

SEMI C3.24-0414

SPECIFICATION FOR SULFUR HEXAFLUORIDE (SF₆) IN CYLINDERS, 99.97% QUALITY

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 23, 2013. Available at www.semiviews.org and www.semi.org in April 2014; originally published in 1984; previously published March 2009.

1 Purpose

1.1 The purpose of this Document is to provide specifications for sulfur hexafluoride (SF₆) that is used in the semiconductor industry.

2 Scope

2.1 This Document covers requirements for sulfur hexafluoride 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 Description

3.1 Sulfur hexafluoride is colorless and odorless. It is noncombustible and has a low toxicity. It is shipped as a liquefied gas under its own vapor pressure.

4 Limitations

4.1 None.

5 Referenced Standards and Documents

5.1 *SEMI Standards and Safety Guidelines*

SEMI C3 — Specifications for Gases

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

6 Terminology

6.1 Terminology appropriate to this standard is defined in SEMI C3.

7 Requirements

7.1 Purity and other requirements for sulfur hexafluoride are given in Table 1.

Table 1 Impurity and Other Requirements for Sulfur Hexafluoride

Purity	99.97%
Impurities	Maximum Acceptable Level (ppm) (See #1)
Air	100
Carbon Tetrafluoride (CF ₄)	100
Hydrogen Fluoride (HF)	1
Water (H ₂ O) (mol/mol)	8
TOTAL LISTED IMPURITIES	209

#1 An analysis of significant figures has not been considered. The number of significant figures will be based on analytical accuracy and the precision of the provided procedure.

8 Properties of Sulfur Hexafluoride (for information only)

Table 2 Properties of Sulfur Hexafluoride

	<i>Metric Units</i>	<i>US Units</i>
CAS Number	2551-62-4	2551-62-4
Molecular Weight	146.054	146.054
Boiling point at 1 atm	−63.7°C	−82.7°F
Density of gas at 20°C (68°F) and 1 atm	6.162 kg/m ³	0.385 lb/ft ³
Specific gravity of gas at 21.1°C (70°F) and 1 atm (air = 1)	5.114	5.114
Density of liquid at −50°C	1910 kg/m ³	119.2 lb/ft ³

9 Test Method for Determining Impurity Limits (Notes 1, 2, and 3)

9.1 *Air and Carbon Tetrafluoride* — This method is for the determination of air and carbon tetrafluoride using a gas chromatograph with a thermal conductivity detector.

9.1.1 *Detection Limit* — 1 ppm (mol/mol).

9.1.2 *Instrument Parameters*

9.1.2.1 Column: 2.4 m (8 ft.) by 6.4 mm (1/4 in.) OD, 5.1 mm (0.201 in.) ID stainless steel tubing packed with Porapak® Q (80/100 mesh) or equivalent.

9.1.2.2 Carrier Flow: 30 mL/min helium.

9.1.2.3 Sample Volume: 1 mL.

9.1.2.4 Temperatures:

- Detector — 110°C
- Column — 70°C

9.1.3 *Calibration Standards* — 90 to 100 ppm (mol/mol) carbon tetrafluoride, 90 to 110 ppm (mol/mol) Air (O₂/N₂ blend), balance helium.

9.1.4 *Operating Procedure*

9.1.4.1 Inject the calibration standard. Analyze the standard using the conditions described above. Record the retention times and peak areas.

9.1.4.2 Inject the sample to be tested in the same manner as the calibration standard. Record the retention times and peak areas.

9.1.4.3 Repeat ¶ 9.1.4.1.

9.1.4.4 Calculate the concentrations of air and carbon tetrafluoride in the sample, using the formula below. The result may not exceed the specification in Table 1 of this Standard.

$$\frac{\text{Sample Peak Area}}{\text{Standard Peak Area}} \times \frac{\text{Concentration of Standard}}{\text{Concentration of Sample}} = \text{Concentration of Sample} \quad (1)$$

9.2 *Hydrogen Fluoride* — This method is for the determination of hydrogen fluoride by quantitative collection in dilute sodium bicarbonate (NaHCO₃) and subsequent analysis by ion chromatography (or Fourier transform infrared [FTIR] spectroscopy. Follow same steps as in ¶ 9.3. See Note 6).

9.2.1 *Detection Limit* — 0.1 ppm for the method.