SEMI® International Standards

450 mm Wafer Activities

*Updated August 30, 2012 for SEMICON Taiwan*
About SEMI Standards

• Established in 1973
  – Well developed: established 39 years

• Experts from the microelectronic, display, photovoltaic, and related industries
  – 23 Committees / 200+ Task Forces
  – 1,674 Companies
  – 4,367 Members

• Exchange ideas and develop globally-accepted technical standards
  – 849 Published Standards

• We are international
  – United States | Japan | Europe | Taiwan | Korea | China

• 25% Discount for SEMI Members
## SEMI International Standards Program History

### Key Topics
- **1973**
  - Silicon Wafers
- **Late 1970’s**
  - Chemicals and Gases
  - Metrology
  - Facilities
- **Late 1980’s**
  - Factory Automation
- **Early 1990’s**
  - Safety Guidelines
- **1994**
  - 300mm
- **2007**
  - Photovoltaics
- **2008**
  - 450mm
- **2010**
  - HB-LED, 3DS-IC

### New Regions
- **1973**
  - United States
- **1980’s**
  - Japan
  - Europe
- **1990’s**
  - Taiwan
  - Korea
- **2010**
  - China

### New Regions
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  - United States
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  - Japan
  - Europe
- **1990’s**
  - Taiwan
  - Korea
- **2010**
  - China
Critical Role of Standardization

SEM I Standards Reduce Manufacturing Complexity, Allowing Companies to Focus on Innovation
High Profile SEMI Standards

- Wafer Dimensions
- Metrics
  - Factory efficiency, equipment reliability, and availability
- Equipment Interface
  - SEMI Equipment Communication Standards (SECS)
  - Generic Equipment Model (GEM)
- Environmental, Health and Safety
  - Safety for semiconductor (S2) and FPD (S26)
  - Energy conservation (S23)
- 300 mm, 450 mm
  - Automated Material Handling Systems
- Photovoltaic
  - Materials, equipment communications
SEMI Standards Program
Consensus-based Standards Development

• SEMI Standards are created through developing consensus in the industry.

• Worldwide distribution of document drafts and ballots ensures global consensus.

• SEMI Standards activities are open to all interested parties, including users, suppliers, trade organizations, and government agencies.
Document Development Path

INDUSTRY NEEDS

- Technology Trends
- Suppliers
- Users
- Other Stakeholders

Use

Idea to Committee
- Authorize Activity
- Document Development
- Ballot Submission
- Ballot Voting / Tallying
- Ballot Adjudication

Publishing
- Procedural Review
SEMI Standards Technical Committees

- **Assembly & Packaging**
- Automated Test Equipment
- Compound Semiconductor Mat’ls
- Environmental Health & Safety
- Facilities
- FPD Factory Automation
- FPD Mask
- FPD Materials & Components
- FPD Metrology
- Gases
- High-Brightness LED
- Information & Control

- **Liquid Chemicals**
- MEMS / NEMS
- Metrics
- Micropatterning
- Photovoltaic
- Photovoltaic Automation
- Photovoltaic Materials
- **Physical Interfaces & Carriers**
- **Silicon Wafer**
- Traceability
- **3DS-IC** (three-dimensional stacked integrated circuits)
# Key Standards and Activities by Wafer Size

<table>
<thead>
<tr>
<th>&lt; 200 mm</th>
<th>200 mm</th>
<th>300 mm</th>
<th>450 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wafer carriers (E1)</td>
<td>Tool Load Port (E15)</td>
<td>Wafer cassettes (E1.9)</td>
<td>Load Port (E154)</td>
</tr>
<tr>
<td>Pod Handles (E47)</td>
<td>Pod Handles (E47)</td>
<td>Front Opening Interface Mech. Standard (FIMS) (E62)</td>
<td>AMHS Stocker to Transport Interface (E156)</td>
</tr>
<tr>
<td>Reticle SMIF Pod (E111, E112)</td>
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<td>Front Opening Unified Pod (FOUP) (E47.1)</td>
<td>Multi-Application Carrier (MAC) (E159)</td>
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<tr>
<td></td>
<td></td>
<td>Kinematic Couplings (E57)</td>
<td>FOSB (M80)</td>
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<tr>
<td></td>
<td></td>
<td>Front Opening Shipping Box (FOSB) (M31)</td>
<td>FOSB Load Port (E162)</td>
</tr>
</tbody>
</table>
“Quick Stats” on 450 mm Activities

