

SEMI E49.4-0298

GUIDE FOR HIGH PURITY SOLVENT DISTRIBUTION SYSTEMS IN SEMICONDUCTOR MANUFACTURING EQUIPMENT

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1 Purpose

1.1 This Document specifies guidelines for high purity (HP) 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 processes are photolithography track equipment, solvent wet stations, and isopropyl alcohol vapor dryers.

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 E49.6 — Guide for Subsystem Assembly and Testing Procedures - Stainless Steel Systems

SEMI F1 — Specification for Leak Integrity of High-Purity Gas Piping Systems and Components

3.2 ASTM Standards¹

3.3 See § 3.3 of SEMI E49.

3.4 ASM Document²

ASM UNS S31603 — Composition of Standard Stainless Steels

3.5 ASME Document³

ASME SA479 — Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels (ASTM A479/A479-90) (Boiler and Pressure Vessel Codes, 1989)

4 Terminology

4.1 See § 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

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 American Society of Metals, Metals Park, OH 44073

³ American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990, USA; Telephone: +1.973.882.1170, Fax: +1.973.882.1717, <https://www.asme.org>

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

5.1.2 N₂ Particle Count (ptc), at ≥0.2 μm size

- <0.18 ptc/L (<5 ptc/ft³) average single count
- <1.8 ptc/L (<50 ptc/ft³) maximum single count

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

5.3 See SEMI E49.6 for recommended gas 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.

<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 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 five pipe diameters in length/height. Pressure gauges with gauge protectors should be used. Pressure transducers are optional.
- 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.
- 6.6 Design should include a means of flow through flushing and draining for removable components or assemblies.
- 6.7 Pumping systems should include surge/pulse suppression devices and provisions for vibration isolation.
- 6.8 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.
- 6.9 All filters should be able to be isolated from process stream for maintenance.
- 6.10 Backflow/back pressure protection should be included in the system.
- 6.11 For processes requiring pressure control, regulators should be included in the system.
- 6.12 The system should have a means of manifolding 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 (½ in.) diameter should conform to ASTM A269.
- 7.1.2 Tubing less than 1.27 cm (½ in.) diameter should conform to ASTM A632.
- 7.1.3 All bar stock should conform to ASTM A479 or ASME SA479.