SEMI® International Standards

Information on 450 mm Wafer Activities

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Published 450 mm Standards

Physical Interfaces & Carriers

- SEMI E154-1110 - Mechanical Interface Specification for 450 mm Load Port
- SEMI E156-0710 - Mechanical Specification for 450 mm AMHS Stocker to Transport Interface
- SEMI E158-1110 - Mechanical Specification for FAB Wafer Carrier Used to Transport and Store 450 mm Wafers (450 FOUP) and Kinematic Coupling

Silicon 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

450 mm Wafer Documents in Development – Silicon Wafer TC

Document #	Description	Status
4812	New Standard: Guide for Flatness Measurement on 450 mm Wafers	Drafting
5069	Specification for 450 mm Wafer Shipping System	Drafting
5070	Revision to SEMI M76, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers	Balloted in cycle1-11, to be reviewed at West
5071	Revision to SEMI M76, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers [Re: Wafer Edge Design]	Drafting
5090	Revision to SEMI M1, Specifications for Polished Single Silicon Wafers [Re: Addition of 450 mm Polished Wafer]	Drafting

450 mm Wafer Documents in Development – PIC TC

Document #	Description	Status
5108	New auxiliary document: Overview guide to SEMI standard for 450mm wafer	Drafting
4760A	New Standard: Mechanical Specification for Front-Opening Shipping Box Used to Transport and Ship 450	Approved for publication
4770A	New Standard: Mechanical Specification for Multi Application Carrier (MAC) Used to Transport and Ship 450 mm Wafers	Approved for publication
4982	New Standard: Mechanical Interface Specification for 450mm FOSB Load Port	Approved for publication
4639	Next Generation Carrier Hand-off	Inactive

450 mm Wafer Documents in Development – Assembly & Packaging TC

Document #	Description	Status
4814	Specification for Frame Cassette for 450 mm Wafer	Drafting
4815	Specification for Tape Frame for 450 mm Wafer	Published as G88-0211
4965	Specification for Load Port for 450 mm Frame Carrier	Drafting

SEMI Standards Task Forces (TFs) on 450 mm

- Silicon Wafer
  - International 450 mm Wafer TF
  - International Advanced Wafer Geometry 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
- Assembly & Packaging
  - Japan 450 mm Assembly and Test Die Prep TF

SEMI M74-1108

- **Specification for 450 mm Diameter Mechanical Handling Polished Wafers**
  - This standard was technically approved by the global Silicon Wafer Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on August 29, 2008. It was available at www.semi.org in October 2008 and on CD-ROM in November 2008.
  - This document specifies 450 mm diameter mechanical handling wafers intended for use in research, development and early design investigation of 450 mm semiconductor equipment such as 450 mm wafers, carriers, load ports, AMHS, and robotics.
  - This specification covers dimensional requirements for 450 mm diameter polished silicon wafers. This specification is intended to address a short-term need for handling wafers. It is not intended to specify wafers used in process development or for technology-specific circuit-quality applications. This document should be superseded by a process development wafer specification, a prime wafer specification and technology-specific guidelines for circuit-quality wafers.
  - A complete purchase specification may require that additional physical properties be specified along with test methods for determining their magnitude (see § 5).
  - Wafers meeting the basic specification requirements herein are suitable for use as “mechanical handling” wafers for equipment set-up and robotic handling applications.
  - For referee purposes, SI (System International, commonly called metric) units shall be used.
  - Responsible TF:
    - International 450 mm Wafer TF under the Silicon Wafer Committee

SEMI M76-0710

- **Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers**
  - This standard was technically approved by the global Silicon Wafer Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on April 30, 2010. Initially available at www.semi.org in June 2010
  - The developmental wafers covered by this specification are intended for use in research and development of process and metrology equipment and fabrication processes required for manufacturing high-density integrated circuits on 450 mm diameter single crystal silicon wafers. They can also be used to establish the techniques and metrology necessary to support a dimensional specification for 450 mm diameter circuit-quality (prime) wafers.
  - This specification covers dimensional and crystallographic orientation requirements for 450 mm diameter, polished single crystal silicon wafers needed in development. This document should be superseded by dimensional specification and technology-specific guidelines for circuit-quality wafers.
  - A complete purchase specification requires that additional physical properties be specified along with test methods for determining their magnitude. If a test instrument is not available, the acceptance criteria should be agreed upon between supplier and customer.
  - This specification also contains guidance to assist equipment manufacturers and others to specify wafers for use in developing selected process equipment and unit processes.
  - The specification for 450 mm diameter mechanical handling wafers used in development of 450 mm semiconductor equipment such as 450 mm wafers carriers, load ports, Automated Materials Handling System (AMHS), and robotics has already been published as SEMI M74.
  - This specification is not intended to be a product wafer specification.
  - For referee purposes, SI (System International, commonly called metric) units shall be used.
  - Responsible TF:
    - International 450 mm Wafer TF under the Silicon Wafer Committee

SEMI E154-1110

- **Mechanical Interface Specification for 450 mm Load Port**
  - The purpose of this document is to define the basic interface dimensions of a load port on the semiconductor manufacturing equipment, where a 450 FOUP can be loaded and unloaded. The intention of this document is to define a set of requirement and features to enable interoperability of load ports and carriers without limiting innovative solutions.
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