• Published Standards and Auxiliary Info: 15
• In the pipeline: 14
  – Submitted for ballots: 2
  – Drafting: 12
Published 450 mm Standards & Auxiliary Information [1/2]

Assembly & Packaging
- SEMI G88-0211 - Specification for Tape Frame for 450 mm Wafer
- SEMI G92-0412 - Specification for Tape Frame Cassette for 450 mm Wafer

Physical Interfaces & Carriers (PIC)
- SEMI E154-0612 - Mechanical Interface Specification for 450 mm Load Port
- SEMI E156-0710 - Mechanical Specification for 450 mm AMHS Stocker to Transport Interface
- SEMI E158-0212 - Mechanical Specification for Fab Wafer Carrier Used to Transport and Store 450 mm Wafers (450 FOUP) and Kinematic Coupling
- SEMI E159-0312 - Mechanical Specification for Multi Application Carrier (MAC) Used to Transport and Ship 450 mm Wafers
- SEMI E162-1111 - Mechanical Interface Specification for 450 mm Front-Opening Shipping Box Load Port
- SEMI AUX023-1211 - Overview Guide to SEMI Standard for 450 mm Wafers
Published 450 mm Standards & Auxiliary Information [2/2]

Silicon Wafers

- SEMI M1-0812 - Specification for Polished Single Crystal Silicon Wafers
- SEMI M49-0412 - Guide for Specifying Geometry Measurement Systems for Silicon Wafers for the 130 nm to 22 nm Technology Generations
- SEMI M52-0412 - Guide for Specifying Scanning Surface Inspection Systems for Silicon Wafers for the 130 nm to 11 nm Technology Generations
- SEMI M62-0712 - Specifications for Silicon Epitaxial Wafers
- SEMI M74-1108 - Specification for 450 mm Diameter Mechanical Handling Polished Wafers
- SEMI M76-0710 - Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers
- SEMI M80-0812 - Mechanical Specification for Front-Opening Shipping Box Used to Transport and Ship 450 mm Wafers
# 450 mm Wafer Documents in Development – Silicon Wafer TC [1]

<table>
<thead>
<tr>
<th>Doc. #</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4812</td>
<td>New Standard: Guide for Flatness Measurement on 450 mm Wafers</td>
<td>Drafting</td>
</tr>
<tr>
<td>5069</td>
<td>New Standard: Specification for 450 mm Wafer Shipping System</td>
<td>Drafting</td>
</tr>
<tr>
<td>5070A</td>
<td>Revision to SEMI M76, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers [Re: Wafer Edge Design]</td>
<td>Drafting</td>
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<tr>
<td>5071</td>
<td>Revision to SEMI M76, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers [Re: Back Surface Contamination and Defect Requirements]</td>
<td>Drafting</td>
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<tr>
<td>5252A</td>
<td>Revision of SEMI M57-1011, Specifications for Silicon Annealed Wafers</td>
<td>Submitted in cycle 5-12 for review at SEMICON Japan</td>
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</table>

[1] SEMI INTERNATIONAL STANDARDS
### 450 mm Wafer Documents in Development – Silicon Wafer TC [2]

