SEMI E49-0702
GUIDE FOR STANDARD PERFORMANCE, PRACTICES, AND SUB-ASSEMBLY FOR HIGH PURITY PIPING SYSTEMS AND FINAL ASSEMBLY FOR SEMICONDUCTOR MANUFACTURING EQUIPMENT

1 Purpose

The purpose of this overview is to provide a basic set of definitions and reference documents for SEMI E49.1 - SEMI E49.9.

2 Scope

These documents reference many performance and method standards that were developed in North America. For semiconductor equipment that will be installed or manufactured in other countries, the users should request compliance to the equivalent or similar performance requirements in their equipment proposal request or purchase order documents.

2.1 The documents in this guide are organized by types of piping distribution systems — gas, DI/chemical, solvent — and by types of assembly and testing procedures — sub-assembly for stainless steel, sub-assembly for polymer and final tool assembly.

2.2 The piping distribution documents include guidelines for system design, performance, materials, and components. Two purity and performance grades are described for each of the three types of distribution systems:

2.2.1 *High Purity (HP)* — For industry standard systems consisting of high grade materials, components, and standard design/configuration, assembly method, and performance capability.

2.2.2 *Ultrahigh Purity (UHP)* — For advanced or special systems consisting of higher grade materials and components, with advanced or integrated design and configuration, the latest assembly methods, and enhanced performance capabilities, especially related to purge or rinse time and contamination levels.

2.2.3 HP systems should have only marginal effect on overall tool purchase price. UHP systems are more customized and have a higher purchase price than HP systems, but the very expensive exotic and/or highly specialized materials and components are not in the scope of UHP. Users should complete an overall tool cost of ownership analysis to determine the optimum application of HP or UHP tool features. Key parameters should include facilities cost and installation cycle time, piping system reliability and maintainability factors, tool and sub-system contribution to contamination, and resultant effects on wafer quality and wafer throughput factors.

3 Referenced Documents

3.1 *SEMI Standards*[1]

SEMI E10 — Guideline for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM)

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

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

SEMI F1 — Specification for Leak Integrity of Toxic Gas Piping Systems

3.2 *American Society of Mechanical Engineers*[2]

ASME SA479 — Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels (ASTM A 479/A 479-90) (Boiler and Pressure Vessel Codes, 1989)

3.3 *ASTM Standards*[3]

ASTM A 269 — Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM A 479 — Standard Specification for Stainless and Heat-Resisting Steel Bar and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A 632 — Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

ASTM D 4327 — Standard Test Method for Anions in Water by Chemically Suppressed Ion Chromatography

ASTM F 1372 — Standard for Scanning Electron Microscope (SEM) Analysis of Metallic Surface Condition for Gas Distribution System Components

ASTM F 1373 — Test Method for Determination of Cycle Life of Automatic Valves for Gas Distribution System Components

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1 Semiconductor Equipment and Materials International, 805 East Middlefield Road, Mountain View, CA 94043

2 American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017

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

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ASTM F 1375 — Test Method for EDX Analysis of Metallic Surface Condition for Gas Distribution System Components

ASTM F 1394 — Standard for Determination of Particle Contribution from Gas Distribution System Valves

ASTM F 1397 — Test Method for Determination of Moisture Contribution for Gas Distribution System Components

ASTM F 1400 — Test Method for Determination of Helium Leak Rate for Gas Distribution System Components

ASTM F 1438 — Test Method for Determination of Surface Roughness by Scanning Tunneling Microscopy for Ultra Pure Water Distribution Components

3.4 *Federal Information Processing Standard*

FED-STD — Federal Standard Cleanroom and Work Station Requirements, Controlled Environment

3.5 *Institute of Environmental Sciences Documents*[4]

IES-RP-CC-001 — Recommended Practices for HEPA Filters

IES-RP-CC-002 — Recommended Practices for Laminar Flow Clean Air Devices

IES-RP-CC-003 — Recommended Practices for Garments Required in Cleanrooms and Controlled Environmental Areas

IES-RP-CC-006 — Recommended Practices for Testing Cleanrooms

3.6 *National Fire Protection Association*[5]

NFPA 49 — Hazardous Chemicals Data

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

3.7 *Military Standards*[6]

MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes

4 Terminology

4.1 *Abbreviations and Acronyms*

Ar — Argon

ASME — American Society of Mechanical Engineers

ASTM — American Society of Testing and Materials Standards

C_v — valve flow coefficient

CVD — chemical vapor deposition

DSF — dead space free

DIW — deionized; for this document, used as deionized water

EDX — Energy-dispersive X-ray

ESCA — Electron spectroscopy for chemical analysis (also known as XPS)

FTIR — Fourier transform infrared

HD — high density, i.e., polymer

HP — high purity

HPM — Hazardous production material

IEEE — Institute of Electrical and Electronics Engineers, Inc.

ID/OD — inside/outside (i.e., diameter)

IPA — Isopropyl alcohol

MFC — mass flow controller

MTBA — mean time between assists

MTBF — mean time between failure

MTTR — mean time to repair

PFA — perfluoroalkoxy

PPB — parts per billion

PTFE — polytetrafuorethylene

PVDF — polyvinylidend fluoride

QA — quality assurance

QC — quality control

R_a — Roughness average (e.g., surface)

SEMI — Semiconductor Equipment and Materials International

SMTR — Smelter's test report

SPC — Statistical process control

TEOS — Tetraethylorthosilicate

TOC — total organic carbons

UHP — Ultrahigh purity

WC — water column, inches (cm) of water

4 Institute of Environmental Sciences, 940 East Northwest Highway, Mount Prospect, IL 60056

5 National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

6 Military Specifications, Commanding Officer, Naval Publications, and Forms Center, Attention: MPFC 105, 5801 Tabor Avenue, Philadelphia, PA 19120

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