used for wafers of 2- and 3-inch nominal diameter and SI (System International), commonly called metric units, for 100 mm and larger diameter wafers.

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.

2 Referenced Standards and Documents

2.1 SEMI Standards and Safety Guidelines

SEMI M1 — Specification for Polished Monocrystalline Silicon Wafers

SEMI M18 — Format for Silicon Wafer Specification Form for Order Entry

2.2 ASTM Standards¹

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

ASTM F26 — Test Methods for Determining the Orientation of a Semiconductive Single Crystal

ASTM F42 — Test Methods for Conductivity Type of Extrinsic Semiconducting Materials

ASTM F47 — Test Method for Crystallographic Perfection of Silicon by Preferential Etch Techniques

ASTM F81 — Test Method for Measuring Radial Resistivity Variation on Silicon Slices

ASTM F84 — Test Method for Measuring Resistivity of Silicon Slices with a Collinear Four-Probe Array

ASTM F154 — Practices and Nomenclature for Identification of Structures and Contaminants Seen on Specular Silicon Surfaces

ASTM F523 — Practice for Unaided Visual Inspection of Polished Silicon Slices

ASTM F533 — Test Method for Thickness and Thickness Variation of Silicon Slices

ASTM F612 — Practice for Cleaning Surfaces of Polished Silicon Slices

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>

ASTM F613 — Test Method for Measuring Diameter of Silicon Slices and Wafers

ASTM F671 — Test Method for Measuring Flat Length on Slices of Electronic Material

ASTM F673 — Test Methods for Measuring Resistivity of Semiconductor Slices with a Noncontact Eddy-Current Gage

ASTM F847 — Test Methods for Crystallographic Orientation of Flats on Single Crystal Silicon Slices and Wafer by X-Ray Techniques

ASTM F928 — Test Methods for Edge Contour of Circular Semiconductor Wafers and Rigid Disk Substrates

ASTM F1241 — Terminology of Silicon Technology

2.3 DIN Standards²

DIN 50431 — Measurement of the Electrical Resistivity of Silicon or Germanium Single Crystals by Means of the Four-Point-Probe Direct Current Method with Collinear Four Probe Array

DIN 50432 — Determination of the Conductivity Type of Silicon or Germanium by Means of Rectification Test or Hotprobe

DIN 50433-1 — Determination of the Orientation of Single Crystals by Means of X-Ray Diffraction

DIN 50433-2 — Determination of the Orientation of Single Crystals by Means of Optical Reflection Figure

DIN 50433-3 — Determination of the Orientation of Single Crystals by Means of Laue Back Scattering

DIN 50434 — Determination of Crystal Perfection of Monocrystalline Silicon Samples on Etched (111)-Surfaces

DIN 50435 — Determination of the Radial Resistivity Variation of Silicon or Germanium Slices by Means of a Four-Point-DC-Probe

DIN 50441-1 — Measurement of the Geometric Dimensions of Semiconductor Slices: Measurement of Thickness

DIN 50441-2 — Measurement of the Geometric Dimensions of Semiconductor Slices: Testing of Edge Rounding

2.4 JIS Standard³

JIS H 0611 — Methods of Measurement of Thickness, Taper, and Bow of Silicon Wafers

2.5 Other Document⁴

ANSI/ASQC Z1.4-1993 — Sampling Procedures and Tables for Inspection by Attributes

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

3 Terminology

3.1 Definitions of terms related to silicon wafer technology are given in ASTM Terminology F1241.

3.2 Definitions for some additional terms are given in SEMI M1.

3.3 The following definitions apply in the context of this Specification:

3.3.1 *hand scribe mark* — any marking, usually on the back surface of a wafer, scratched manually into the silicon surface, as with a diamond tipped scribe, for purposes of wafer identification.

3.3.2 *test wafer* — a silicon wafer suitable for process monitoring in semiconductor manufacturing. Also called *monitor wafer*.

² Deutsches Institut für Normung e.V., Available from Beuth Verlag GmbH, Burggrafenstrasse 4-10, D-10787 Berlin, Germany; <http://www.din.de>

³ Japanese Standards Association, 4-1-24 Akasaka, Minato-ku, Tokyo 107-8440, Japan; Telephone: +81.3.3583.8005, Fax: +81.3.3586.2014, <http://www.jsa.or.jp>

⁴ American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: +1.212.642.4900, Fax: +1.212.398.0023, <http://www.ansi.org>

3.3.3 *virgin test wafer* — a test wafer that has not been previously used in semiconductor manufacturing.

4 Ordering Information

4.1 Purchase orders for silicon test wafers furnished to this Specification shall include the items from the appropriate specification groups listed in Table 1.

Table 1 Test Wafer Categories

<i>Category</i>	<i>Applicable Specification Groups</i>
A	1, 2, 3
B	1, 2
C	1

4.2 Items which may be specified when ordering silicon wafers are listed in SEMI M18. Not all of these items are required for ordering test wafers. The following items are included in the three specification groups; numbers in square brackets following the item are the item numbers in SEMI M18:

4.2.1 *Group 1 — General and Geometrical:* Growth method [1.1], diameter [6.1], surface orientation [6.9], thickness [6.7], orientation fiducials (flats and notches) [6.2–6.5], and edge profile [6.6].

4.2.2 *Group 2 — Surface Characteristics:* Surface defects as listed in Table 2 [7.1–7.8, 7.10, 7.13, 7.14, 8.1–8.4].

4.2.3 *Group 3 — Basic Intrinsic Properties:* Conductivity type [1.3], dopant [1.4], resistivity [2.1], and radial resistivity variation [2.2].

4.3 Not all of the above items must be specified explicitly; the specifications for many of the items are determined by the combination of wafer category and nominal diameter. In all cases, the following must be specified on the purchase order for all classes of test wafers.

4.3.1 Wafer category (A, B, or C).

4.3.2 Nominal diameter and surface orientation (see § 5).

4.3.3 Growth method (see § 6).

4.3.4 Lot acceptance procedures (see § 8).

4.3.5 Certification (if required) (see § 11).

4.3.6 Packing and Marking (see § 12).

4.4 For Class B test wafers, that require controlled surface characteristics (see § 10), the following must be specified in addition to the items listed in ¶ 4.3:

4.4.1 Light levels of visual inspection of wafers if different from those specified in § 9.9.

4.5 For Class A wafers, the following must be specified in addition to the items listed in §§ 4.3 and 4.4 (see § 7):

4.5.1 Conductivity type.

4.5.2 Resistivity.

4.5.3 Radial resistivity variation.

5 Dimensions and Permissible Variations

5.1 The material shall conform to the dimensions and dimensional tolerances as specified for the specified wafer classification in the Dimension and Tolerances Requirements Table in the polished silicon test wafer standard applicable to the specified nominal diameter with or without a secondary flat, as specified.

5.2 If test wafers are specified to be edge contoured, the profile shall conform to the requirements in § 5.2 of SEMI M1 and to the dimension C_y in the associated polished silicon wafer standard applicable to the same nominal diameter and