<table>
<thead>
<tr>
<th>Doc. #</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>5424</td>
<td>Revision to SEMI M62-0712, Specifications for Silicon Epitaxial Wafers [Addition of 450 mm epi wafer]</td>
<td>Drafting</td>
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<tr>
<td>5441</td>
<td>Revision of SEMI M1-0812, Specifications for Polished Single Crystal Silicon Wafers [Addition of node-specific guides]</td>
<td>To be submitted in cycle 6-12 for review at SEMICON Japan</td>
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<tr>
<td>5442</td>
<td>Reapproval of SEMI M74-1108, Specification for 450 mm Diameter Mechanical Handling Polished Wafers</td>
<td>Submitted in cycle 5-12 for review at SEMICON Japan</td>
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<tr>
<td>5450</td>
<td>Revision to SEMI M49-0412, Guide for Specifying Geometry Measurement Systems for Silicon Wafers for the 130 nm to 22 nm Technology Generations (Update 450 mm wafer usage)</td>
<td>To be submitted in cycle 7-12 for review at SEMICON Japan</td>
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</table>
### 450 mm Wafer Documents in Development – PIC TC [1]

<table>
<thead>
<tr>
<th>Document #</th>
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<tbody>
<tr>
<td>TBA</td>
<td>Revision to Overview Guide to SEMI Standard for 450 mm Wafers</td>
<td>Drafting</td>
</tr>
<tr>
<td>5463</td>
<td>Revision to SEMI E83-1106, Specification for 300 mm PGV Mechanical Docking Flange with title change to: Specification for PGV Mechanical Docking Flange [Update for 450 mm usage]</td>
<td>To be submitted for cycle 6-12</td>
</tr>
<tr>
<td>5464</td>
<td>Revision to SEMI E154-0612, Mechanical Interface Specification for 450 mm Load Port</td>
<td>Drafting</td>
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<tr>
<td>5465</td>
<td>Revision to SEMI E111-1106, Mechanical Specification for a 150 mm Reticle SMIF Pod (RSP150) Used to Transport and Store a 6 Inch Reticle [Update for 450 mm standards]</td>
<td>Drafting</td>
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</table>
# 450 mm Wafer Documents in Development – PIC TC [2]

<table>
<thead>
<tr>
<th>Document #</th>
<th>Description</th>
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<tbody>
<tr>
<td>5466</td>
<td>Revision to SEMI E112-1106, Mechanical Specification for a 150 mm Multiple Reticle SMIF Pod (MRSP150) Used to Transport and Store Multiple 6 Inch Reticles [Update for 450 mm standards]</td>
<td>Drafting</td>
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</table>
## 450 mm Wafer Documents in Development – Assembly & Packaging TC

<table>
<thead>
<tr>
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<th>Description</th>
<th>Status</th>
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<tbody>
<tr>
<td>4965C</td>
<td>New Standard: Mechanical Interface Specification for 450 mm Load Port for Tape Frame Cassettes in the Backend Process</td>
<td>Drafting</td>
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</table>
SEMI Standards Task Forces (TFs) on 450 mm

- **Silicon Wafer**
  - International 450 mm Wafer TF
  - International Advanced Surface Inspection TF
  - International Advanced Wafer Geometry TF
  - International Annealed Wafer TF
  - International Epitaxial Wafer TF
  - International Polished Wafer TF

- **Physical Interfaces & Carriers**
  - International 450 mm Physical Interfaces & Carriers TF (450 mm IPIC TF)
  - International 450 mm Shipping Box TF
  - North America 450 mm Assembly Test Die Prep TF
  - North America 450 mm Shipping Box TF
  - International Process Module Physical Interface TF (IPPI-TF) NEW
  - 450 mm AMHS TF NEW

- **Assembly & Packaging**
  - Japan 450 mm Assembly and Test Die Prep TF
300mm PIC related Standards

