SEMI C45-0518
SPECIFICATION AND GUIDE FOR TETRAETHYLORTHOSILICATE (TEOS)

This Standard was technically approved by the Liquid Chemicals Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 13, 2017. Available at www.semiviews.org and www.semi.org in May 2018; originally published June 1999; previously published June 2009.

1 Purpose

1.1 The purpose of this Document is to standardize requirements for tetraethylorthosilicate used in the semiconductor industry and testing procedures to support those standards. Test methods have been shown to give statistically valid results.

2 Scope

2.1 The scope of this Document is all grades of tetraethylorthosilicate used in the semiconductor industry.

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 Limitations

3.1 None.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI C1 — Guide for the Analysis of Liquid Chemicals

4.2 *ASTM Standard*[1]

ASTM D5127 — Standard Guide for Ultra-Pure Water Used in the Electronics and Semiconductor Industries

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

5 Terminology

5.1 None.

6 Physical Properties (for information only)

Chemical Formula	$(C_2H_5O)_4Si$
CAS #	78-10-4
Molecular Weight	208.33
Appearance	Clear liquid
Density	0.94 gm/mL
Mol. Wt	208.37 g/mol
Boiling Point	161.1°C
Water Reactive	Very slow reaction to form ethanol

[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

Documents Document Sharing Hub
Full document details: SEMI C45-0518

7 Requirements

7.1 The requirements for tetraethylorthosilicate for Grade 1 are listed in Table 1.

8 Grade 1 Procedures

NOTE 1: Each laboratory is responsible for verifying the validity of the method within its own operation.

8.1 *Assay* — Analyze the sample by gas chromatography (see SEMI C1, in the § 7.2, Guidelines for Assay by Wide Bore Column Gas Chromatography). The parameters cited have given satisfactory results.

8.1.1 *Column* — 30 meter × 530 micron fused silica capillary, coated with 5 micron film of DB-1 or equivalent (100% methyl silicone which has been surface bonded and cross linked).

8.1.2 *Column Temperature* — 60°C isothermal for 1 minute, then programmed to 200°C at 20°C/min.

Injector Temperature:	120°C
Detector Temperature:	260°C
Sample Size:	1 µL splitless
Carrier Gas:	Helium at 3 mL/min
Detector:	Thermal Conductivity
Retention Times (min)	
Water	2.0
Ethanol	2.5
TEOS	7.8

8.2 *Color* — Dilute 1.0 mL of platinum-cobalt stock solution (APHA No. 500) to 100 mL with water. Compare this standard (APHA No. 5) with 100 mL of sample in Nessler tubes. View vertically over a white background. The sample must be no darker than the standard.

8.3 *Water* — This analysis is done by Coulometric Karl Fisher method. The cell is dried with a dry nitrogen gas stream for twenty minutes. Reagents are added and a blank (no sample) is run. 5 g of sample is added to the dry Coulometric Karl Fischer water analyzer. Results are obtained in ppm by dividing the micrograms of water found in the sample by weight of TEOS in grams.

8.4 *Trace Metals Analysis* — The following method has given satisfactory results in determining trace metal impurities at the specified value for each of the following trace metals: aluminum (Al), arsenic (As), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), potassium (K), sodium (Na), tin (Sn), titanium (Ti), and zinc (Zn). Any other alternate method may be used as long as method validation according to SEMI C1 can be demonstrated.

8.4.1 *Special Reagents* — All water used in the *Trace Metals Analysis* and *Boron Analysis* should be a deionized water meeting the criteria for Type E1.1 in ASTM D5127.

8.4.1.1 *Mixed Acid* — 1% HF–2% HNO_3 prepared by dilution of ultra pure acids with appropriate weights of deionized water.

8.4.1.2 *Standards* — Composite standard solutions containing 0, 1, 2, and 4 ppb multi-element standards are prepared by diluting with mixed acid of appropriate weights for ICP-MS. Single-element standards are prepared (Ca, Fe, K, Na) for GFAA.

8.4.2 *Sample Preparation* — In a clean environment, place 100 g of sample in a clean PFA Teflon closed bottle equipped with an inlet and outlet tube and evaporate under a nitrogen purge at approximately 110°C. When dry, close the inlet and the outlet tube and digest the residue at 100°C for 30 minutes with 7 mL of mixed acid solution. Cool and transfer the contents with deionized water. Dilute the transferred contents with deionized water to a final volume of 14 mL.

Documents
Document Sharing Hub
Full document details: SEMI C45-0518