

SEMI PV91-1019

SPECIFICATION FOR TRICHLOROSILANE USED IN POLYSILICON PRODUCTION

This Standard was technically approved by the Photovoltaic – Materials Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on July 21, 2019. Available at www.semiviews.org and www.semi.org in October 2019.

1 Purpose

- 1.1 The purpose of this Document is to provide specifications for different grades of trichlorosilane that are used in polysilicon industry.
- 1.2 With the growth of the photovoltaic market, the customers demand for quality of polysilicon is extremely high. Trichlorosilane is one of the critical raw materials of polysilicon production.
- 1.3 The impurity content in trichlorosilane may directly impact the quality of polysilicon. The standard for trichlorosilane is to guide the production plants to obtain higher quality materials.

2 Scope

- 2.1 This Document covers the requirements for all grades of trichlorosilane used in the polysilicon production industry.
- 2.2 If analytical methods are incomplete, the requirements are presented as a guideline.

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 Description

- 3.1 Trichlorosilane is an inorganic compound, colorless and volatile liquid. It is flammable and corrosive material. Trichlorosilane rapidly decomposes in water producing silicone polymer and hydrochloric acid.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C10 — Guide for Determination of Method Detection Limits

SEMI C28 — Specification and Guide for Hydrofluoric Acid

SEMI C35 — Specification and Guide for Nitric Acid

SEMI MF1630 — Test Method for Low Temperature FT-IR Analysis of Single Crystal Silicon for III-V Impurities

SEMI MF1723 — Practice for Evaluation of Polycrystalline Silicon Rods by Float-Zone Crystal Growth and Spectroscopy

4.2 ASTM Standard¹

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 Refer to SEMI Standards Compilation of Terms (COTs) for a list of the most current terms and their definitions.

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>

5.2 Abbreviations and Acronyms

- 5.2.1 CRM — certified reference material
- 5.2.2 CVD — chemical vapor deposition
- 5.2.3 GC — gas chromatography
- 5.2.4 ICP-MS — inductively coupled plasma mass spectrometry
- 5.2.5 LTFT-IR — low temperature Fourier transform infrared
- 5.2.6 ppbw — parts per billion by weight
- 5.2.7 ppmw — parts per million by weight
- 5.2.8 ppta — parts per trillion atomic
- 5.2.9 TCS — trichlorosilane

6 Requirements

6.1 The purity requirements for the various grades of TCS are listed in Table 1.

Table 1 Impurity Limits and Other Requirements for TCS

	<i>Commercial - Low Purity</i>	<i>Refined - High Purity</i>
Assay (TCS)	≥99.5%	≥99.9%
The sum of B, Al, P, Ca, Na, Cr, Fe, Ni, Cu, Zn, Pb	≤200 ppbw ^{#1}	≤50 ppbw ^{#1}
The sum of B, Al, Ga	-	≤260 ppta ^{#2}
The sum of P, As, Sb	-	≤680 ppta ^{#2}

#1 Impurity limits in liquid phase of TCS, can be measured by ICP-MS.

#2 Impurity limits in solid silicon made from the TCS, can be measured by LTFT-IR.

7 Physical Properties

7.1 The properties of TCS are given in Table 2 (for information only).

Table 2 Properties of TCS (for information only)

Chemical Formula	SiHCl ₃
Molecular Weight	135.45
CAS Number	10025-78-2
Boiling point at 101.325 kPa	31.8°C (89.2°F, 304.9 K)
Melting Point	-126.6°C (-195.9°F, 146.6 K)
Density at 0°C	1.35 g/mL

8 Summary of Test Method

NOTE 1: The chlorosilanes sample is flammable and corrosive.

8.1 *Gas Chromatography (GC) for Chlorosilanes Assay* — This procedure is to determine the chlorosilanes (dichlorosilane, trichlorosilane, silicon tetrachloride) using gas chromatography with a thermal conductivity detector (TCD). Each component in mixture has specific boiling point, polarity, adsorption which allows to separate and analyze each component in the chromatographic column. The content of each component can be calculated by area.

8.1.1 *Detection Limit* — 100 ppm.