- E110 (Operator Interface)
- Carriers:
  - E47.1 (FOUP), E1.9 (Cassette), M31 (FOSB), E103 (SWIF), E119 (FOBIT)
- M1, M28 (Wafer)
- E144 (RF Air Interface)
- E57 (Kinematic Coupling)
- E62 (FIMS)
- E15.1 (Load Port)
- E84 (Carrier Hand off Parallel I/O)
- E64 (Cart Docking Interface) and E83 (PGV Docking Flange)
- E63 (BOLTS-M) and/or E92 (BOLTS-Light) or E131 (IMM)
- E85 (Stocker Interface)
- E72 (Equipment Footprint, Height, and Weight)
- E22.1 (Cluster-Tool End Effector)
- E21.1 (Cluster-Tool Module Interface)
- E26.1 (Cluster-Tool Footprint and/or E25 (Cluster-Tool Access))
Overview of 450mm SEMI Standards

*Except packaging standards

Status

Published
Developing
No change
Same as 300mm

Carriers:
- E158(450 FOUP), E159(450 MAC), M80(450 FOSB)
- E84(Carrier Hand off Parallel I/O)
- E144(RF Air Interface)
- E154(FOUP & MAC Load Port) or E162(FOSB Load Port)
- Exx(PGV Docking Flange)
- Exx(Cluster-Tool Module Interface)
- Exx(Cluster-Tool End Effector)
# 450mm/300mm Comparison table

*Except packaging standards*

<table>
<thead>
<tr>
<th>Item</th>
<th>300mm</th>
<th>450mm</th>
<th>Standard Name</th>
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<tbody>
<tr>
<td><strong>Wafer</strong></td>
<td>N/A</td>
<td>M74</td>
<td>Mechanical Handling Polished Wafer</td>
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<tr>
<td></td>
<td>M1</td>
<td>←</td>
<td>Polished Single Crystal Si Wafer</td>
</tr>
<tr>
<td></td>
<td>M28</td>
<td>M76</td>
<td>Developmental Polished Single Crystal Si Wafer</td>
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<tr>
<td><strong>Load Port</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E15.1</td>
<td>E154</td>
<td>Load Port</td>
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<td></td>
<td>E62</td>
<td>FIMS</td>
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<td>E63</td>
<td>E154</td>
<td>BOLTS-M</td>
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<td>E64</td>
<td>Cart Docking Flange</td>
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<tr>
<td></td>
<td>E110</td>
<td>Indicator / Switch Placement</td>
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<tr>
<td></td>
<td>E83</td>
<td>E83.1?</td>
<td>PGV Docking Flange</td>
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<tr>
<td></td>
<td>N/A</td>
<td>E162</td>
<td>FOSB Load port</td>
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<tr>
<td><strong>FOUP</strong></td>
<td>E1.9</td>
<td>E158</td>
<td>Cassette</td>
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<td>E47.1</td>
<td>Front Opening Unified Pod</td>
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<td></td>
<td>E57</td>
<td>Kinematic Coupling</td>
<td></td>
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<td><strong>MAC</strong></td>
<td>N/A</td>
<td>E159</td>
<td>Multi Application Carrier</td>
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<td><strong>FOSB</strong></td>
<td>M31</td>
<td>M80</td>
<td>Front Opening Shipping Box</td>
</tr>
<tr>
<td><strong>STK I/F</strong></td>
<td>E85</td>
<td>E156</td>
<td>Stocker Interface</td>
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<tr>
<td><strong>Cluster tool</strong></td>
<td>E21.1</td>
<td>Exx</td>
<td>Cluster-Tool Module Interface</td>
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<td></td>
<td>E22.1</td>
<td></td>
<td>Cluster-Tool End Effector</td>
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<tr>
<td><strong>Communication</strong></td>
<td>E84</td>
<td>←</td>
<td>Carrier Hand off Parallel I/O</td>
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<tr>
<td></td>
<td>E99</td>
<td>←</td>
<td>Carrier Reader/Writer Functional</td>
</tr>
<tr>
<td></td>
<td>E144</td>
<td>←</td>
<td>RF Air Interface</td>
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</tbody>
</table>
Thank you!

• More information at:
  www.semi.org/450
  www.semi.org/standards