# SEMI E152-0619
# SPECIFICATION FOR MECHANICAL FEATURES OF EUV POD FOR 150 mm EUVL RETICLES

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## 1 Purpose

1.1 This Standard specifies EUV Pod for the 150 mm Extreme Ultraviolet Lithography (EUVL) reticle, used to ship, transport and store a 6-inch reticle. The EUV Pod consists of an outer pod and a protective inner pod. The EUV Pod is to be used when a conventional reticle carrier does not meet the requirements of EUVL.

## 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 their interchangeability at all mechanical interfaces. Many requirements given in this Specification are in the form of maximum or minimum dimensions with very few required surfaces. No material requirements or microcontamination limits are given in this Specification.

2.2 Because of high attenuation feature of EUV light, a conventional pellicle film cannot be placed in front of EUVL reticles. The inner pod is to protect reticles from particle contamination.

2.3 The EUV Pod has the following components and subcomponents. The baseplate of inner pod has two possible configurations depending on the intended usage. They are designated Type A and Type B. Detail configuration requirements for each are shown in Table 2.

2.3.1 Key:

- Required feature: ▪
- Optional feature: ◊
  - Outer pod shell
    - ▪ One (1) EUV pod ID placement volume
    - ◊ Top robotic handling flange
    - ◊ Two (2) side robotic handling flanges
  - Outer pod door
    - ▪ Four (4) door sensing pads
    - ▪ Four (4) info pads
    - ▪ Features which mate with kinematic coupling pins
    - ▪ Pod latch-pin holes
    - ▪ One (1) EUV pod RFID placement volume
    - ▪ Kinematic pins to locate baseplate
    - ◊ Four (4) bottom conveyor rails
  - Inner pod cover
    - ▪ End-effector exclusion volumes
    - ▪ Two (2) side robotic handling flanges



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- Inner pod baseplate
  - Two (2) primary side robotic handling flanges
  - Two (2) secondary side robotic handling flanges
  - Reticle exclusion areas
  - Reticle handling exclusion volumes
  - End-effector exclusion volumes
  - Baseplate identification exclusion area
  - Features for reticle alignment and Data Matrix identification
  - Features which mate with kinematic coupling pins
  - Registration pin features
  - ◊ Five (5) front edge grip exclusion volumes

2.4 Existing specifications for the EUV substrate, blank and reticle are to be followed. Therefore, any requirement specified in this Standard shall not negatively impact performances derived from the specifications in SEMI P37, SEMI P38, and SEMI P40.

**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 Cassette Used to Transport and Store 300mm Wafers

SEMI E19.4 — Specification for 200 mm Standard Mechanical Interface (SMIF)

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

SEMI E100 — Specification for a Reticle SMIF pod (RSP) to Transport and Store 6 Inch or 230mm Reticles

SEMI P37 — Specification for Extreme Ultraviolet Lithography Mask Substrates

SEMI P38 — Specification for Absorbing Film Stacks and Multilayers on Extreme Ultraviolet Mask Blanks

SEMI P40 — Specification for Mounting Requirements and Alignment Reference Locations for Extreme Ultraviolet Mask

SEMI T16 — Specification for the use of Data Matrix Symbology for Automated Identification of Extreme Ultraviolet Masks

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

## 4 Terminology

4.1 *Abbreviations and Acronyms*

4.1.1 *EUV* — extreme ultraviolet

4.1.2 *KC* — kinematic coupling

4.1.3 *RFID* — radio frequency identification

4.2 *Definitions*

4.2.1 *bilateral reference plane (BRP)* — a vertical plane that bisects the baseplate and is perpendicular to both the horizontal and facial reference planes. The bilateral reference plane is coplanar with the bilateral datum plane defined in SEMI E57.



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4.2.2 *EUV pod* — the EUV pod is a dual pod minienvironment. It consists of an inner pod and an outer pod. See Figure 1.

4.2.3 *exclusion area* — a specified area on a physical surface reserved for one or more specific uses.

4.2.4 *exclusion volume* — a specified volume reserved for one or more specific uses.

4.2.5 *facial reference plane (FRP)* — a vertical plane that bisects the baseplate and is perpendicular to both the horizontal and bilateral reference planes. The facial reference plane is coplanar with the facial datum plane defined in SEMI E57.

