

SEMI PV3-0310

GUIDE FOR HIGH PURITY WATER USED IN PHOTOVOLTAIC CELL PROCESSING

This standard was technically approved by the global Photovoltaic Committee. This edition was approved for publication by the global Audits & Reviews Subcommittee on December 16, 2009. Initially available at www.semi.org in February 2010.

1 Purpose

1.1 This guide is provided for multiple purposes. It may be used as a basis for establishing performance criteria for purchases of new High Purity Water (HPW) equipment. It may also be used internally by facility engineers to set process control parameters for the operation of their HPW systems. This guide may be used by process engineers to establish reasonable expectations about the quality of the HPW being supplied to them by facilities.

NOTE 1: These suggested guidelines are published as technical information and are intended for informational purposes only.

2 Scope

2.1 Water is used extensively in the production of photovoltaic cells and associated manufacturing for all wet processing steps such as the rinsing of substrate wafers and panels. HPW is typically produced for this purpose using Reverse Osmosis/Deionized resin bed technologies. The quality of the water impacts device yield. Requirements for higher purity water may increase with changes in the photovoltaic cell over time.

2.2 The guidelines are targeted for HPW produced for photovoltaic manufacturing.

2.3 The guidelines consider both general photovoltaic manufacturing facilities as well as critical manufacturing tools.

2.4 Location for water quality specification is defined at Point-of-Use (POU), which is a Point of Connection (POC) of the manufacturing tool on the HPW distribution lateral.

NOTICE: 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 and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This guide is not intended to set an absolute performance requirement for a HPW system. Performance requirements should be determined based on the sensitivity of the manufacturing process to the purity of the water, the sensitivity of the instrumentation, and the costs associated with installation, maintenance, and monitoring the water system parameters.

3.2 This set of guidelines has been established from a variety of sources and inputs including; (1) an industry survey that SEMI Photovoltaic Standards Committee provided to members of its standards activities; (2) typical HPW levels from a large selection of photovoltaic HPW systems, as measured by independent laboratories that test high purity water for the photovoltaic industry; (3) specifications from water system equipment manufacturers; and (4) input from producers and users of HPW during SEMI Photovoltaic Standards Committee meetings and through the balloting process. However, it is up to each individual owner of a HPW system to set specifications for the purity of its water based on the owner's needs and available resources.

3.3 ASTM D5127 is considered in setting specifications for the purity of reagent grade water needed in a laboratory for analytical testing of photovoltaic materials and process chemicals.

3.4 The guidelines are based on current state-of-the-art PV manufacturing and do not take into account enabling future technologies.

3.5 The quality of the data measured will depend on which testing method and calibration techniques are used. Consequently, trends observed in the values may be as meaningful as absolute values.

4 Referenced Standards and Documents

4.1 SEMI Standard

SEMI C1 — Guide for the Analysis of Liquid Chemicals

4.2 ASTM Standards¹

ASTM D859 — Standard Test Method for Silica in Water

ASTM D2791 — Standard Test Method for On-line Determination of Sodium in Water

ASTM D4327 — Standard Test Method for Anions in Water by Chemically Suppressed Ion Chromatography

ASTM D5127 — Standard Guide for Ultra Pure Water Used in the Electronics and Semiconductor Industries

ASTM D5173 — Standard Test Method for On-Line Monitoring of Carbon Compounds in Water by Chemical Oxidation, by UV Light Oxidation, by Both, or by High Temperature Combustion Followed by Gas Phase NDIR or by Electrolytic Conductivity

ASTM D5391 — Standard Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample

ASTM D6317 — Standard Test Method for Low Level Determination of Total Carbon, Inorganic Carbon and Organic Carbon in Water by Ultraviolet, Persulfate Oxidation, and Membrane Conductivity Detection

ASTM D7126 — Standard Test Method for On-Line Colorimetric Measurement of Silica

ASTM F1094 — Test Method for Microbiological Monitoring of Water Used for Processing Electron and Microelectronic Devices by Direct Pressure Tap Sampling Valve and by the Presterilized Plastic Bag Method

4.3 SEMATECH Document²

Technology Transfer #92010949B SEMATECH Provisional Test Method for Determining Particle Contribution and Retention by UPW Distribution System Components Appendix 3, SEM Direct Count Method for Bacteria and Particle Enumeration of Ultrapure Water Samples

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 HPW — High Purity Water System

5.1.2 RO — Reverse Osmosis

5.1.3 TOC — Total Organic Carbon

5.1.4 UPW — Ultrapure Water System

5.2 Definitions

5.2.1 *DI (deionized) water* — generally refers to water that has passed through a full-train ion exchange system or RO water that has been polished by ion exchange.

5.2.2 *High Purity Water system (HPW)* — lower grade than UPW, due to lower requirements for dissolved gases, ions, TOC, bacteria and particles. There are two quality choices to be chosen by end user depending on needs:

5.2.2.1 *high purity quality* — quality of HPW required for higher sensitivity PV processes.

5.2.2.2 *standard purity quality* — quality of HPW required for lower sensitivity PV processes.

5.2.3 *raw water* — any untreated natural water like river water, lake water, ground water, or seawater. May also refer to the treated feed water that enters a plant from a municipal drinking water source or other source.

¹ American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959, USA. Telephone: 610.832.9585; Fax: 610.832.9555; <http://www.astm.org>

² SEMATECH, 2706 Montopolis Drive, Austin, TX 78741, <http://www.sematech.org>