SEMI E62-1106
SPECIFICATION FOR 300 mm FRONT-OPENING INTERFACE MECHANICAL STANDARD (FIMS)

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1 Purpose

1.1 This Standard specifies the tool side of the interface between a process or metrology tool and a front-opening box.

2 Scope

2.1 This Standard is intended to set an appropriate level of specification that places minimal limits on innovation while ensuring modularity and interchange-ability at all mechanical interfaces. Only the physical interface is specified; no materials requirements or micro-contamination limits are given. The interface specified in this standard can be for a sealed mini-environment, but it could also just be a well-defined automation interface.

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 E1.9 — Mechanical Specification for Cassettes Used to Transport and Store 300 mm Wafers

SEMI E15 — Specification for Tool Load Port

SEMI E19 — Standard Mechanical Interface (SMIF)

SEMI E47.1 — Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers

SEMI E57 — Mechanical Specification for Kinematic Couplings Used to Align and Support 300 mm Wafer Carriers

SEMI M31 — Provisional Mechanical Specification for Front-Opening Shipping Box Used to Transport and Ship 300 mm Wafers

3.2 *ISO Standard*[1]

ISO 4287 — Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters

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

4 Terminology

4.1 *Definitions*

4.1.1 *bilateral datum plane* — a vertical plane that bisects the wafers and that is perpendicular to both the horizontal and facial datum planes (as defined in SEMI E57).

4.1.2 *box* — a protective portable container for a cassette and/or substrate(s).

4.1.3 *carrier capacity* — the number of substrates that a carrier holds (as defined in SEMI E1.9).

4.1.4 *cassette* — an open structure that holds one or more substrates.

4.1.5 *door seal zone* — a surface on the exterior side of the port door for sealing to the box door.

[1] International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, http://www.iso.org

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4.1.6 *facial datum plane* — a vertical plane that bisects the wafers and that is parallel to the front side of the carrier (where wafers are removed or inserted). On tool load ports, it is also parallel to the load face plane specified in SEMI E15 on the side of the tool where the carrier is loaded and unloaded (as defined in SEMI E57).

4.1.7 *frame seal zone* — a surface on the exterior side of the frame of the port door for sealing to the frame of the box door.

4.1.8 *horizontal datum plane* — a horizontal plane from which projects the kinematic-coupling pins on which the carrier sits. On tool load ports, it is at the load height specified in SEMI E15 and might not be physically realized as a surface (as defined in SEMI E57).

4.1.9 *load face plane* — the furthest physical vertical boundary plane from the cassette centroid or carrier centroid on the side (or sides) of the tool where loading of the tool is intended (as defined in SEMI E15).

4.1.10 *minienvironment* — a localized environment created by an enclosure to isolate the product from contamination and people.

4.1.11 *pod* — a box having a standard mechanical interface (SMIF) as defined in SEMI E19.

4.1.12 *wafer carrier* — any cassette, box, pod, or boat that contains wafers (as defined in SEMI E15).

5 Ordering Information

5.1 The purchaser of a load port must specify whether the load port is intended for a SEMI E47.1 compliant front-opening box or a FOSB with automated-shippable door according to SEMI M31 (see ¶ 6.8 for details).

6 Requirements

6.1 *Datum Planes* — The physical alignment mechanism from the box to the tool load port consists of features (not specified in this standard) on the box that mate with three or six pins underneath as defined in SEMI E57. Most of the dimensions of the interface from the box to the tool load port are determined with respect to the three orthogonal datum planes defined in that standard: the horizontal datum plane, the facial datum plane, and the bilateral datum plane. However, the dimensions in this standard do not apply when the box is placed on the load port, but rather when the box has been moved horizontally into place against the front-opening interface. Otherwise, the front-opening interface would interfere with the kinematic coupling during loading, and the minimum rear clearance in SEMI E15 would be violated.

6.2 *Symmetry* — All of the dimensions for the interface are bilaterally symmetric about the bilateral datum plane and about a plane *z*30 above the horizontal datum plane with the following exceptions (as viewed by a person standing in front of the tool and facing the interface):

- The registration pins are in the lower right and upper left quadrants of the port door.
- Both latch keys turn 90° counter-clockwise from vertical to unlatch the box door from the box.

6.3 *Door Alignment Maintenance Mechanism* — The two registration pins that are used to limit the maximum displacement of the box door while on the port door are shown in Figures 1 and 2 and specified in Table 1. The over-all surface finish of the registration pins must have a final roughness height less than or equal to *r*47. The registration pins are surrounded by reserved space for optional vacuum application.

