

SEMI E49.9-0298 (Withdrawn 0303) GUIDE FOR ULTRAHIGH PURITY GAS DISTRIBUTION SYSTEMS IN SEMICONDUCTOR MANUFACTURING EQUIPMENT

This Standard was technically approved by the Gases Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee. 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: Paragraphs entitled 'NOTE:' are not an official part of this Standard or Safety Guideline and are not intended to modify or supersede the official Standard or Safety Guideline. These have been supplied by the global technical committee to enhance the usage of the Standard or Safety Guideline.

NOTICE: This Standard was balloted and approved for withdrawal in 2003; it has been replaced by SEMI E49.8.

1 Purpose

1.1 This Guide specifies guidelines for ultrahigh purity (UHP) gas distribution systems in semiconductor production equipment.

2 Scope

2.1 Gas distribution systems consist of stainless steel (SS) piping designed to supply the following types of gases to the process chamber:

2.1.1 *Specialty Gases* — Corrosive, flammable, pyrophoric, oxidizer, toxic, inert, and mixtures.

2.1.2 *Bulk Gases* — Nitrogen, oxygen, argon, hydrogen, and helium.

2.2 Typical processes include diffusion, anneal, plasma etch, chemical vapor deposition, physical vapor deposition, and ash.

3 Referenced Standards and Documents

3.1 SEMI Standards and Safety Guidelines

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 ASMETM Standards¹

ASME SA479 — Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

3.3 ASM Documents²

ASM UNS S31603 — Composition of Standard Stainless Steels

3.4 ASTM[®] Standards³

ASTM A269 — Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

¹ The 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>. ASME trademark is owned by The American Society of Mechanical Engineers.

² American Society of Metals, Metals Park, OH 44073, USA.

³ 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.

ASTM A479 — Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A632 — Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

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

ASTM F1372 — Standard Test Method for Scanning Electron Microscope (SEM) Analysis of Metallic Surface Condition for Gas Distribution System Components

ASTM F1375 — Standard Test Method for Energy Dispersive X-Ray Spectrometer (EDX) Analysis of Metallic Surface Condition for Gas Distribution System Components

ASTM F1394 — Standard for Determination of Particle Contribution from Gas Distribution System Valves

ASTM F1397 — Standard Test Method for Determination of Moisture Contribution for Gas Distribution System Components

3.5 NFPA® Documents⁴

NFPA 49 — Hazardous Chemicals Data

NFPA 704 — Standard System for the Identification of the Fire Hazards of Materials

3.6 SEMATECH Specifications⁵

SEMASPEC 90120392B — Test Method for Determination of Regulator Performance Characteristics for Gas Distribution System Components

SEMASPEC 90120393B — Test Method for Determination of Filter Flow Pressure Drop Curves for Gas Distribution System Components

SEMASPEC 90120394B — Test Method for Determination of Valve Flow Coefficients for Gas Distribution System Components

SEMASPEC 90120400B — Test Method for Determination of Surface Roughness by Contact Profilometry for Gas Distribution System Components

SEMASPEC 90120403B — Test Method for XPS Analysis of Surface Composition and Chemistry of Electropolished Stainless Steel Tubing for Gas Distribution System Components

SEMASPEC 90120573B — Test Method for AES Analysis of Surface and Oxide Composition of Electropolished Stainless Steel Tubing for Gas Distribution System Components

4 Terminology

4.1 Refer to § 4 in SEMI E49.

5 Performance Guidelines

5.1 Purity Indices

- Particle Count (ptc), at $\geq 0.02 \mu\text{m}$.
 - $\leq 0.18 \text{ ptc/L}$ (5 ptc/ft^3) average single count.
 - $\leq 1.8 \text{ ptc/L}$ (50 ptc/ft^3) maximum single count.
- Moisture Level — $\leq 20 \text{ ppb}$.
- Oxygen Level — $\leq 10 \text{ ppb}$.
- Total Hydrocarbon (THC) — $\leq 20 \text{ ppb}$.

⁴ National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, USA; Telephone: +1.617.770.3000, Fax: +1.508 895-8301, <http://www.nfpa.org>. NFPA trademark is owned by National Fire Protection Association.

⁵ SEMATECH, 257 Fuller Road, Suite 2200, Albany, NY 12203, USA; Telephone: +1.518.649.1000, <http://www.sematech.org>