Background Statement for SEMI Draft Document 4688B
NEW STANDARD: MECHANICAL SPECIFICATION FOR 450MM AMHS STOCKER TO TRANSPORT INTERFACE

Note: This background statement is not part of the balloted item. It is provided solely to assist the recipient in reaching an informed decision based on the rationale of the activity that preceded the creation of this document.

Note: Recipients of this document are invited to submit, with their comments, notification of any relevant patented technology or copyrighted items of which they are aware and to provide supporting documentation. In this context, “patented technology” is defined as technology for which a patent has issued or has been applied for. In the latter case, only publicly available information on the contents of the patent application is to be provided.

Background
This document is being developed to define the mechanical interface between stockers and transport components (i.e. OHT, OHS and conveyor) of a 450mm Automated Material Handling System (AMHS). To accommodate differences between transport systems, this document defines multiple interface options.

This specification is intended to enable interoperability between AMHS components supplied by multiple vendors. When both stocker and transport components are supplied by the same vendor, the interfaces defined in this document may not apply.

Although the ballot for Doc 4688A did not receive any negatives, the TF decided to withdraw it for further work, in light of some comments that could not be corrected by editorial change. All comments from the ballot have been considered by the TF. Changes from 4688A that appear in this document include the following:

- editorial changes for clarity of meaning
- several additions to the definitions in Terminology
- definitions in Terminology edited for consistency with referenced standards
- items in Terminology sections listed in alphabetical order
- labeled load face plane in relevant figures
- definitions of several dimensions in Table 1 were clarified

Note: The documents highlighted in this document have been approved by the Physical Interfaces and Carriers committee and are awaiting Letters of Assurance on certain intellectual property matters. Consequently, SEMI Standards designation numbers have not yet been assigned, but will be upon receipt of such letters. If this document is approved prior to the receipt of the Letters of Assurance, it will be held for publication along with the documents in question until the Letters of Assurance are received.

This formal letter (yellow) ballot will be discussed and adjudicated at the SEMI NA Spring 2010 Standards Meetings taking place in San Jose, CA, March 28-April 1, 2010.
NEW STANDARD: MECHANICAL SPECIFICATION FOR 450MM AMHS STOCKER TO TRANSPORT INTERFACE

1 Purpose
1.1 This specification defines the dimensional requirements for the load ports of 450 FOUP stockers. It is intended to provide the required features and dimensions that define the physical interfaces between different types of transport equipment and stockers and to facilitate the use of different automated transport systems in order to meet the different material handling requirements found throughout the factory. This is done by defining four options of interfaces that both the stocker and transport system must comply with. Options defined are as follows:

- Option A: Active transport (e.g. active OHS) loads a FOUP horizontally to an internal stocker load port. Option A is shown in Figure 1.
- Option B: Active Transport (e.g. OHT) picks or places a FOUP vertically to/from an external stocker load port. The conceptual illustration of Option B is shown in Figure 2.
  NOTE: The dimensional requirements of Option B are covered in SEMI Exxx.
- Option C: Passive Transport (e.g. passive OHS or conveyor) carries a FOUP to/from stocker port location. The FOUP door is parallel to the stocker. Option C is shown in Figure 3.
- Option D: Passive Transport (e.g. conveyor) carries a FOUP to/from an internal stocker port location. The FOUP door is parallel to the stocker. Option D is shown in Figure 4.

2 Scope
2.1 This standard covers physical interfaces of 450 FOUP stocker to transport equipment. Similar requirements covering physical interfaces of 450 mm semiconductor manufacturing equipment to transport equipment are in SEMI Exxx.

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

3 Limitations
3.1 This standard does not specify that every type of 450 FOUP stocker has to interface with every type of 450 mm transport system. It only specifies four different options of physical interface. This standard only specifies single FOUP hand off.

3.2 Each option of this specification defines the minimum interface requirements between a stocker load port and a transport system using that option. The stocker user and AMHS suppliers should jointly own the responsibility of defining transport system specific interface dimensions that are not defined in this standard.

3.3 This standard specifies the minimum requirements and adequate conditions for having an interface to a 450 FOUP stocker. Those areas which may limit the competitiveness of stocker and or interfacing equipment are intentionally not listed in this standard.

4 Referenced Standards
4.1 SEMI Standards and Documents
SEMI Exxx — MECHANICAL INTERFACE SPECIFICATION FOR 450 mm LOAD PORT
SEMI Eyyy — MECHANICAL SPECIFICATION FOR FAB WAFER CARRIER USED TO TRANSPORT AND STORE 450 MM WAFERS (450 FOUP) AND KINEMATIC COUPLING

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

NOTE 1: For many of the used terms, see SEMI E xxx.

