

# SEMI C35-0118

## SPECIFICATION AND GUIDE FOR NITRIC ACID

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 August 18, 2017. Available at [www.semiviews.org](http://www.semiviews.org) and [www.semi.org](http://www.semi.org) in January 2018; originally published in 1979; previously published July 2008.

### 1 Purpose

1.1 The purpose of this Document is to standardize requirements for nitric acid used in the semiconductor industry and testing procedures to support those standards. Test methods have been shown to give statistically valid results. Alternative methods can be used as long as method validation per SEMI C1 has been demonstrated. This Document also provides a guide for a grade of nitric acid for which a need has been identified. In the case of this Guide, the test methods may not have been statistically validated yet.

### 2 Scope

2.1 The scope of this Document is grades of nitric acid 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

SEMI C27 — Specification and Guide for Hydrochloric Acid

SEMI C44 — Specification and Guide for Sulfuric Acid

#### 4.2 ASTM Standard<sup>1</sup>

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 Properties

**Table 1 Properties of Nitric Acid**

|                  |                  |
|------------------|------------------|
| Chemical Formula | HNO <sub>3</sub> |
| CAS Number       | 7697-37-2        |
| Density at 25°C  | 1.42 g/mL        |

<sup>1</sup> 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>

## 7 Requirements

7.1 The requirements for nitric acid for Grades 1 and 2 and suggested values for Tier B are listed in Table 2.

## 8 Grade 1 Procedures

NOTE 1: Alternative methods can be used as long as method validation per SEMI C1 has been demonstrated.

8.1 *Assay* — Accurately weigh a small glass-stoppered conical flask containing about 15 mL of water. Deliver from a pipet about 2 mL of the sample near the water surface, stopper immediately, cool, and reweigh. Dilute to about 50 mL with water, add 0.10 mL of methyl orange indicator solution (see SEMI C1) and titrate with standardized 1 N sodium hydroxide to a red to yellow color change.

$$\% \text{ Assay} = \frac{\text{mL} \times \text{N of NaOH} \times 6.301}{\text{Mass of sample (g)}}$$

8.2 *Color* — Dilute 2.0 mL of platinum-cobalt stock solution (APHA No. 500, see SEMI C1) to 100 mL with water. Compare this standard (APHA No. 10) with 100 mL of sample in Nessler tubes. View vertically over a white background. The sample shall be no darker than the standard.

### 8.3 Chloride

#### 8.3.1 Special Reagents

8.3.1.1 *Nitric Acid* — SEMI C35, Grade 2.

8.3.2 Dilute 84 mL (120 g) of sample with 10 mL of water, add 1 mL of silver nitrate reagent solution (see SEMI C1), and evaporate to dryness on a steam bath in a hood. Dissolve the residue in 0.5 mL of ammonium hydroxide, dilute with 20 mL of water, and add 1.5 mL of nitric acid (see ¶ 8.3.1.1). Any turbidity produced shall be no greater than that produced when 0.01 mg of chloride ion (see SEMI C1) is treated as the sample.

### 8.4 Phosphate

#### 8.4.1 Special Reagents

8.4.1.1 *Sulfuric Acid* — SEMI C44, Grade 2.

8.4.2 To 35 mL (50 g) of sample add 10 mL of sodium carbonate reagent solution (see SEMI C1) and evaporate to dryness on a steam bath in a hood. Dissolve the residue in 25 mL of 0.5 N sulfuric acid (made by dilution of ¶ 8.4.1.1). Add 1 mL of ammonium molybdate reagent solution (see SEMI C1) and 1 mL of p-(methilamino)phenol sulfate reagent solution (see SEMI C1). Allow to stand at room temperature for 2 hours. Any blue color produced shall be no greater than that produced when 0.01 mg of phosphate ion (PO<sub>4</sub>) (see SEMI C1) is treated as the sample.

### 8.5 Sulfate

#### 8.5.1 Special Reagents

8.5.1.1 *Hydrochloric Acid* — SEMI C27, Grade 2.

8.5.1.2 *5% (v/v) Hydrochloric Acid Solution* — Dilute 50 mL of hydrochloric acid (see ¶ 8.5.1.1) to 1 L using water meeting the criteria for Type E1 in ASTM D5127 with regards to metal content.

8.5.1.3 *Sulfuric Acid* — SEMI C44, Grade 2.

8.5.2 To 70 mL (100 g) of sample add 10 mL of sodium carbonate reagent solution (see SEMI C1) and evaporate to dryness in a hood. Dissolve the residue in 10 mL of water and 1 mL of 5% (v/v) hydrochloric acid; filter if necessary. Add 1 mL of barium chloride reagent solution (see SEMI C1), mix, and allow to stand for 10 minutes. Any turbidity developed shall be no greater than that produced when 0.05 mg of sulfate ion (SO<sub>4</sub>) (see SEMI C1) is treated as the sample.

### 8.6 Arsenic and Antimony (as As)

#### 8.6.1 Special Reagents

8.6.1.1 *Sulfuric Acid* — SEMI C44, Grade 2.