4.2.6 *front edge grip* — handling of a reticle by contact with its sides and front edge.

4.2.7 *horizontal reference plane (HRP)* — a horizontal plane parallel with the top surface of the load port door as defined in SEMI E19.4 and coplanar with the horizontal datum plane defined in SEMI E57.

4.2.8 *inner pod* — a set of components that creates a secondary isolated environment for protecting the reticle. The inner pod has two major elements, a baseplate and a cover. See Figure 1.

4.2.9 *inner pod baseplate (or, baseplate)* — a device intended to hold the reticle front side down and position the reticle. See Figure 1.

4.2.10 *inner pod cover (or, cover)* — a device to enclose the reticle when connected to the inner pod baseplate. See Figure 1.

4.2.11 *load port* — the interface location on the equipment where pods are loaded and unloaded.

4.2.12 *outer pod* — a device for holding an inner pod during shipping/transport/storage and for various processing steps. The outer pod interfaces with process and exposure equipment. The outer pod positions and protects the inner pod and does not directly contact the reticle. The outer pod has two major elements, a door and a shell. See Figure 1.

4.2.13 *outer pod door (or, door)* — a device to hold and position the inner pod within the outer pod. It allows for access to the inner pod. The outer pod door will interface with automated process equipment, exposure equipment and material handling systems. See Figure 1.

4.2.14 *outer pod shell (or, shell)* — a device to isolate and protect the inner pod. It is a component of the outer pod and is used with the outer pod door. The outer pod shell will interface with automated process equipment, exposure equipment and material handling systems. See Figure 1.

4.2.15 *placement volume* — a specified volume within which one or more specified objects are placed.

4.2.16 *RFID Transponder or RFID* — an electronic identification device consist of electronic circuits and antenna.

4.2.17 *side grip* — handling of a reticle by contact only with its sides.

4.2.18 *type A baseplate* — a configuration of inner pod baseplate intended for uses with EUVL exposure tools. See Table 2 and § A1-1.4.

4.2.19 *type B baseplate* — a configuration of inner pod baseplate intended for uses other than with EUVL exposure tools. See Table 2.

## 5 Requirements

5.1 *Reticle Exclusion Areas* — The areas on the reticle reserved for contacting the reticle.

5.1.1 *Automated Handling Area* — Area on the reticle surface reserved for automated handling is shown in Figure 2 by the yellow colored regions and defined by *x16* and *y18* in Table 1.

5.1.2 *Baseplate Contact Area* — Area on the reticle surface reserved for contact by the baseplate is shown in Figure 2 by the blue colored regions and defined by *x15*, *x16*, *y17* and *y18* in Table 1.

5.2 *Reticle Handling Exclusion Volumes* — Volume in an open inner pod around the baseplate that must remain free from intrusions to accommodate reticle handling. There are two methods for reticle handling covered in this Standard, side grip and front edge grip. Side grip is always possible while front edge grip will depend on the pod configuration specified (see Table 2).



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5.2.1 *Side Grip Exclusion Volume* — Volume in an open inner pod which must remain free to allow automation to lift and handle the reticle along its side is shown in Figure 2 and defined by *x12*, *y12*, and *z11* in Table 1. The volume extends from the edge of the reticle in the HRP outward to and beyond the edge of the baseplate.

5.2.2 *Front Edge Grip Exclusion Volume* — Volume in an open inner pod which must remain free to allow automation to lift and handle the reticle along its front edge is shown in Figure 3 and defined by *x10*, *x11*, *x31*, *x32*, *y23*, *y26*, *y39*, *y40*, and *z18* in Table 1. See Table 2 for application of this method.

5.3 *Baseplate Mass and Dimensions* — The outer dimensions of the baseplate in the horizontal reference plane are shown in Figure 5 and defined by *x2* and *y2* in Table 1. The *z*-dimension of the baseplate is not controlled. The mass of the baseplate (without reticle) is defined by m1 in Table 1.

5.4 *Inner Pod Mass* — The masses of the inner pod baseplate and inner pod consist of baseplate and cover are defined by *m1* and *m2* in Table 1.

