

SEMI E137-1104

GUIDE FOR FINAL ASSEMBLY, PACKAGING, TRANSPORTATION, UNPACKING, AND RELOCATION OF SEMICONDUCTOR MANUFACTURING EQUIPMENT

This guide was technically approved by the Global Gases Committee and is the direct responsibility of the North American Gases Committee. Current edition approved by the North American Regional Standards Committee on July 11, 2004. Initially available at www.semi.org September 2004; to be published November 2004.

NOTICE: This standard replaces SEMI E49.1, which has been removed from publication as of the November 2004 (1104) publication cycle.

1 Purpose

1.1 The objective of this document is to establish standard guidelines for activities specific to the final assembly, packaging, transportation, unpacking, and relocation of semiconductor manufacturing equipment (SME) to the cleanroom manufacturing area.

2 Scope

2.1 This standard has been developed as a guide for final assembly through relocation of SME, separate subassemblies, and components from the customer's loading dock/receiving area to their cleanroom manufacturing area for both high and ultrahigh purity applications.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Specific guidance associated with environment, health, and safety (EHS) concerns are not in the scope of this document.

NOTE 1: The SEMI EHS Technical Committee is working on a new related safety guideline document that provides EHS considerations for SME preparation, packaging, shipping, and handling including the handling of shipping and packaging materials.

3.2 Process specifications related to wafer particles and/or quality (e.g., ionic contamination) are not in the scope of this document. Parameters, such as particles per wafer pass (PWP), should be in the customer's specific equipment process performance specification.

4 Referenced Standards

4.1 SEMI Standards

SEMI C41 — Specifications and Guidelines for 2-Propanol

SEMI F63 — Guidelines for Ultrapure Water Used in Semiconductor Processing

4.2 ISO Standard¹

ISO 14644-1 — Cleanrooms and Associated Controlled Environments, Part 1: Classification of Air Cleanliness

4.3 APA — The Engineered Wood Association²

NOTE 2: The APA — Engineered Wood Association was formerly known as the American Plywood Association.

PS 1 — Voluntary Product Standard for Construction and Industrial Plywood

4.4 USA Department of Defense (DOD)³

MIL-D-3464 — Military Specification — Desiccants, Activated, Bagged, Packaging Use and Static Dehumidification

MIL-PRF-131 — Performance Specification — Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-sealable

1 International Organization for Standardization, ISO Central Secretariat, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland. Telephone: 41.22.749.01.11; Fax: 41.22.733.34.30, Website: www.iso.ch

2 APA-The Engineered Wood Association, 7011 So. 19th, Tacoma, WA 98466, (253) 565-6600, Fax: (253) 565-7265 Website: <http://www.apawood.org>

3 United States of America (USA) Department of Defense (DOD) ASSIST Quick-Search, Website: <http://www.dodssp.daps.mil/products.htm>

4.5 Western Wood Products Association (WWPA)⁴

Western Lumber Grading Rules (WLGR)

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

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 DOD — Department of Defense

5.1.2 EPS — Expanded Polystyrene

5.1.3 IPA — Isopropyl Alcohol (2-propanol)

5.1.4 ISO — International Organization for Standardization

5.1.5 PO — Purchase Order

5.1.6 PWP — Particles Per Wafer Pass

5.1.7 SEMI — Semiconductor Equipment and Materials International

5.1.8 SME — Semiconductor Manufacturing Equipment

5.1.9 UPW — Ultrapure Water

5.1.10 USA — United States of America

5.1.11 WLGR — Western Lumber Grading Rules

5.1.12 WWPA — Western Wood Products Association

6 Cleaning and Wrapping Materials

6.1 For cleaning and triple wrap packaging, the following materials are recommended:

6.1.1 UPW (reference SEMI F63)

6.1.2 IPA (reference SEMI C41)

6.1.3 Ultralow particle generation, ultralow extractable ion level, polyester, ISO ST 14644-1 (subsequently called ISO) Class 5 cleanroom-compatible swabs and wipes with sealed edges

6.1.4 Ultralow particle generation, hydrocarbon-free, ultralow extractable ion level, ~150 µm (0.006 in.) thick, natural polyethylene film

6.1.5 Ultralow particle generation adhesive tape

7 Assembly and Pre-Packaging Procedures

7.1 Pre-Assembly

7.1.1 Machining, sawing, welding, brazing, grinding, sanding, and other manufacturing operations incompatible with cleanrooms should be completed before components are brought into the clean assembly area.

7.1.2 All SME components should be vacuumed, blown off with filtered air, and cleaned with a solution of 10 to 70% IPA diluted in UPW using wipes and swabs immediately prior to being brought into the clean assembly area.

7.1.3 Cutting oils, lubricants, and solder flux should be removed before components are brought into the clean assembly area.

7.2 Clean Assembly Area

7.2.1 All components of the SME should be assembled in at least an ISO Class 6 or better (ISO Class 5 preferred) cleanroom.