6.4 *Locking Mechanism* — The box door is locked and unlocked by a set of two 13.5 mm by 5 mm heads on shafts that have a 5 mm diameter. These latch keys must unlatch the box door from the box by rotating counter-clockwise to horizontal and must latch the box door to the box by rotating clockwise to vertical (as viewed by a person standing in front of the tool facing the *interface*). The latch keys must not rotate beyond these limits of the rotation angle ψ. To allow seal compression by latches, the torque delivered by the port to turn the latch keys must be at least *f*30. Thus, it is recommended that no box door be designed that needs more torque than this. Figure 3 shows front, side and top views of the latch keys. In addition, convex features on the outer edges of the latch keys (adjacent to the surface defined by *y*36) must have a blend radius of *r*41 to prevent small contact patches with large stresses that might cause wear and particles. Other convex features on the latch keys need only be de-burred and rounded off. The over-all surface finish of the latch keys must have a final roughness height less than or equal to *r*47.

6.5 *Seal Zones* — On the exterior side of the port must be two areas for sealing to the box. The door seal zone must be just inside the rim of the port door in the area between *x*32 and *x*33 from the facial datum plane and between *z*32

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and *z*33 from the vertical center line of the port (which is *z*30 above the facial datum plane). Similarly, the frame seal zone must be on the frame of the port door in the area between *x*34 and *x*35 from the facial datum plane and between *z*34 and *z*35 from the vertical center line of the port. The door and its frame must be designed to mate with a front-opening box that conforms to SEMI E47.1. Specifically, the port door and its frame must have surfaces that mate with the seal zones and the reserved spaces for vacuum application (which includes all of the circles bounded by *r*38 except for the holes for the registration pins at the center of each circle). It is recommended that a gap be maintained between mating surfaces on the box and load port (unless the minienvironment is purged with an inert gas, in which case a tight seal is recommended).

6.6 *Inner and Outer Radii* — All required concave features may have a radius of up to *r*45 to allow cleaning and to prevent contaminant build-up. All required convex features may also have a radius of up to *r*46 to prevent small contact patches with large stresses that might cause wear and particles. Note that these limits on the radius of all required features are specified as a maximum (not a minimum) to ensure that the required features are not rounded off too much. The lower bound on the radius is up to the interface supplier. Note also that this radius applies to every required feature unless another radius is called out specifically.

6.7 *Force Between Box and Port* — The force with which the load port holds the box in place against the FIMS interface must be greater than the force with which the load port presses the box door into the box.

6.8 *Force with Which the Load Port Presses the Box Door into the Box* — The load port must press the box door into the box with a force of *f*34. As an optional feature on a load port, which is intended to be used for a FOSB according to SEMI M31with an automated-shippable door, this force has an increased value compared to the normal value specified for other front-opening boxes as outlined in Table 1.

NOTE 1: Please note additional information in § A1-3 of SEMI M31.

NOTE 2: Carrier and load port suppliers are encouraged to consider the explanation related to the potential opening/closing scenarios of box doors, such as the relationship between force and gap, when designing their product (see Appendix 2, Application Notes).

6.9 *Door Return Repeatability* — The load port must return the port door to the closed position after opening with a repeatability given by the dimensions *x*37 and *z*37.

6.10 *Force Applied by Latch Keys* — If the load port uses retracting latch keys, once the latch keys have been turned to the position that unlocks the box door from the box ($\psi = 0 \pm 1°$), the force (in a direction perpendicular to the facial datum plane) applied by each latch key to the FOUP door must be no greater than *f*35.

6.11 *Door Accommodation* — The load port must mate completely with the box at the FIMS interface. One method to accomplish this is to have the load port door protrude sufficiently (with some cushioning ability) to meet the box door. The load port door (at least on the seal zone plate) must also accommodate variations in angle (with respect to the Facial Datum Plane) of the box door.

7 Related Documents

7.1 *SEMI Standards and Safety Guidelines*

SEMI E15.1 — Specification for 300 mm Tool Load Port

SEMI E63 — Mechanical Specification for 300 mm Box Opener/Loader to Tool Standard (BOLTS-M) Interface

SEMI E103 — Mechanical Specification for a 300 mm Single-Wafer Box System that Emulates a FOUP

SEMI E119 — Mechanical Specification for Reduced-Pitch Front-Opening Box for Interfactory Transport of 300 mm Wafers

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