5.1 Abbreviations and Acronyms

5.1.1 AMHS — Automated Material Handling Systems

5.1.2 BP — Bilateral plane

5.1.3 FP — Facial Plane

5.1.4 HP — Horizontal Plane

5.1.5 OHS — Overhead Shuttle

5.1.6 OHT — Overhead Hoist Transport

5.2 Definitions

5.2.1 450 FOUP — used generally as a “term” only to identify the front-opening carrier used in fabs for 450 mm wafers. [SEMI E xxx]

5.2.2 450 stocker load boundary (LB) — a plane parallel to the facial plane establishing the boundary between the stocker load port and the fab aisle

5.2.3 active transport system — a transport system that transfers a carrier to and from a load port using robotics located on the transport.

5.2.4 Bilateral plane (BP) — a vertical plane, defining x=0 of a system with three orthogonal planes (HP, BP, FP), coincident with the nominal location of the rear primary KC pin, and midway between the nominal locations of the front primary KC pins. [SEMI E xxx]

5.2.5 external stocker load port — a load port that is external to the stocker equipment boundary (such as a shelf or ledge on the stocker).

5.2.6 facial plane (FP) — a vertical plane, defining y=0 of a system with three orthogonal planes (HP, BP, FP), coincident with the center of circle defined by the centerline of the three kinematic coupling pins. [SEMI E xxx]

5.2.7 FOUP — as used herein, a 450 FOUP.

Note: These are the carriers specified in SEMI Eyyy.

5.2.8 horizontal plane (HP) — a horizontal plane, defining z=0 of a system with three orthogonal planes (HP, BP, FP), coincident with the nominal location of the uppermost points (tips) of the three kinematic coupling pins. [SEMI E xxx]

5.2.9 internal stocker load port — a load port that is recessed from the stocker equipment boundary (a cavity or cutout in the stocker).

5.2.10 load face plane — the furthest physical vertical boundary plane from the cassette centroid or carrier centroid on the side (or sides) of the equipment where loading of the equipment is intended.

5.2.11 overhead shuttle (OHS) — an AMHS vehicle that does not use a vertical hoist mechanism to transfer the carrier from one piece of equipment to another. An OHS is typically supported on top of transport rail while overhead hoist transport (OHT) vehicles hang from underneath the transport rail.

5.2.12 overhead hoist transport (OHT) — a rail guided vehicle and hoist used to transport material above the factory floor over the heads of factory personnel.

5.2.13 passive transport system — a transport system that requires the equipment to transfer the carrier to and from the equipment load port to the transport.
5.2.14 stocker — an AMHS storage device.

5.2.15 stocker crane — stocker transfer agent that moves carriers between stocker storage location and internal load port location.

5.2.16 stocker port robot — robot for transport of the carrier to/from vehicle or conveyor and from/to internal load port location in a stocker.

5.2.17 transport system — the component of AMHS that moves material from one part of the factory to another.

6 Requirements

6.1 The FOUP shall be loaded and unloaded with the door parallel to and away from the load face plane as illustrated in Figures 1, - 4.

6.2 The wafers in the FOUP are to be oriented horizontally face up with zero nominal tilt at the time they are placed on the load port. The tolerance in the horizontal plane is determined by the registration and alignment feature between the FOUP and the load port, as specified in SEMI Exxx.

6.3 AMHS equipment load ports on 450 FOUP stockers must conform to one of the following configuration options (¶6.3.1, ¶6.3.2, ¶6.3.3 or ¶6.3.4). The dimensional requirements for the configurations are in Table 1. Figures 1-4 illustrate the options and are not intended to contain requirements, be dimensionally accurate or be to scale.

6.3.1 In Option A, an active transport (active OHS) loads/unloads a FOUP to/from an internal stocker load port utilizing the KC mating grooves on the FOUP. The stocker load port must therefore maintain the center exclusion volume below the HP as shown in Figure 1. This exclusion volume in the stocker load port facilitates FOUP delivery from the transport using the secondary set of kinematic pins. Although the stocker may use any of the other FOUP handling features, the two primary kinematic coupling pins closest to the door are reserved for the stocker port. An exclusion height above the FOUP, defined by dimension C, allows for clearance during FOUP transfer. The central exclusion volume below the HP is defined by dimensions H1, A1, A2, D, D1 and D3. The central exclusion volume below the HP has a height H1, width (A1+A1) extending from the load face plane to a distance (D – D1), width (A2+A2) from that point to a distance D3 away from the FP with total depth of (D+D3).