7.2.2 A set of clean assembly tools should be maintained in the clean assembly area.

7.2.2.1 If this is not possible, tools should be vacuumed, blown off with filtered air, and cleaned with a solution of 10 to 70% IPA diluted in UPW using wipes and swabs immediately prior to each time they reenter the clean assembly area.

7.2.2.2 The assembly tools in the clean assembly area should be cleaned periodically and as needed if they become contaminated during usage.

7.3 Pre-Packaging

7.3.1 All SME with water (including UPW) or other liquids should be fully emptied and completely dried using dry, hydrocarbon-free air or nitrogen.

7.3.1.1 All SME with UPW that comes in direct contact with the production units (e.g., wafers) should have lines, baths, tanks, etc. flushed with a bacteria retardant (e.g., H₂O₂ solution, iodine/UPW solution) before emptying them fully.

7.3.2 All utility lines should be capped before and during shipment.

7.3.3 The SME with vacuum chambers should have these chambers and vacuum lines sealed and shipped under vacuum.

7.3.4 The SME should be clearly marked showing correct lifting points for removal from shipping container.

⁴ Western Wood Products Association (WWPA), 522 SW Fifth Ave. Suite 500, Portland, Oregon 97204-2122, Tel: 503-224-3930, Fax: 503-224-3934, Website: <http://www.wwpa.org>

7.3.5 Following final assembly and test, all exposed surfaces should be thoroughly cleaned with a solution of 10 to 70% IPA diluted in UPW using wipes and swabs.

7.3.6 The SME should be inspected thoroughly for cleanliness.

7.3.6.1 The supplier should provide a copy of their inspection results (e.g., marked checklist) with the SME.

8 Triple Wrap Strategy

8.1 The following procedures support the strategy of totally enclosing and sealing the SME, separate subassemblies, or support components in three layers of protective wrapping (see Section 9) so that each layer forms a protective seal against moisture and particles.

8.2 Each individual wrap layer is intended to be removed at a specific stage of delivery and relocation (see Section 16) adhering to the following guidelines.

8.2.1 *Inner Wrap* — This inner wrap should stay with the SME, separate subassemblies, and components all the way into the final cleanroom or a staging area of the same cleanliness level for wipe down. The wrap should be cleaned prior to movement into the cleanroom.

8.2.2 *Middle Wrap* — This middle wrap should stay with the SME, separate subassemblies, and components until they reach at least an ISO Class 7 intermediate staging area. The wrap should be cleaned before leaving the customer's loading dock/receiving area and again before it is removed in the staging area.

8.2.3 *Outer Wrap* — This wrap is used to protect the SME, separate subassemblies, and components while in transit to the loading dock. While the SME, separate subassemblies, and components are on the customer's loading dock/receiving area, the outer shipping materials should be removed. The wrap should also be cleaned and removed.

9 Packaging Procedures

9.1 *Packaging in Clean Assembly Area* — The SME, separate subassemblies, and components should then be totally enclosed in a clean polyethylene inner wrap using tape as required.

9.1.1 A humidity indicator should be included inside of the initial wrapping layer.

9.1.2 If two sets of pallets are used, the inner pallet should also meet the requirements of Section 10.2 and should be enclosed with the SME, separate subassemblies, and components.

9.1.2.1 The inner pallet should be clearly marked showing correct lifting points for removal from shipping container.

9.2 *Packaging in Dedicated Clean Packaging Area* — After the inner (i.e., first) wrap is applied, the SME, separate subassemblies, and components should be relocated to a dedicated clean (ISO Class 7 or better) packaging area.

9.2.1 SME, separate subassemblies, and components should then be totally enclosed in two more independent layers (i.e., middle and outer wraps) of clean polyethylene film using tape as required.

9.2.2 After the SME, separate subassemblies, and components are triple wrapped, they should be placed on a pallet (see Sections 10 and 11) so that the triple wrapping is not damaged or violated.

9.2.2.1 The pallet should be movable (with SME, separate subassemblies, and components attached to it) with a conventional pallet jack or forklift.

9.2.2.2 The SME, separate subassemblies, and components should be capable of placement on and removal from the pallet with a conventional pallet jack or fork lift without compromising or tearing any of the triple wrapping.

9.3 After placement on the pallet, the SME, separate subassemblies, and components should be relocated to a separate crating area.

10 Crating Procedures

10.1 Design

10.1.1 The maximum outside crating dimensions should be sized not to exceed the maximum size requirements for method(s) of shipment (e.g., airfreight, air-ride trailers).

10.1.1.1 Crating shape and dimensions should be optimized to obtain transportation cost savings, when possible.

10.1.2 To ensure crate stability in transit, any crate over 1.2 m (48 in.) tall should be constructed so that the narrowest other dimension is no less than half the crate's height.

10.2 Crating/Packaging Materials

10.2.1 All wood products used should meet the regulatory requirements (e.g., heat treated wood regulations) of the country of delivery and any interim countries that the SME may be transported through.