

SEMI E49.6-1103 (Reapproved 1211) GUIDE FOR SUBSYSTEM ASSEMBLY AND TESTING PROCEDURES – STAINLESS STEEL SYSTEMS

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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.

1 Purpose

1.1 This Guide establishes standard guidelines for cleanroom activities specific to the manufacturing, assembly, testing, and integration of materials and components used in stainless steel semiconductor manufacturing equipment.

2 Scope

2.1 This Standard has been developed as a guide for the assembly and testing of high purity and ultrahigh purity gas and solvent subsystems.

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 C57 — Specification for Argon

SEMI C59 — Specification for Nitrogen

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

SEMI F58 — Test Method for Determination of Moisture Dry-Down Characteristics of Surface-Mounted and Conventional Gas Distribution Systems by Atmospheric Pressure Ionization Mass Spectrometry (APIMS)

SEMI F70 — Test Method for Determination of Particle Contribution of Gas Delivery System

SEMI F78 — Practice for Gas Tungsten Arc (GTA) Welding of Fluid Distribution Systems in Semiconductor Manufacturing Applications

SEMI F81 — Specification for Visual Inspection and Acceptance of Gas Tungsten Arc (GTA) Welds in Fluid Distribution Systems in Semiconductor Manufacturing Systems

3.2 ASTM® Standards¹

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

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

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.

4 Terminology

4.1 Refer to § 4 of SEMI E49.

5 Facility Guidelines

5.1 *Gowning Area Class 10,000/1,000 (ISO Class 7/6) for HP/UHP* — All personnel working in cleanrooms should wear paper booties prior to entering the gowning area. Personnel should wear polyester gowns, hood, and boots, pure latex or nitrile gloves (no talc), and safety glasses before entering clean areas.

5.2 *Materials Staging Area Class 10,000/1,000 (ISO Class 7/6) for HP/UHP* — Materials used in the cleanroom should have the outer bag removed and the inner bag wiped down with cleanroom wipes saturated with a 50/50, 30/70, or 10/90 IPA/DI mix in the materials staging area prior to entry into the cleanroom.

5.3 *Assembly/Test Area Class 100 (ISO Class 5) for HP and UHP* — Welding cleanroom requirements must be met per SEMI F78.

5.4 Packaging area class 100 (ISO Class 5) for HP and UHP.

6 Utility System Guidelines

6.1 *Purge Gases* — Argon or nitrogen must be used for purging gas systems during assembly and for testing, using cryogenic source. Particle filtration should be 99.99999% removal of 0.003 µm particles.

- Argon quality should meet the requirements of SEMI C57.
- Nitrogen quality should meet the requirements of SEMI C59.

7 Materials Procedures

7.1 *Procedures for Incoming Materials and Components (Component Suppliers)*

7.1.1 *Identification Guidelines*

7.1.1.1 Every deliverable item should have some scheme of positive and permanent identification, so that traceability is provided from the steel melt source to the final metal finishing and packaging through site installation.

7.1.1.2 This identification should provide nondestructive post installation traceability.

7.1.1.3 Clearly visible labeling (without the need to open the package) should be provided at each level of packaging.

7.1.2 *Packaging and Shipping Guidelines*

7.1.2.1 Double bagging should be required. Multiple inner bags are acceptable.

7.1.2.2 The inner bag should be cleanroom compatible and should prevent damage from normal handling.

7.1.2.3 Vacuum sealing or dry inert gas purging should be used on the inner bag.

7.1.2.4 The ends of the component should be protected using some non-contaminating method.

7.1.2.5 The outer bag may be any suitable material.

7.1.3 *Documentation*

7.1.3.1 Components should be identified by lot number or serial number.

7.1.3.2 Initial testing shall be conducted to qualify new designs and processes including changes, as applicable. The component manufacturer shall establish a procedure for periodic monitoring of the manufacturing process to ensure continual compliance to requirements as noted in this Guide. Documentation records must be kept available for inspection for at least one year.

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

7.2 Receiving

7.2.1 All incoming material should be segregated from 'acceptable material' until it has been formally accepted through documented procedure.

7.2.2 All cartons should be opened (100%); all goods should be checked visually for damage (e.g., torn bags, inadequate padding causing damage).

7.2.3 Material should be stored in original packaging. Do not open until ready to use or inspect. Inspection involving opening sealed plastic bags should be conducted within the materials staging cleanroom. After inspection, purge and heat-seal the material into a clean polyethylene bag.

7.2.4 Any material failing initial inspection should be immediately 'red tagged' and set aside in a 'quarantine' area until the supplier of the material is notified and disposition is determined.

7.3 Acceptance and Rejection of Incoming Material

7.3.1 All material should be identified by lot number or serial number, allowing traceability back to source documentation. All material should be identified with a heat code, allowing traceability back to the raw material heat. Only material so marked should be accepted.

7.3.2 All material should meet a purchasing specification and be provided with documentation demonstrating compliance. Only material so documented should be accepted.

7.3.3 A mutually agreeable quality program, including sampling, should be used to inspect and test components and assemblies for parameters such as: surface contamination (e.g., hydrocarbon, particulate), tubing quality, wall thickness, nicks, scratches; surface roughness, pits, stringers, particle count, weldability, helium leak rate (inboard/outboard/across seat), and dimensions.

7.3.4 The material should be accepted only after these incoming QA checks are completed.

8 Construction Procedures

8.1 Systems shall be constructed in accordance with SEMI F78 and inspected per SEMI F81.

8.2 Subsystem Assembly Protocol

8.2.1 Gas panel and solvent system assembly should be performed only by trained competent personnel.

8.2.2 Proper procedures for tightening face seal and other connections, valve bonnets, regulator bonnets, and other components should be followed at all times. Manufacturers recommended assembly instructions should be followed at all times.

8.2.3 To minimize entrained contaminants, components and subassemblies should be capped or under purge before and after assembly. Partially assembled gas panels should be under purge or capped at all times.

8.2.4 Assemblers should at all times be wearing clean gloves; soiled, discolored or torn gloves should be replaced immediately.

8.2.5 Components, assemblies or subassemblies which are dropped or damaged during the assembly process should be red-tagged and inspected before use. Face seal gaskets which are dropped should be discarded.

9 Assembly Qualification and Quality Assurance

9.1 Tests should be successfully completed and results documented for all performance parameters (purity indices) specified.

9.2 Leak rate tests should be conducted on 100% of all subsystems per SEMI F1.

9.3 *Design Qualification* — Gas delivery system design performance should be qualified in terms of two parameters: particulate generation and contaminant spike recovery. This testing should be performed on the initial gas delivery system prototype and on any design revision which significantly impacts the component selection or system configuration. Test results should be kept on file and made available to the end user upon request.

9.3.1 *Particulate Generation* — Static and dynamic particle testing should be performed in accordance with SEMI F70 with a flow rate of at least 3 times the maximum process flow rate at the recommended supply pressure,