

SEMI PV12-1115

SPECIFICATION FOR PHOSPHORIC ACID USED IN PHOTOVOLTAIC APPLICATIONS

This Standard was technically approved by the Photovoltaic - Materials Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 31, 2015. Available at www.semiviews.org and www.semi.org in November 2015; originally published November 2010.

1 Purpose

1.1 The purpose of this Document is to standardize requirements for phosphoric acid used in the photovoltaic 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 grades of phosphoric acid used in the photovoltaic 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 C35 — Specifications and Guideline for Nitric Acid

SEMI C36 — Specifications for Phosphoric Acid

4.2 ASTM Standard¹

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 Phosphoric Acid

**Table 1 Properties of Phosphoric Acid
(for information only)**

CAS Number	7664-38-2
Molecular Formula	H ₃ PO ₄
Molecular Weight	98
Density at 25°C (86%)	1.70 g/mL

7 Requirements

7.1 The requirements for phosphoric acid for PV Grades 1 and 2 are listed in Table 2.

¹ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA; Telephone: 610.832.9585, Fax: 610.832.9555, <http://www.astm.org>

Table 2 Impurity Limits and Other Requirements for Phosphoric Acid

	<i>PV Grade 1</i>	<i>PV Grade 2</i>
	<i>(Specification)</i>	<i>(Specification)</i>
Assay (H ₃ PO ₄) (86%)	85%–87%	85%–87%
Nitrate (NO ₃)	5 ppm max.	5 ppm max.
Sulfate (SO ₄)	12 ppm max.	12 ppm max.
Chloride (Cl)	1 ppm max.	1 ppm max.
Aluminum (Al)	500 ppb max.	500 ppb max.
Antimony (Sb)	10000 ppb max.	6000 ppb max.
Arsenic (As)	300 ppb max.	50 ppb max.
Barium (Ba)	--	500 ppb max.
Boron (B)	--	--
Cadmium (Cd)	--	--
Calcium (Ca)	1500 ppb max.	1000 ppb max.
Chromium (Cr)	200 ppb max.	200 ppb max.
Copper (Cu)	150 ppb max.	150 ppb max.
Iron (Fe)	2000 ppb max.	1000 ppb max.
Lead (Pb)	300 ppb max.	150 ppb max.
Lithium (Li)	100 ppb max.	100 ppb max.
Magnesium (Mg)	200 ppb max.	100 ppb max.
Manganese (Mn)	100 ppb max.	100 ppb max.
Nickel (Ni)	250 ppb max.	250 ppb max.
Potassium (K)	1500 ppb max.	500 ppb max.
Sodium (Na)	2500 ppb max.	1000 ppb max.
Tin (Sn)	--	--
Titanium (Ti)	--	--
Vanadium (V)	--	--
Zinc (Zn)	2000 ppb max.	1500 ppb max.

8 PV Grade 1 Procedures

8.1 *Assay* — Weigh to the nearest 1 mg about 1 mL of sample in a 250 mL glass-stoppered flask, dilute with 120 mL of water, add 0.5 mL of thymolphthalein indicator solution, and titrate with standardized 1 N sodium hydroxide to the first appearance of a blue color against a white background.

$$\% \text{Assay} = \frac{\text{Volume of NaOH (ml)} \times \text{Normality of NaOH} \times 4.900}{\text{Mass of sample (g)}} \quad (1)$$

8.2 *Chloride* — Dilute 9 mL (15 g) of sample with 25 mL of water, and add 0.5 mL of nitric acid and 1 mL of silver nitrate reagent solution (see SEMI C1). Any turbidity produced should be no greater than that produced when 0.015 mg of chloride ion (Cl) is treated as the sample.

8.3 Nitrate

8.3.1 Prepare the following solutions:

- *Sample Solution A* — Add 3 mL (5 g) of sample to 2 mL of water, dilute to 50 mL with brucine sulfate reagent solution (see SEMI C1) and mix.