

SEMI E15-95

SPECIFICATION FOR INTER-EQUIPMENT MATERIAL TRANSPORT INTERFACE

1 Introduction

1.1 This specification has been developed in cooperation with the Japan Electronic Industry Development Association Committee 12 on Electronic Communications.

1.2 *Scope*— This specification deals with the mechanical interface between wafer fabrication material transport systems and wafer fabrication/inspection equipment (tools). The concept defines the placement and orientation of a cassette or cassette in a container on a tool to allow reasonable interfacing with mechanized material movement systems without compromising human access to perform the material exchange function.

1.3 *Purpose*— Humans have the ability and flexibility to place cassettes or cassettes in containers into a wide variety of orientations and locations with respect to the front of a production tool, while automated material transport systems do not, without excessive cost. This standard allows reasonable and cost effective access by material transport systems to production tools by limiting the placement and orientation of wafers or their containers on such tools.

1.4 *Impact*— The incorporation of this standard requires equipment designers to limit the placement of input/output ports on tools to specific heights and orientations and limited depths. Restrictions are also placed on clearances to obstructions which may be adjacent to such ports. Compliance with this specification for tools with enclosed interfaces (e.g., loadlocks or other local environmental enclosure) requires the removal of cassettes or containers from such interfaces.

2 Applicable Documents

SEMI Documents— *SEMI E1* — SEMI Specification, 3 inch, 100 mm, 125 mm, & 150 mm Plastic & Metal Wafer Carriers

SEMI E19 — SEMI Specification, Standard Mechanical Interface

SEMI E1.7 — SEMI Specification, 200 mm Plastic and Metal Wafer Carriers, General Usage (Proposed)

3 Selected Definitions

3.1 *alignment pocket* — Any form of mechanical shape (other than flat) local to a cassette or container designed to position or otherwise externally constrain a container to a production tool. (See Figure 2, L1 and L2.)

3.2 *box* — An enclosure for semiconductor wafer cassettes (also referred to as "container").

3.3 *cassette* — A plastic or metal wafer carrier as defined in SEMI E1 and SEMI E1.7.

3.4 *cassette centroid* — The theoretical center of a stack of wafers in a cassette formed by the pocket center line (see SEMI Standard E1, Section 2) and the "center" pocket as defined by the location associated with dividing dimension B3 by two. (See SEMI E1, Figure 1.)

3.5 *cassette envelope* — A rectangular box with vertical sides which completely contains a cassette, even if the cassette is tilted. (See Figure 1.)

3.6 *container* — A protective transport device for a cassette (also called a box).

3.7 *container centroid* — As specified by the container manufacturer; in the absence of any such specification, the location of the cassette centroid within the container.

3.8 *container envelope* — A rectangular box with vertical sides which completely contains a container, even if the container is tilted. (See Figure 1.)

3.9 *enclosed interface* — Any port which cannot satisfy the minimum requirements of clearance to obstructions without sacrificing the port's technical performance (such as a vacuum loadlock).

3.10 *global orientation* — The general orientation of a wafer or wafers in a tool; may be vertical or horizontal.

3.11 *load depth* — The horizontal distance from the load face plane to cassette centroid or container centroid. (See Figures 3, 3A, and 4 (D).)

3.12 *load face plane* — The furthest physical vertical boundary plane from cassette centroid or container

centroid on the side (or sides) where loading of the tool is intended. (See Figures 3, 3A, and 4.)

3.13 *load height* — The distance from the bottom of the cassette or container to the floor on which the tool is installed. (See Figure 4 (H).)

3.14 *local clearance* — The distance between the external surface of a cassette or container to nearby vertical obstructions such as an alignment pocket. (See Figure 2, L1 and L2.)

3.15 *placement tolerance* — The maximum misplacement of a cassette or container by a material transport system on a tool for which the tool will operate properly. (See Figure 3, M.)

3.16 *port* — A location on a tool where wafers, cassettes, or containers are placed to allow the tool to process wafers.

3.17 *spacing* — The minimum spacing between centroids. (See Figure 3 and 3A, S.)

3.18 *tool* — Any piece of semiconductor fabrication or inspection equipment designed to process wafers delivered in cassettes (as defined in SEMI E1 or SEMI E1.7) or cassettes in containers intended for use with an automated material transport system.

3.19 *tilt* — A small angle of offset from the normal horizontal or vertical surfaces of a cassette or container designed to preferentially align or keep wafers in their normal place. (See Figure 1, T.)

4 Requirements

4.1 The dimensions for the placement of a cassette containing wafers, or a container within which exists a cassette containing wafers on a tool, are given in Table 1 for wafer sizes from 70 mm (~3") through 200 mm (~8"). The placement of a standard interface (such as defined in SEMI E19) conforms to the appropriate cassette or container.