5.5 *Inner Pod Dimensions* — The outer dimensions of the inner pod are shown in Figures 4 and 6 and defined by *x5*, *y3*, and *z6* in Table 1.

5.6 *Reticle Position Within Inner Pod* — Inner pod baseplate shall provide constraints at *x1* and *y1* to maintain the reticle position in an open inner pod. Constraints are limited to contacting reticle at baseplate contact area as defined in ¶ 5.1.2. The vertical reticle position is defined by *z4* in Table 1 and Figure 6.

5.7 *Inner Pod Position Within the Outer Pod* — The nominal inner pod location on the outer pod is defined by the position of the baseplate and the cover. The baseplate is shown in Figures 6 and 7 and defined by *x2*, *y2*, and *z7* in Table 1. The cover is shown in Figures 4, 6, and 7 and defined by *x3*, *y3*, and *z5* in Table 1. The centroid positions of the inner pod are defined by *x33*, *x34*, *y41*, and *y42* in Table 1. The outer pod door shall contain the primary kinematic-coupling (KC) pins shown in Figure 9 and defined by *x18*, *x30*, *y15*, *y21*, *z14*, *z15*, *d2*, *r2*, and *r3* in Table 1 to position and retain the inner pod baseplate.

5.8 *Inner Pod Handling Exclusion Volumes* — The outer pod must not intrude into the inner pod baseplate and cover exclusion volumes when the outer pod is open to allow for automated handling of the inner pod.

5.8.1 *Baseplate Exclusion Volume* — The volume in an open outer pod, which must remain free to allow automation to handle the baseplate. The primary volume is shown in Figures 5, 6, and 8 and defined by *x2*, *x14*, *x20*, *x21*, *y28*, *y37*, and *z12* in Table 1. The secondary volume is shown in Figure 5 and 8 and defined by *x4*, *x17*, *y5*, *y29*, *z3*, *z13*, and *r1* in Table 1. The primary and secondary volume extends in the *z* direction from the multiple baseplate locations defined above to the top of the outer pod door surface shown in Figure 6 and defined by *z2* and *z7* in Table 1. The two exclusion volumes will vary in size depending on the baseplate type being used (see Table 2).

5.8.2 *Cover Exclusion Volume* — The volume in an open outer pod, which must remain free to allow automation to handle the inner pod cover, is shown in Figure 8 and defined by *x3*, *x5*, and *y4* in Table 1. The volume extends in the *z*-direction from the cover to the top of the outer pod door surface shown in Figure 6 and defined by *z2*, *z5*, and *z7* in Table 1.

5.8.3 *End-Effector Exclusion Volume* — No obstruction shall exist above the top surface of the outer pod door to inhibit access to the inner pod by the end-effector. This volume extends upward from the outer pod door top surface and outward in the *x*- and *y*-direction from the inner pod (defined by *x3* and *y3* in Table 1) to the edge of the outer pod door.

5.9 *Baseplate Exclusion Area* — Area on the baseplate reserved for positioning the baseplate on the outer pod door and which must remain free of any protruding features is shown in Figure 8 and defined by *x22*, *x24*, *x26*, *y2*, *y31*, *y33*, *y34*, and *d1* in Table 1. The baseplate shall have features to mate with the primary and secondary kinematic coupling (KC) pins shown in Figure 9 and defined by *x18*, *x19*, *y14*, *y15*, *y21*, *y22*, *z14*, *z15*, *d2*, *r2*, and *r3* in Table 1. The features shall provide lead in capability that allows for baseplate misalignment of *r4* in any horizontal direction. However, it is recommended that automation placing baseplates on the pins use as little of this lead-in capability as possible to avoid wear.

5.10 *Baseplate Features for Reticle Alignment and Data Matrix* — The baseplate must allow for optical alignment and identification of the SEMI T16 data matrix symbol on the quality surface of the reticle (see Table 2 for application). Alignment window locations are defined by *x6*, *x7*, *y6*, and *y7* in Figure 5 and Table 1. The data matrix symbol window is defined by *x8*, *x9*, *y8*, and *y9* in Figure 5 and Table 1. This Standard does not cover optical specifications for



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windows, which can vary if different wavelengths were used for alignment and data matrix reading in different exposure tools.

