

SEMI E63-0223

SPECIFICATION FOR 300 mm BOX OPENER/LOADER TO TOOL STANDARD (BOLTS-M) INTERFACE

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1 Purpose

1.1 This Standard specifies the tool side of the mechanical interface between the main part of a process or metrology tool and the component that opens boxes and presents the boxes to the tool wafer handler for unloading and loading 300 mm wafers. The box opener/loader unit would include one or more load ports (that would conform to SEMI E15.1) as well as storage capacity for empty boxes or waiting lots (if needed by the tool throughput). The box opener/loader unit might not only be configured to handle boxes (that would conform to SEMI E47.1 and SEMI E62) but also to open cassettes (that would conform to SEMI E1.9). This Standard defines one interface for all such carriers and for any carrier capacity (13 and 25 wafers).

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 interchangeability at all mechanical interfaces. Only the mechanical interface is specified; no materials requirements or micro-contamination limits are given.

2.2 The interface specified in this Standard is designed for a tool with a sealed minienvironment, but it could also just be a well-defined automation interface.

2.3 This interface is not intended to provide high repeatability or rapid removal (both of which can be provided by other couplings in the box opener/loader unit).

2.4 This Specification also does not apply when load ports are stacked one on top of the other.

2.5 This Specification does not apply when inserting open cassettes into load-lock chambers directly.

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 E15.1 — Specification for 300 mm Tool Load Port

SEMI E19 — Specification for Standard Mechanical Interface (SMIF)

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

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

SEMI E62 — Specification for 300 mm Front-Opening Interface Mechanical Standard (FIMS)

3.2 ISO® Standards¹

ISO 68-1 — ISO General Purpose Screw Threads – Basic Profile – Part I: Metric Screw Threads

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. [SEMI E57]

4.1.2 *BOLTS plane* — a plane parallel to the facial datum plane near the front of the tool where the box opener/loader is attached.

4.1.3 *box* — a protective portable container for a cassette and/or substrate(s). [SEMI E15]

4.1.4 *box opener/loader* — the equipment component that opens wafer carriers (if needed) and presents the carriers to the equipment's wafer handler for unloading and loading wafers.

4.1.5 *carrier capacity* — the number of substrates that a carrier holds. [SEMI E1.9]

4.1.6 *cassette* — an open structure that holds one or more substrates. [SEMI E15]

4.1.7 *equipment front end module (EFEM)* — consists of the carrier handler that receives carriers from the factory material handling system on one or more load ports (as specified in SEMI E15.1), opens the carriers (if needed), and may include a substrate handler for unloading and loading wafers from the carrier to the process part of the equipment.

4.1.8 *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. [SEMI E57]

4.1.9 *horizontal datum plane* — a horizontal plane from which project 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. [SEMI E57]

4.1.10 *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. [SEMI E15]

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

4.1.12 *pod* — a box having a Standard Mechanical Interface (SMIF) per SEMI E19. [SEMI E15]

4.1.13 *seal zone* — a surface on the tool at the BOLTS plane for sealing to the box opener/loader.

4.1.14 *tool* — any piece of semiconductor fabrication or inspection equipment designed to process wafers delivered in wafer carriers. [SEMI E15]

4.1.15 *wafer carrier* — any cassette, box, pod, or boat that contains wafers. [SEMI E15]

5 Requirements

5.1 *Datum Planes* — The physical alignment mechanism for the box consists of features (not specified in this Standard) on the box that kinematically couple with three or six pins underneath as defined in SEMI E57. Many of the dimensions of the BOLTS interface 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. The BOLTS plane is defined to be parallel to and at a distance y_{70} from the facial datum plane of the carrier (when the carrier is docked and in position for wafer extraction and insertion). The tolerance on y_{70} is the installation tolerance.

5.1.1 The cycle-to-cycle repeatability on y_{70} (without replacing the box opener/loader unit) shall be within y_{75} .

¹ International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, <http://www.iso.org>. ISO trademark is owned by International Organization for Standardization.