6.3.2 In Option B, an OHT loads/unloads a FOUP to/from an external stocker load port. The stocker must be equipped with an active transfer device to move the FOUP to/from internal stocker storage locations. The stocker load port is open from above to facilitate vertical delivery from an OHT. The stocker load port features, exclusion volumes, and dimensions are defined in SEMI Exxx, Options A, B, or C.

6.3.3 In Option C, the FOUP is oriented with the FOUP door parallel to the load face plane on a passive transport (e.g. passive OHS or conveyor) for pickup by the stocker port robot. In option C, the transport system shall use the FOUP handling features that are compatible with the exclusion volumes for the transport. This includes the use of the primary kinematic coupling pins (all 3 pins accessible). The stocker port robot shall use the secondary kinematic coupling pins (all 3 pins accessible) to transfer the FOUP. The transport system must maintain the center exclusion volume shown in Figure 3 to allow for the stocker port robot to use the secondary kinematic pins to transfer the FOUP, but no open volume internal to the stocker is required as in Figure 1, Option A. The center exclusion volume of the transport system below the HP is defined by dimensions H1, A2 and D4.

6.3.4 In Option D, the FOUP is oriented with the FOUP door parallel to the load face plane for transfer to/from an internal stocker port position by a passive transport system (e.g. Conveyor). In Option D, the transport system shall use the SEMI standard handling features that are compatible with the exclusion volumes for the transport. This includes the conveyor rail on the FOUP bottom, and the primary kinematic coupling pins (all 3 pins). At the internal stocker port position, the stocker crane shall use the SEMI standard handling features that are compatible with the exclusion volumes for the stocker. This includes the secondary kinematic coupling pins (all 3 pins accessible). For transport system installation in the stocker an exclusion volume is required in the stocker and is defined by dimension A3, C, H2, D and D5. For pickup of the FOUP by the stocker crane an exclusion volume is required in the transport system and is defined by dimensions A2, H1 and D4.
Table 1 Dimensional Requirements for 450 mm AMHS Load Ports

All dimensions are in mm unless otherwise indicated.

<table>
<thead>
<tr>
<th>Dim</th>
<th>Definition</th>
<th>Option A</th>
<th>Option B</th>
<th>Option C</th>
<th>Option D</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Width of the central exclusion volume below the HP from the load face plane to a distance D1 from the FP of a FOUP sitting at the transfer position on the stocker port (symmetric about the BP).</td>
<td>183(min)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>A2</td>
<td>Width of the central exclusion volume used for center pickup using the secondary kinematic coupling pins (symmetric about the BP)</td>
<td>156(min)</td>
<td>N/A</td>
<td>156(min)</td>
<td>156(min)</td>
</tr>
<tr>
<td>A3</td>
<td>Width of exclusion volume for passive transport installation measured from the BP to the nearest obstruction on the stocker (symmetric about the BP).</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>500(min)</td>
</tr>
<tr>
<td>C</td>
<td>Height of the nearest stocker obstacle above the FOUP measured from the top of the FOUP sitting on the stocker port (Option A) or the passive transport (Option C, D).</td>
<td>80(min)</td>
<td>N/A</td>
<td>80(min)</td>
<td>80(min)</td>
</tr>
<tr>
<td>D</td>
<td>Distance from the load face plane to the FP of the FOUP sitting on the stocker port (Option A) or the passive transport (Option D).</td>
<td>295(max)</td>
<td>N/A</td>
<td>N/A</td>
<td>295(max)</td>
</tr>
<tr>
<td>D1</td>
<td>Depth of the central exclusion volume used for center pickup using the secondary kinematic coupling pins measured from the FP of the FOUP sitting at the transfer position on the stocker port toward the load face plane.</td>
<td>245(max)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>D2</td>
<td>Distance from the FP of the FOUP sitting at the transfer position on the transport system to the load face plane.</td>
<td>N/A</td>
<td>N/A</td>
<td>380(max)</td>
<td>N/A</td>
</tr>
<tr>
<td>D3</td>
<td>Depth of the central exclusion volume used for center pickup using the secondary kinematic coupling pins measured from FP of the FOUP sitting on the transfer position on the stocker port away from the load face plane.</td>
<td>245(min)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>D4</td>
<td>Depth of cavity or cutout in the passive transport for center pickup using the secondary kinematic coupling pins, measured from FP of the FOUP sitting at transfer position on the passive transport</td>
<td>N/A</td>
<td>N/A</td>
<td>175(min)</td>
<td>175(min)</td>
</tr>
<tr>
<td>D5</td>
<td>Depth of exclusion volume for passive transport installation measured from the FP to the nearest obstruction on the stocker</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>245(max)</td>
</tr>
<tr>
<td>H1</td>
<td>Height of the exclusion volume below the HP of the FOUP sitting on the stocker load port (Option A) OR the transport system (Options C,D)</td>
<td>200(min)</td>
<td>N/A</td>
<td>200(min)</td>
<td>200(min)</td>
</tr>
<tr>
<td>H2</td>
<td>Minimum height of exclusion volume for passive transport installation measured from the HP to the nearest obstruction on the stocker.</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>300(min)</td>
</tr>
</tbody>
</table>

