

SEMI E49.3-0298 (Withdrawn 1104)

GUIDE FOR ULTRAHIGH PURITY DEIONIZED WATER AND CHEMICAL DISTRIBUTION SYSTEMS IN SEMICONDUCTOR MANUFACTURING 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: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONS, lists) therein. The paragraph symbol (§§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§§ and §§§§) the symbols are used to reference more than one section or paragraph, respectively.

NOTICE: This Standard was balloted and approved for withdrawal in 2004; it has been replaced by SEMI E49.2.

1 Purpose

1.1 This Guide specifies guidelines for ultrahigh purity (UHP) deionized water and chemical distribution systems in semiconductor production equipment.

2 Scope

2.1 The distribution systems consist of polymer piping designed to supply the following types of liquid chemicals to the process:

- Acids, bases, and oxidizers
- Deionized water
- Corrosive solvents

2.2 Typical tools include wet clean stations, wafer scrubbers, and photolithography coaters and developers.

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 Referenced Standards and Documents

3.1 SEMI Standards and Safety Guidelines

SEMI E49 — Guide for Standard Performance, Practices, and Sub-Assembly for High Purity Piping Systems and Final Assembly for Semiconductor Manufacturing Equipment

SEMI E49.7 — Guide for Subsystem Assembly and Testing Procedures – Polymer Systems

3.2 ASTM® Standards¹

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

ASTM F1438 — Standard Test Method for Determination of Surface Roughness by Scanning Tunneling Microscopy for Gas Distribution System Components

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

4 Terminology

4.1 Refer to § 4 of SEMI E49.

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>. ASTM trademark is owned by ASTM International.

5 Performance Guidelines

5.1 Leak Tests

5.1.1 Pressure Decay Test

- *Test Media* — Nitrogen (N₂)
- *Pressure* — 2.1 kg/cm² (30 psig) maximum; 1.75 kg/cm² (25 psig) minimum
- *Time* — 120 minutes (2 hours)
- *Fail-Pressure Loss* — >2% of test pressure, after compensation for temperature variation.

5.1.2 Hydrostatic Pressure Test

- *Test Media* — DI water (pumped)
- *Pressurization Media* — Nitrogen (N₂)
- *Pressure* — 2 times operating pressure or 7.0 kg/cm² (100 psig), whichever is less
- *Time* — 4 hours
- *Fail-Pressure Loss* — Any pressure loss or any visible leakage, compensated for temperature gradient and/or material expansion.

5.2 Purity Indices

5.2.1 Particle Count (ptc) at ≥0.2 μm Size

- <2 ptc/L average single count
- <4 ptc/L maximum single count
- Test media is DI water

5.2.2 DI Water Flush Test — The specified limit is the difference between incoming and outgoing DI water.

- *Resistivity* — ±0.2 MΩ·cm.
- *Total Organic Carbons (TOC)* — <2 ppb.

5.3 All performance measures are absolute values, relative to respective test instrument background level.

5.4 Refer to SEMI E49.7 for recommended DI/chemical system testing procedures.

5.5 *Reliability and Maintainability Indices* — Equipment supplier should provide actual DIW/Chemical system performance data and/or component reliability data, accompanied by the associated failure analysis method.

<i>Indices</i>	<i>Hours</i>
Mean time between failure (MTBF)	
Mean time between assists (MTBA)	
Mean time to repair (MTTR)	
Start-up time (Initial)	

6 Design Guidelines

6.1 All polyvinylidene fluoride (PVDF) should be thermally butt welded, as a minimum, using interactive automated welding equipment. Thermal butt welding is preferred.

6.2 All perfluoroalkoxy (PFA) tubing should be joined with a flare compression type technique. Flaring can be done at room temperature or at elevated temperature, depending on the technique required by the component supplier.