5.1.2 If the carrier is rotated after being placed on the loadport, the facial datum plane of the carrier and the BOLTS plane may no longer be parallel to the load face plane of the equipment. If the carrier is not rotated, the distance (called the docking stroke) between the facial datum plane when the carrier is placed on the loadport (undocked) and the facial datum plane when the carrier is in position for wafer extraction and insertion (docked) must be $y76$ (but this is only a requirement for equipment delivered in the year 2000 or later).

5.2 *Symmetry* — All of the dimensions for the interface are bilaterally symmetric about the bilateral datum plane. These dimensions are shown in Figure 1 and specified in Table 1.

5.3 *Hole Opening* — The BOLTS interface consists of a hole in the front of the tool at the BOLTS plane, a seal zone surrounding the hole, six threaded holes for bolting on the box opener/loader, reserved spaces for the box opener/loader inside the tool from the hole, and an exclusion volume for the box opener/loader outside of the hole. The dimensions of the hole are defined by $x71$, $z71$, and $z76$.

5.4 *Seal Zone* — On the BOLTS plane surrounding the hole opening shall be a flat area for sealing between the tool and the box opener/loader. The inner dimensions of the seal zone are the same as the hole opening, and the outer dimensions of the seal zone are defined by $x72$, $z72$, and $z77$.

5.4.1 The flatness of the seal zone must be within $y71$.

5.4.2 The perpendicularity of the seal zone to the facial and horizontal datum planes shall be within σ .

5.5 *Bolt Holes* — At six points on the BOLTS plane there must be threaded holes for bolting on the box opener/loader.

5.5.1 The opening of the threaded holes shall be within the flatness of the seal zone ($y71$).

5.5.2 The holes shall be at least $y73$ deep.

5.5.3 The internal threads shall conform to the ISO 68-1 specification which has a nominal diameter of 8 mm (0.31 in.), a thread pitch of 1.25 mm (0.05 in.), a normal length of engagement from 4 to 12 mm (0.16 to 0.47 in.), and no allowance (variation from basic diameter).

5.5.4 The centers of the threaded holes shall be located as follows: at $x73$ to the left and right of the bilateral datum plane; and the top, middle, and bottom pairs of threaded holes at $z78$ above, $z75$ below, and $z73$ below the horizontal datum plane, respectively.

5.5.5 Not all of these bolt holes need to be used by every box opener/loader. Note that the middle pair of threaded holes is in the seal zone, and so it may be covered up by some gaskets (which are not specified here).

5.6 *Reserved Spaces* — Inside the tool from the BOLTS plane are volumes reserved for the box opener/loader into which tool and its wafer handler shall not protrude.

5.6.1 A permanent reserved space is bounded by $x70$, $y74$, $z70$, and $z80$.

5.6.2 When the door is closed, there is an additional temporary reserved space bounded by $x70$, $y72$, and $z81$.

5.6.3 When the door is being opened or closed by the box opener/loader, there is a further temporary reserved space bounded by $x70$, $y74$, and $z81$.

5.6.4 When the door is fully open, it will be withdrawn into the permanent reserved space, and the tool wafer handler may extend into the box to extract or insert wafers.

5.7 *Exclusion Volume* — Outside the tool from the BOLTS plane is a volume reserved for the box opener/loader into which the exterior of the tool shall not protrude. This exclusion volume is bounded by $x74$, $z79$, and the floor.

5.7.1 Within these boundaries and outside of the seal zone, no part of the tool shall protrude closer to the facial datum plane than the closest point of the seal zone.

5.7.2 It is recommended that no part of the tool should overhang the box opener/loader, even above $z79$. Note that $x74$ has been chosen to allow the minimum width between adjacent load ports defined in SEMI E15.1.

5.8 *Inner and Outer Radii*

5.8.1 All required concave features may have a radius that shall not exceed $r75$ to allow cleaning and to prevent contaminant build-up.