1 User to specify which option (see §6).
2 All dimensions for Option B are specified in SEMI Exxx.
Active Transport (e.g. active OHS) horizontally delivers a FOUP to an internal stocker load port

**Option A**

(Kinematic Coupling Pin Pick-Up)

<table>
<thead>
<tr>
<th>Option A</th>
<th>H1 (min)</th>
<th>A1 (min)</th>
<th>A2 (min)</th>
<th>C (min)</th>
<th>D (max)</th>
<th>D1 (max)</th>
<th>D3(min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>183</td>
<td>156</td>
<td>80</td>
<td>295</td>
<td>245</td>
<td>245</td>
</tr>
</tbody>
</table>

**NOTE1:** Top view of central exclusion volume. the stocker uses the primary set of kinematic coupling pins.

**NOTE2:** Transport uses secondary set of kinematic coupling pins.

**Figure 1**

AMHS Load Port Option A
Active Transport (e.g., OHT) picks or places a FOUP vertically to/from an external stocker load port.

This illustration is reference only. Actual dimensions are according to SEMI Exxx.

Figure 2
AMHS Load Port Option B
Passive Transport (e.g., passive OHS or Conveyor) carries a FOUP to/from stocker port position. The FOUP door is parallel to the stocker.

NOTE 1: Stocker robot uses secondary set of kinematic coupling pins.

NOTE 2: Vehicle or conveyor uses the primary set of kinematic coupling pins.

NOTE 3: Exclusion volume in passive transport (e.g., vehicle or conveyor lift unit).

NOTE 4: Conveyor is only shown in 3D illustration in this figure to no fixed design concept of stocker interface to conveyor today. When it will be designed, stocker interface to conveyor should be added in this figure or new option.

<table>
<thead>
<tr>
<th>Option C (Kinematic Coupling Pin Pick-Up)</th>
<th>H1 (min)</th>
<th>A2 (min)</th>
<th>C (min)</th>
<th>D2 (max)</th>
<th>D4 (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>156</td>
<td>80</td>
<td>380</td>
<td>175</td>
</tr>
</tbody>
</table>

Figure 3
AMHS Load Port Option C (Kinematic Coupling Pin Pick-Up)
Passive Transport (e.g., conveyor) carries a FOUP to/from an internal stocker port position. The FOUP door is parallel to the stocker.

The example of lifting mechanism is shown in Related Information R1-1.2

<table>
<thead>
<tr>
<th>Option D</th>
<th>$H1$ (min)</th>
<th>$H2$ (min)</th>
<th>$A2$ (min)</th>
<th>$A3$ (min)</th>
<th>$C$ (min)</th>
<th>$D$ (max)</th>
<th>$D4$ (min)</th>
<th>$D5$ (max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Kinematic Coupling Pin Pick-Up)</td>
<td>200</td>
<td>300</td>
<td>156</td>
<td>500</td>
<td>80</td>
<td>295</td>
<td>175</td>
<td>245</td>
</tr>
</tbody>
</table>

Figure 4
AMHS Load Port Option D (Kinematic Coupling Pin Pick-Up)
RELATED INFORMATION 1

NOTICE: This related information is not an official part of SEMI XX. This related information was approved for publication by full letter ballot procedure on MM, DD, YYYY.

R1-1.1 This specification is intended to enable interoperability between AMHS components supplied by multiple vendors. When both storage and transport components are supplied by the same vendor, the interfaces defined in this document may not apply.

R1-1.2 This illustration shows an example of a mechanism with primary kinematic pins—FOUP lifting-up mechanism with kinematic pins—at the conveyor’s stocker port location to position the FOUP for pickup by the secondary pins of the -

R1-1.2 In lifting FOUP by it, the stocker crane to transfer the FOUP to/from the stocker shelf. Illustrated for Option D, although the locator could be rotated about a vertical axis by 90 degrees for Option C.

NOTICE: SEMI makes no warranties or representations as to the suitability of the standard(s) set forth herein for any particular application. The determination of the suitability of the standard(s) is solely the responsibility of the user. Users are cautioned to refer to manufacturer’s instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

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