

SEMI E49.2-1104

GUIDELINE FOR THE QUALIFICATION OF POLYMER ASSEMBLIES USED IN ULTRAPURE WATER AND LIQUID CHEMICAL SYSTEMS IN SEMICONDUCTOR PROCESS EQUIPMENT

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 16, 2004. Available at www.semi.org in November 2004; originally published in 1995; previously published February 1998.

NOTICE: This Document was completely rewritten in 2004, and is a replacement for the previous versions of both SEMI E49.2 and SEMI E49.3.

NOTICE: Paragraphs entitled NOTE are not an official part of this Document and are not intended to modify or supersede it.

1 Purpose

1.1 The objective of this Document is to provide a guideline by which the purity and mechanical integrity of all ultrapure water (UPW) and liquid chemical assemblies shipped to end users may be qualified. It is also the purpose of this Guideline to complement the following:

- SEMI F57, Provisional Specification For Polymer Components Used in Ultrapure Water and Liquid Chemical Distribution Systems; and
- SEMI E49.7, Purity Guide For the Design and Manufacture of Ultrapure Water and Liquid Chemical Systems in Semiconductor Process Equipment

NOTE 1: As with any SEMI Guide, the practices outlined herein are recommendations, not specifications. Users of this Document should recognize that alternate practices are not excluded as long as they produce results that are equivalent to those produced using the recommendations outlined here and meet the requirements of the end user.

2 Scope

2.1 To ensure the purity and mechanical integrity of UPW and liquid chemical assemblies the following tests and quality guidelines are recommended:

- *Hydrostatic Pressure Tests* — See Table 1, §§ 9.1 and 9.2.
- *Ultrapure Water Flush Test* — See Table 1, §§ 9.1 and 9.3.
- *Particle Test* — See Table 1, §§ 9.1 and 9.4.
- *Ionic and Metallic Contamination Tests* — See Table 1, §§ 9.1 and 9.5.
- *Certification* — See § 10 for defining, establishing, executing, and maintaining a certification program.
- *Traceability* — See § 11 for the responsibilities for suppliers to verify compliance with SEMI F57, SEMI E49.7, and this Document.

2.2 Typical semiconductor process equipment with UPW and liquid chemical delivery assemblies includes, but is not limited to the following:

- Wafer Handling Equipment
- Wafer Cleaning Systems
- Chemical Filtration/Mixing Skids provided by OEM
- Wet Clean Stations
- Wafer Scrubbers
- CMP

- Photolithography Coaters and Developers
- Ion Implanters
- Metrology Equipment
- Ancillary equipment provided with the process equipment.

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 For the purposes of this Document, qualification recommendations are limited to the purity and mechanical integrity of assemblies as outlined in the purpose and scope. Qualification recommendations are not intended to address any other operational parameters (for example, flow capacity, flow rates, reliability, chemical compatibility etc.).

3.2 This Guideline does not define the purity performance requirements of individual components, which may be addressed by SEMI F57. Nor does this Document provide guidelines for the design and manufacture of assemblies, which may be addressed by SEMI E49.7.

3.3 Facility distribution systems are also outside the scope of this Guideline.

3.4 Stainless steel or other non-polymeric assemblies are outside the scope of this Document. Refer to SEMI E49.4, SEMI E49.5, and SEMI E49.6 for information on stainless steel components and assemblies.

3.5 This Guideline is not intended to apply to assemblies used in the delivery of liquids that do not contact the wafer's surface, for example drainage and cooling assemblies.