4.2 Cassettes are the wafer carrier of choice. However, the standard is based upon the concept that any container or layers of containers can be used. Dimensions are specified as clearances to cassettes or container envelopes. (See envelope concept in Figure 1.)

4.3 The global orientation of the cassette or container is constrained to be parallel or perpendicular to the load face plane with respect to any surfaces or features used by automated material transport systems to place or remove such cassette or container from the tool.

Allowable orientations are: for cassettes vertical (wafers horizontal), the cassette opening must be opposite the load face plane; for cassettes horizontal (wafers vertical), the cassette "H bar" either faces away or faces right to the load face plane when viewed from the load face plane. This requirement applies to cassettes in containers. The maximum tilt angle is 5 degrees for vertical cassettes/containers and 15 degrees for horizontal cassettes.

4.4 The load height is specified in Figure 4 as follows:

4.4.1 For applications which deal with the interfacing of cassettes, dimension H is 900 mm (~35.4") $\pm$ 10 mm (~0.4").

4.4.1.1 Tools intended for direct mechanical connection to material transport means also allow the load port(s) to be fully adjustable over the full 900 mm (~35.4") $\pm$ 10 mm (~0.4") height range.

4.4.2 For applications which deal with cassettes in containers, dimension H is greater than or equal to 900 mm (~35.4") and less than or equal to 1300 mm (~51.2").

4.5 The placement tolerance is defined as $\pm$ 1 mm (~0.04"). (See Figure 3.)

4.6 Tools which require placement tolerances either tighter than specified in 4.5, or which must satisfy continued human interaction for material exchange, may use shallow alignment pockets for containers not to exceed the dimensions shown in Figure 2 (L1 and L2).

4.7 Clearances (C1, C2, C3, L1, and L2) are defined with respect to the largest cassette/container envelope required. For cassettes, envelopes are defined using cassette dimensions from SEMI E1 or SEMI E1.7. For cassettes in containers, envelopes are defined using the container standard (if any) or the container manufacturer's specifications. (See Figure 1 for concept and Figures 3 and 4 for use.)

4.8 Dimension S specifies the recommended minimum spacing between cassette/container centroids to allow tools to be upgraded from cassette to the largest known present-day commercially available containers without major retrofit. Designers are cautioned to obtain detailed information from container manufacturers before determining a minimum value for S in any application as standards do not presently exist. In any case, if S violates clearance C1 in any application, then C1 prevails. (See Figures 3 and 3A.)

4.9 Although a vertical clearance, C3, to a horizontal obstruction is acceptable for some automated handling, tools intended for use with overhead track systems may need an unrestricted vertical clearance above the cassette or container. Users are cautioned to include Section 4.9 compatibility in equipment specifications if unlimited overhead access is needed.

4.10 For installations using overhead means for transporting material to the tool, the optional use of multiple rows of ports is allowed. Such rows conform to all of the requirements of 4.1 through 4.9 with the exception of dimension D, which is replaced by dimension S between rows. (See Figure 3A.) The requirements of Section 4.8 also apply.

Table 1. Dimension Requirements

C1	minimum	30 mm (~1.2")	see Note 1
C2	minimum	30 mm (~1.2")	see Note 1
C3	minimum	225 mm (~9")	see Note 2
D	maximum	250 mm (~10")	
H	cassettes containers	900 mm (~35.4") 900 mm (~35.4")	+ 10 mm (~0.4") minimum to 1300 mm (~51.2") maximum
L1	maximum	6 mm (~0.25")	
L2	minimum	3 mm (~0.13")	
M	maximum	+1 mm (~0.04")	
S	minimum recommended	280 mm (~11.02") 355 mm (~13.98")	up to 150 mm (6") diameter wafer containers for 200 mm (8") diameter wafer containers (see Note 3)
T	maximum (cassettes only)	5 degrees 15 degrees	(cassette/container vertical) (cassette horizontal, see Section 4.3)

Note 1: For applications requiring continued human access for material exchange, it is recommended that the minimum value of C1 and C2 be increased to 50 mm (~2").

Note 2: Unrestricted capability may be required; see Section 4.9.

Note 3: Values are for containers - see Section 4.8 for cassettes and restrictions.

Dimension Definitions

C1 — Minimum side clearance between cassette or container envelopes or vertical obstruction or between adjacent rows

C2 — Minimum rear clearance from cassette or container envelope to vertical obstruction

C3 — Minimum clearance above cassette or container envelope to horizontal obstruction

D — Maximum load depth to cassette or container centroid

H — Allowable loading height to bottom of cassette or container envelope

L1 — Maximum depth of alignment pocket

L2 — Minimum clearance to cassette or container envelope at the top of the alignment pocket

M — The maximum misplacement of a cassette or container on a tool for which the tool will properly function

S — Recommended minimum spacing between cassette or container centroids

T — Maximum cassette or container tilt angle