



SEMI E49.5-95

GUIDE FOR ULTRAHIGH PURITY SOLVENT DISTRIBUTION SYSTEMS IN SEMICONDUCTOR MANUFACTURING EQUIPMENT

1 Purpose

This document specifies guidelines for ultrahigh purity (UHP) solvent distribution systems in semiconductor production equipment.

2 Scope

2.1 The distribution systems consist of stainless steel (SS) piping designed to supply flammable solvents only.

2.2 Typical tools include photolithography track equipment, solvent wet stations, and isopropyl alcohol vapor dryers.

3 Referenced Documents

3.1 *Generic Standards and Specifications* — See Section 3 of SEMI E49 and Section 10 of this document.

3.2 *Guide for Subsystem Assembly and Testing Procedures - Stainless Steel Systems* — See SEMI E49.6 and Section 3 of SEMI E49.

3.3 *American Society of Testing and Materials (ASTM) Standards*¹ — See Section 3.3 of SEMI E49.

3.4 *American Society of Metals (ASM) Document*²

ASM UNS S31603 — Composition of Standard Stainless Steels

4 Terminology

See Section 4 of SEMI E49.

5 Performance Guidelines

5.1 Leak Test and Purity Indices

5.1.1 Pressure Decay Test

- Test Media — Nitrogen (N₂)
- Pressure — 2 times system operating pressure
- Time — 24 hours

- Temperature — Constant
- Fail — Pressure loss > 1% of test pressure

5.1.2 N₂ Particle Count (ptc), at ≥ 0.1 μm Size

- < .18 ptc/L (< 5 ptc/ft³) average single count
- < 1.8 ptc/L (< 50 ptc/ft³) maximum single count

5.1.3 Moisture Level — ≤ 200 ppb

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

5.3 See SEMI E49.6 (Guide for Subassembly and Testing Procedures - Stainless Steel Systems) for recommended solvent system testing procedures.

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

Indices	Hours
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 weld joints should be automatically orbital butt welded.

6.2 Mechanical fittings should be used where required for component removal/replacement.

6.3 Dead volumes should be less than three pipe diameters in length/height. Blind runs such as pressure gauges should not be used.

6.4 A means of process liquid sampling should be installed as close as possible to point of dispense.

6.5 Incoming process liquids require filters and should be located downstream of any regulator and as close as possible to point of dispense.

¹ American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

² American Society of Metals, Metals Park, OH 44073



6.6 The system internal volume should be minimized by use of Dead Space Free (DSF) branch valves and/or multi-component integrated assemblies.

6.7 Design should include a means of flow through flushing and draining for removable components or assemblies.

6.8 Pumping systems should include surge/pulse suppression devices and provisions for vibration isolation.

6.9 Supply and drain lines on a recirculation system should be separated by an isolation valve. The system should not use one line to perform both functions.

6.10 All filters should be able to be isolated from process stream for maintenance.

6.11 Ball and needle type valves should not be used.

6.12 Backflow/back pressure protection should be included in the system.

6.13 For processes requiring pressure control, regulators should be included in the system. Pressure transducers and a means of pressure display should be included on the equipment.

6.14 The systems should have a means of manifold-ing supply and drain lines onboard, so that there is a single point connection for each individual liquid.

7 Materials Guidelines

7.1 *Material Mechanical Characteristics - Stainless Steel*

7.1.1 All tubing greater than or equal to 1.27 cm (1/2 in.) diameter should conform to ASTM A 269.

7.1.2 Tubing less than 1.27 cm (1/2 in.) diameter should conform to ASTM A 632.

7.1.3 All bar stock should conform to ASTM A 479.

7.1.4 All steel should conform to ASM UNS S31603 for chemical composition with the following exceptions:

- Sulfur as reported by the SMTR $\leq 0.030\%$
- Carbon as reported by the SMTR $\leq 0.030\%$

7.2 Stainless steel should be 316L electropolished for solvent system wetted flow streams.

7.3 Materials for valve seats, diaphragms, gaskets, and O-rings should be chemically compatible to the process gas.

7.4 *Material Performance Guidelines*

7.4.1 The performance guidelines below are SS qualification values to be demonstrated by the original component manufacturer. Semiconductor equipment suppliers should provide proof that their components conform to these requirements.

7.4.2 The performance tests should be considered production qualification tests. It is the responsibility of the component manufacturer to provide statistically valid data which correlates their production tests to these qualification tests (e.g., Statistical Process Control, MIL-STD-105D).

7.4.3 The equipment supplier should be responsible for maintaining and supplying, upon request, documentation that proves their components meet the user's materials performance requirements.