4 Referenced Standards and Documents

4.1 SEMI Standards and Safety Guidelines

SEMI C59 — Specifications and Guidelines for Nitrogen

SEMI E49.4 — Guide for High Purity Solvent Distribution Systems in Semiconductor Manufacturing Equipment

SEMI E49.5 — Guide for Ultrahigh Purity Solvent Distribution Systems in Semiconductor Manufacturing Equipment

SEMI E49.6 — Guide For Subsystem Assembly and Testing Procedures – Stainless Steel Systems

SEMI E49.7 — Purity Guide for the Design and Manufacture of Ultrapure Water and Liquid Chemical Systems in Semiconductor Process Equipment

SEMI F57 — Provisional Specification for Polymer Components Used in Ultrapure Water and Liquid Chemical Distribution Systems

SEMI F61 — Guide for Ultrapure Water System Used in Semiconductor Processing

4.2 ASTM Standards¹

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

ASTM D5997-96 — Standard Test Method for On-Line Monitoring of Total Carbon, Inorganic Carbon in Water by Ultraviolet, Persulfate Oxidation, and Membrane Conductivity Detection

4.3 Other Documents

Hydrostatic Pressure and Leak Testing of Polymer Piping Systems Used in High-Purity Water Applications²

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>

² Mayer, Burkhardt, Rydzewski, UltraPure Water Journal, May/June 2002, pp. 27–40.

5 Terminology

5.1 See § 4 of SEMI E49.

5.2 For the purposes of this Document, ‘assembly’ or ‘assemblies’ is defined as a combination of two or more UPW or liquid chemical delivery components and is always capitalized when used in this manner.

5.3 For the purposes of this Document, assemblies shipped to end users are those assemblies sent to semiconductor manufacturers which will not undergo any additional testing, cleaning, or other qualification processes. The semiconductor manufacturer may perform additional testing outside the tests outlined by this Document.

5.4 For the purposes of this Document, ‘supply chain’ is defined as those manufacturers involved in producing components, integrating or assembling components, and testing assemblies.

5.5 For the purposes of this Document, components include but are not limited to all product covered by SEMI F57 as well as product not covered by SEMI F57 such as pumps, storage tanks, drums, pressure vessels, filter housing, sensors, monitors, or ultra-filtration, and pumps.

5.6 NIST is the National Institute of Standards and Technology.

6 Performance Guidelines

Table 1 Overview of Recommended Tests

<i>Test</i>	<i>Frequency</i>	<i>Performance Guideline</i>	<i>Test Method/ Reporting of Results</i>
Hydrostatic Pressure	Every assembly shipped to the end user	No visible leakage and $\leq 5\%$ pressure decay	§ 9.1 § 9.2
Ultrapure Water Flush	Every assembly shipped to the end user	Resistivity: $\geq 18 \text{ M}\Omega \cdot \text{cm}$ @ 25°C (77°F) Allowable TOC adders (ppb): ≤ 7.5	§ 9.1 § 9.3
Particle	Periodic testing – see §§ 10.7 and 10.8	Allowable particle adders: (particles/L $\geq 0.1 \mu\text{m}$): ≤ 120	§ 9.1 § 9.4
Ionic Contamination	Periodic testing – see §§ 10.7 and 10.8	Allowable ionic adders (ppb): F ⁻ : ≤ 7.5 Cl ⁻ : ≤ 0.40 NO ₂ ⁻ , Br ⁻ , NO ₃ ⁻ , HPO ₄ ⁼ , SO ₄ ⁼ ≤ 0.05	§ 9.1 § 9.5
Metallic Contamination	Periodic testing – see §§ 10.7 and 10.8	Allowable metallic adders (ppb): Al, Ba, B, Ca, Cr, Cu, Fe, Pb, Li, Mg, Mn, Ni, K, Na, Sr, and Zn: ≤ 0.02	§ 9.1 § 9.5

#1 Table 1 provides an overview of the tests recommended within this Document and associated performance criteria. For detailed explanations of testing frequency, test methods, and some examples of tests, refer to the sections identified within the table.

7 Utility Recommendations

NOTE 2: These are minimum utility recommendations for the media used during qualification of an assembly.

7.1 Nitrogen

- Nitrogen quality should meet requirements of SEMI C59.
- Particle filtration should be 99.99999% removal of 0.003 micron particles.