

SEMI C53-1102

SPECIFICATIONS FOR DIMETHYL SULFOXIDE (DMSO) [GRADES 1 AND 2]

These specifications were technically approved by the Global Liquid Chemicals Committee and are the direct responsibility of the European Liquid Chemicals Committee. Current edition approved by the European Regional Standards Committee on August 26, 2002. Initially available at www.semi.org September 2002; to be published November 2002. Originally published November 2001; previously published March 2002.

1 Purpose

1.1 The purpose of this document is to standardize requirements for dimethyl sulfoxide 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 DMSO used in the semiconductor industry.

2.2 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Limitations

3.1 None.

4 Referenced Standards

4.1 SEMI Standards

SEMI C1 — Specifications for Reagents

NOTE 1: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 None.

6 Physical Property (for information only)

Density (d 20/4)	1.10 g/mL
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7 Requirements

7.1 The requirements for dimethyl sulfoxide for grades 1 and 2 are listed in Table 1.

8 Grade 1 and Grade 2 Procedures

8.1 Assay — Analyze the sample by gas chromatography (see SEMI C1, Section 3.1, Guidelines for Assay by Wide Bore Column Gas

Chromatography). The parameters cited have given satisfactory results.

8.1.1 *Column* — 50 meter × 320 micron I.D., fused silica capillary, coated with 5 micron film of OV-1 or equivalent (100% methyl silicone which has been surface bonded and cross linked).

Column Temperature:	135°C isothermal
Injector Temperature:	240°C
Detector Temperature:	280°C
Sample Size:	1 µl
Carrier Gas:	Helium at 1.2 mL/min.
Detector:	Flame ionization
Approximate Retention Times (min):	
Dimethylsulfide	3.8
Dimethylsulfoxide	10.9
Dimethylsulfone	14.1

8.2 *Color* — Using a colorimeter, compare sample in a specific glass tube with flat bottom, graduated at 113 and 250 mm, with a standardized color reference disk CAA (Scale 2.5 to 30 APHA units).

8.3 *Water* — Use a Karl Fischer (KF) coulometer, consisting of a titration beaker, an electrode generator and an electrode indicator with double platinum wire; having as reagents Hydranal Coulomat A solution at the anode and Hydranal Coulomat C solution at the cathode. Add 500 µl of sample, taking care to protect the sample from moisture. Read directly the water content of sample in µg of water.

8.4 *Acidity* — Use a potentiograph with a compound glass electrode and a titration vat with nitrogen inlet. To 100 mL of sample add 5 mL of water, 5 mL of methanol and 2 drops of titan yellow under nitrogen-stream. The titration is performed with N/100 tetrabutylammonium hydroxide (TBAH) in isopropanol. The equivalence point is at about -400 mV. The density (see SEMI C1, Section 3.8) of the Dimethyl sulfoxide sample to be titrated must be determined to express the result in (meq/g).

8.5 *Residue after Evaporation* — The residue after evaporation is defined as the relative amount of residue

remaining after evaporation of a sample of DMSO followed by heating of the residue: Heat a clean 200 mL beaker at 105°C in an oven for 30 min., cool for 30 min. in a dessicator charged with calcium chloride and weigh. Place 100 g of DMSO into the 200 mL tared beaker. Evaporate the liquid gently, so that boiling does not occur, in a hood protected from any possibility of contamination. When all the sample has evaporated, dry the residue in an oven at 105°C for 30 minutes and cool the beaker for 30 min in a dessicator charged with calcium chloride and reweigh.

8.5.1 Calculate the residue as parts per million (ppm).

8.6 *Trace Metal Determination* — The following method has given satisfactory results in determining trace metal impurities at the value specified for each of the following trace metals : aluminum (Al), antimony (Sb), arsenic (As), boron (B), calcium (Ca), chromium (Cr), copper (Cu), gold (Au), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), potassium (K), sodium (Na), tin (Sn), titanium (Ti) and zinc (Zn). Alternate methods may be used as long as the method has been validated according to SEMI C1 Section 3.14.

8.7 Special Reagents

8.7.1 *Water* — The water used for all the dilution, calibration, and standards should meet suggested guidelines for pure water for semiconductor processing.

8.7.2 *Sample Preparation* — In a clean environment, dilute 25 mL of sample by adding 25 mL of water. Prepare reagent blanks.

8.7.3 *Analysis* — Using the prepared sample and reagent blanks, analyze the elements by inductively coupled plasma (ICP). The density (see SEMI C1, Section 3.8) of the DMSO sample must be determined to express the result in ppb.

8.7.4 Notes

NOTE 2: Each laboratory is responsible for verifying the validity of the method within its own operation.

Table 1 Impurity Limit and Other Requirements for Dimethyl Sulfoxide

	Grade 1 (specification)	Grade 2 (specification)
Assay (CH ₃ SOCH ₃)	99.8% min.	99.8% min.
DMSO ₂ (CH ₃ SO ₂ CH ₃)	0.05% max.	0.05% max.
DMS (CH ₃ SCH ₃)	0.05% max.	0.05% max.
Color (APHA)	10 max.	10 max.
Water (H ₂ O)	0.05% max.	0.05% max.
Acidity	0.0007 µeq/g max.	0.0007 µeq/g max.
Residue after	50	50

	Grade 1 (specification)	Grade 2 (specification)
evaporation (ppm)		
Aluminum (Al)	50 ppb max.	10 ppb max.
Antimony (Sb)	50 ppb max.	10 ppb max.
Arsenic (As)	50 ppb max.	10 ppb max.
Barium (Ba)	50 ppb max.	10 ppb max.
Boron (B)	50 ppb max.	10 ppb max.
Cadmium (Cd)	50 ppb max.	10 ppb max.
Calcium (Ca)	50 ppb max.	10 ppb max.
Chromium (Cr)	50 ppb max.	10 ppb max.
Copper (Cu)	50 ppb max.	10 ppb max.
Iron (Fe)	50 ppb max.	10 ppb max.
Lead (Pb)	50 ppb max.	10 ppb max.
Lithium (Li)	50 ppb max.	10 ppb max.
Magnesium (Mg)	50 ppb max.	10 ppb max.
Manganese (Mn)	50 ppb max.	10 ppb max.
Nickel (Ni)	50 ppb max.	10 ppb max.
Potassium (K)	50 ppb max.	10 ppb max.
Sodium (Na)	50 ppb max.	10 ppb max.
Tin (Sn)	50 ppb max.	10 ppb max.
Titanium (Ti)	50 ppb max.	10 ppb max.
Vanadium (V)	50 ppb max.	10 ppb max.
Zinc (Zn)	50 ppb max.	10 ppb max.

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