

# SEMI C53-0704 (Reapproved 0312) SPECIFICATIONS FOR DIMETHYL SULFOXIDE (DMSO) [GRADES 1 AND 2]

This Standard was technically approved by the global Liquid Chemicals Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 24, 2011. Available at [www.semiviews.org](http://www.semiviews.org) and [www.semi.org](http://www.semi.org) in March 2012; originally published November 2001; previously published July 2004.

**NOTICE:** This Document was reapproved with minor editorial changes.

## 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.

**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

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

## 5 Terminology

5.1 None.

## 6 Physical Property (for information only)

6.1 Density (d 20/4): 1.10 g/mL

## 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, Guidelines for Assay by Wide Bore Column Gas Chromatography). The parameters cited have given satisfactory results.

8.1.1 *Column* — 50 m × 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

#### 8.1.1.1 *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  $\mu$ L of sample, taking care to protect the sample from moisture. Read directly the water content of sample in  $\mu$ g 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) 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  $105^{\circ}\text{C}$  in an oven for 30 minutes, cool for 30 minutes 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 of the sample has evaporated, dry the residue in an oven at  $105^{\circ}\text{C}$  for 30 minutes and cool the beaker for 30 minutes 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), barium (Ba), boron (B), cadmium (Cd), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), lithium (Li), magnesium (Mg), manganese (Mn), nickel (Ni), potassium (K), sodium (Na), tin (Sn), titanium (Ti), vanadium (V) and zinc (Zn). Alternate methods may be used as long as the method has been validated according to SEMI C1.

#### 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) of the DMSO sample must be determined to express the result in ppb.

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