5.11 *Outer Pod Interface* — The outer pod must be compatible with SEMI E100 except as noted in the following sections.

5.11.1 *Outer Pod Mass* — The mass of the outer pod consist of door and shell is defined by *m3* in Table 1.

5.11.2 *Outer Pod Dimensions* — The outer dimensions of the outer pod shall be in accordance with SEMI E100 except as follows. The outer pod height (*z155* as defined in E100) is redefined by *z19* in Table 1 and Figure 7. The optional robotic handling flange height (*z156* in E100) is redefined by *z23* in Table 1 and Figure 7.

5.11.3 *Outer Pod Door Force and Torque* — The latch pin torque required to latch or unlatch the outer pod door is defined by *t1* in Table 1 of this Standard. The port door of the load port shall apply a force defined by *f1* in Table 1 to position the outer pod door into the latching position within the outer pod shell. The outer pod door latching position is defined by *z21* in Table 1. The outer pod door latching or unlatching shall only be performed when the outer pod door is in its latching position.

5.11.4 *Info Pad Configurations* — When a EUV pod is placed on a load port the info pads A, B, C, and D may communicate information about a specific EUV pod and/or inner pod. The info pad locations are shown in Figure 10 and defined by SEMI E100. Info pad configurations for EUV pod are shown in Table 3, which extend the info pad configuration Table 1 in SEMI E100.

5.11.5 *KC Pin Height* — The height of KC pins on outer pod doors is defined by *z22* in Table 1 and Figure 9.

5.12 *Outer Pod RFID Transponder Placement Volume* — The volume in the outer pod where the RFID transponder is placed. The entire RF transponder shall be positioned within the volume as shown in Figure 10 and defined by *x28*, *x29*, *y36*, *z1* and the top surface of the outer pod door in Table 1. EUV pod suppliers may also place other features in this volume such as the outer pod wall, RFID transponder support brackets, etc.

5.13 *EUV Pod ID Placement Volume* — The volume in outer pod shell where ID labels are to be mounted. Its precise location shall be defined by SEMI E100 in § 6.13.

5.14 *EUV Pod Conveyor Rails* — The optional surfaces on the EUV pod bottom for transporting the EUV pod as defined in SEMI E100.

5.15 *Baseplate Registration Holes* — The holes on the bottom of the baseplate (labeled A, B, C, D, E, F) which may be used for handling and identification are defined by *d1*, *x27*, *x35*, *y30*, *y35*, *y43*, and *z20* in Tables 1 and 2 and Figure 5.

5.16 *Baseplate Identification (ID) Exclusion Area* — The area reserved on the baseplate for marking or identification is defined by *x36*, *x37*, *y8*, and *y9* in Table 1 and Figure 8.

5.17 *Rear Purge Port Areas* — The outer pod door shall contain two rear purge areas. The purge areas are defined by *x39*, *y45*, and *d3* in Table 1 and Figure 11.

5.18 *Front Purge Port Areas* — The outer pod door shall contain two front purge port areas. The purge areas are defined by *x40*, *y46*, and *d4* in Table 1 and Figure 12.

## 6 Related Documents

6.1 A design example of EUV Pod and its performance description are given in ¶ 6.1.1, and a review of different EUVL reticle carriers including the example of EUV Pod is given in ¶ 6.1.2. The history of development of EUVL reticle handling and carriers is found in ¶¶ 6.1.3 through 6.1.5.

6.1.1 Gomei, Y., *et al.*, "EUVL mask dual pods to be used for mask shipping and handling in exposure tools." SPIE 6517 (2007) 65170W.

6.1.2 He, L., *et al.*, "Status and path to a final EUVL reticle-handling solution." SPIE 6517 (2007) 65171O.

6.1.3 Proceedings EUV Mask Workshop, Nov. 1st, 2004, Miyazaki, Japan; http://www.sematech.org/meetings/archives/litho/euvl/20041101/index.htm

6.1.4 Proceedings EUV Mask Workshop, Feb 28th, 2005, San Jose, CA, USA; http://www.sematech.org/meetings/archives/litho/euvl/20050228/index.htm



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6.1.5 Orvek, K., *et al*., "Concept Demonstration of Integrated Particle Defect Control of EUVL Masks." presented at EUVL Symposium 2005, San Diego CA. The material is available from SEMATECH.

