

SEMI PV27-0316

SPECIFICATION FOR AMMONIUM HYDROXIDE USED IN PHOTOVOLTAIC APPLICATIONS

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1 Purpose

1.1 This Document standardizes requirements for some grades of ammonium hydroxide used in the photovoltaic (PV) industry. Testing procedures are also included to support those requirements. Test methods have been shown to give statistically valid results.

2 Scope

2.1 The scope of this Document is for grades of ammonium hydroxide used in the PV 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 — Specifications and Guidelines for Hydrochloric Acid

SEMI C35 — Specifications and Guideline for Nitric Acid

4.2 ASTM Standards¹

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 of Ammonium Hydroxide

Table 1 Properties of Ammonium Hydroxide

Chemical Formula	NH ₄ OH
CAS Number	7664-41-7

7 Requirements

7.1 The requirements for ammonium hydroxide PV Grades 1 and 2 are listed in Table 2.

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>

8 PV Grade 1 Procedures

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

NOTE 2: 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 flask containing about 15 mL of water. Deliver from a pipet about 2 mL of the sample near the water surface, stopper immediately, and reweigh. Add 0.1 mL of methyl red indicator solution (see SEMI C1) and titrate with standardized 1 N hydrochloric acid to a yellow-to-red color change.

$$\% \text{Assay} = \frac{\text{Volume of HCl (mL)} \times \text{Normality of HCl} \times 1.703}{\text{Mass of sample (g)}} \quad (1)$$

8.2 *Appearance* — Place 15 mL of the sample in a 20 × 150 mm test tube and compare with water in a similar tube. When viewed across the column by means of transmitted light, the two liquids should be equal in clarity and free from suspended matter.

8.3 *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 must be no darker than the standard.

8.4 *Carbon Dioxide* — Dilute 11 mL (10 g) of sample with 10 mL of carbon dioxide-free water and add 5 mL of a clear, saturated solution of barium hydroxide. Any turbidity should be no greater than that produced when the same volume of the barium hydroxide solution is added to 21 mL of the carbon dioxide-free water containing 0.5 mg of anhydrous sodium carbonate.

8.5 Anions

8.5.1 The following method has given satisfactory results in determining anion impurities at the values specified for each of the following anions: chloride (Cl), phosphate (PO₄), nitrate (NO₃), and sulfate (SO₄). Alternative methods may be used as long as appropriate method validation as per SEMI C1 has been demonstrated.

8.5.2 Special Reagents

8.5.2.1 *Eluent* — Prepare an eluent solution that is 2.2 mm sodium carbonate (Na₂CO₃) and 0.75 mm sodium bicarbonate (NaHCO₃) in deionized water meeting the criteria for Type E1.1 in ASTM D5127. Store eluent under a helium gas blanket.

8.5.2.2 *Regenerant* — Prepare a 0.025 N sulfuric acid (H₂SO₄) in deionized water meeting the criteria for Type E1.1 in ASTM D5127.

8.5.3 *Potassium Carbonate Solution* — Prepare a solution containing 500 mg of reagent grade potassium carbonate (K₂CO₃) into 100 mL of water meeting the criteria for Type E1.1 in ASTM D5127.

8.5.4 Sample Preparation

8.5.4.1 In a clean environment, place 40 g of sample into a clean beaker. Add 1 mL of a 5 mg/mL potassium carbonate solution and evaporate carefully (at 100°C) to a volume of 0.5 mL. Dilute with water meeting the criteria for Type E1.1 in ASTM D5127 to a final volume of 20 mL.

8.5.5 Analysis

8.5.5.1 Using the prepared solutions and blanks, analyze chloride, nitrate, phosphate, and sulfate by ion chromatography. Run a reagent blank. Samples and reagent blanks should be prepared and analyzed in triplicate.

8.5.5.2 *Columns* — Precolumn should be AG4-A (Dionex) or equivalent and Separation column should be AS4-A (Dionex) or equivalent.

8.6 Trace Metal Analysis

8.6.1 The following method has given satisfactory results in determining metal ion impurities at the values specified for each of the following metals: aluminum (Al), antimony (Sb), arsenic (As), boron (B), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), nickel (Ni), potassium (K), sodium (Na), tin (Sn), titanium (Ti), and zinc (Zn). Alternative methods may be used as long as appropriate method validation as per SEMI C1 has been demonstrated.