**Table 1 Outer Pod and Inner Pod Specification**

| *Symbol Used* | *Figure* | *Value Specified (mm, unless specified)* | *Tolerance (mm, unless specified)* | *Reference Measured From* | *Feature Measured To* |
|---|---|---|---|---|---|
| *HRP* | | | | Horizontal reference plane | |
| *BRP* | | 0 | 0 | Bilateral reference plane | Nominal baseplate centerline |
| *FRP* | | 0 | 0 | Facial reference plane | Nominal baseplate centerline |
| *x1* | | See Table 2 | See Table 2 | Bilateral reference plane | Edge of reticle constraint |
| *x2* | 5, 6, 8 | 96.8 | Maximum | Bilateral reference plane | Edge of baseplate |
| *x3* | 4, 6, 8 | 99.8 | Maximum | Centerline of cover | Side edge of cover |
| *x4* | 5 | See Table 2 | See Table 2 | Bilateral reference plane | Secondary baseplate exclusion volume |
| *x5* | 4, 8 | 109.00 | ±0.25 | Centerline of cover | Cover flange |
| *x6* | 5 | 54.50 | Maximum | Bilateral reference plane | Edge of reticle alignment window |
| *x7* | 5 | 70.00 | Minimum | Bilateral reference plane | Edge of reticle alignment window |
| *x8* | 5 | 62.50 | Maximum | Bilateral reference plane | Edge of reticle data matrix window |
| *x9* | 5 | 68.50 | Minimum | Bilateral reference plane | Edge of reticle data matrix window |
| *x10* | 2 | 72.00 | ±0.25 | Bilateral reference plane | Edge of reticle handling exclusion volume – front edge grip |
| *x11* | 2 | 82.00 | ±0.25 | Bilateral reference plane | Edge of reticle handling exclusion volume – front edge grip option |
| *x12* | 2 | 58.7 | Maximum | Bilateral reference plane | Edge of reticle handling exclusion volume – side grip option |
| *x13* | 2 | 76.55 | Minimum | Bilateral reference plane | Edge of reticle handling exclusion volume – side grip |
| *x14* | 5 | 3.00 | ±0.30 | Edge of baseplate | Baseplate notch |
| *x15* | 2 | 5.0 | Maximum | Edge of reticle | End of baseplate contact area |
| *x16* | 2 | 17.0 | Maximum | Edge of reticle | End of baseplate contact area |
| *x17* | 5 | 50.00 | ±0.50 | Bilateral reference plane | Center of baseplate notches |
| *x18* | 9 | 57.90 | ±0.20 | Bilateral reference plane | Primary KC pin location |
| *x19* | 9 | 42.40 | ±0.20 | Bilateral reference plane | Secondary KC pin location |
| *x20* | 5, 8 | 72.86 | ±0.50 | Bilateral reference plane | Edge of baseplate exclusion volume |
| *x21* | 5, 8 | 80.00 | ±0.25 | Bilateral reference plane | Edge of baseplate exclusion volume |
| *x22* | 5, 8 | See Table 2 | See Table 2 | Bilateral reference plane | Baseplate corner notch |
| *x23* | 4 | 3.00 | ±0.25 | Bilateral reference plane | Cover notch |
| *x24* | 8 | 14.00 | ±0.50 | Bilateral reference plane | Baseplate exclusion area |
| *x26* | 8 | 8.00 | ±0.50 | Bilateral reference plane | Baseplate exclusion area |
| *x27* | 5 | 37.48 | ±0.25 | Bilateral reference plane | Baseplate registration hole |
| *x28* | 4 | 101.0 | ±1.0 | Bilateral reference plane | RFID placement volume |
| *x29* | 4 | 131.0 | ±1.0 | Bilateral reference plane | RFID placement volume |
| *x30* | 9 | 6.3 | | KC pin centerline | Origin of KC pin radius |
| *x31* | 3 | 70.10 | ±0.25 | Bilateral reference plane | Edge of front edge grip exclusion volume option |



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