SEMI E156-0710

- **Mechanical Specification for 450 mm AMHS Stocker to Transport Interface**
  - This document is being developed to define the mechanical interface between stockers and transport components (i.e. OHT, OHS and conveyor) of a 450 mm 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.
  - Scope:
    - Physical interfaces of 450 mm stocker to transport equipment.
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

SEMI E158-1110

- **Mechanical Specification for Fab Wafer Carrier Used to Transport and Store 450 mm Wafers (450 FOUP) and Kinematic Coupling**
  - The purpose of this document is to establish basic physical dimensions for the carriers intended to be used to transport and store 450 mm wafers, as specified by SEMI M74, within semiconductor device manufacturing facilities.
  - This document is intended to define the reference planes for the dimensions of the carriers and the load port features that will interact with the carriers.
  - This document is intended to define a set of requirements to ensure interoperability of load ports and carriers without limiting innovative solutions.
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

Document 4812

- **New Standard: Guide for Flatness Measurement on 450 mm Wafers**
  - Rationale:
    - The characterization of 450mm wafers is one prerequisite for developing these wafers and for qualification of the material for IC processes. One of the most challenging requirements to the new material is the wafer flatness therefore the industry needs and has to agree as soon as possible how flatness has to be measured on 450mm. Within the Advanced wafer geometry taskforce a guide for flatness measurement of 450mm wafers is planned to be developed. Changing from 300mm to 450 mm wafer may result in a methodology which differs significantly from that for 300mm .
  - Scope:
    - 450mm wafer development, specification of 450mm wafers
  - Responsible TF:
    - International Advanced Wafer Geometry TF under Silicon Wafer Committee

Document 5069

- **New Standard: Specification for 450 mm Wafer Shipping System**
  - Rationale:
    - 450 mm wafers are expected to be used for the next generation Fab.
    - The standards for 450 mm wafer specification (mechanical and developmental wafer) and for 450 mm in-fab carriers & Loadport have been approved at technical committees and some are published already.
    - Yellow ballot for 450 mm Shipping Box Specification document 4760 was reviewed at SEMICON West 2010, and re-ballot document 4760A is to be issued for cycle 7, 2010 by solving remaining issues. The development of 450mm Wafer Shipping System Standard is requested as a next step.
  - Scope:
    - The materials, dimensions and necessary items related to 450 mm wafer shipping system, such as wafer shipping boxes, bags, labels, cushions, secondary containers, pallets, and shipping documentation.
    - Review 300 mm wafer shipping system SEMI M45, and define appropriate shipping system for 450 mm wafer.
    - Standardization items such as:
      - Drop Height Assumption | Wafer Shipping Box Bagging System | Wafer Shipping Box and Bag Labeling | Secondary Container Labeling | Secondary Container | Cushions | Pallet | Shipment Documentation | Transportation Logistics
  - Responsible TF:
    - International 450 mm Shipping Box TF under Silicon Wafer Committee

Document 5070

- Revision to SEMI M76-0710, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers
  - Rationale:
    - An update of M76 to improve the edge shape design.
  - Scope:
    - Improve M76 with better edge shape definition.
  - Responsible TF:
    - International 450 mm Wafer TF under Silicon Wafer Committee

Document 5071

- Revision to SEMI M76-0710, Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers
  - Rationale:
    - Industry needs guidance with respect to handling of 450mm wafers before arriving at IC manufacturers. For being able to develop the appropriate handlings concept M76 should contain information about wafer back surface contamination and defectivity requirements.
  - Scope:
    - Technology generation 32nm and higher, Wafer specification, 450mm activities
  - Responsible TF:
    - International 450 mm Wafer TF under Silicon Wafer Committee

Document 5090

- Revision to SEMI M1-0311, Specifications for Polished Single Crystal Silicon Wafers
  - Rationale:
    - The International 450 mm Wafer TF wants to incorporate specifications for polished 450 mm silicon wafers into SEMI M1. This document will provide this incorporation and in a second line item, upgrade certain non-controversial aspects of SEMI M1.
  - Scope:
    - Tables covering 450 mm diameter silicon wafer specifications will be incorporated into SEMI M1 at various locations. All other related additions will be incorporated into SEMI M1. In addition, in a separate line item, certain additions and corrections to SEMI M1 will be proposed to allow for changes in referenced standards and other related technology improvements. It should be noted that the edge profile specs for 450 mm have not been fully developed. When this occurs, additional changes to Appendix 3 of SEMI M1 may be required. When this happens, an additional snarf will be prepared.
  - Responsible TF:
    - International Polished Wafer TF under Silicon Wafer Committee

Document 4770A

- **450mm Horizontal Multi Application Carrier Standard (450 H-MAC)**
  - Rationale:
    - There is a need by multiple end users in the Semiconductor industry for a carrier which can address various applications that already exist in the industry for 300mm wafer manufacturing and wafer shipping. To full fill this need the carrier shall enable factory integration compatibility with 450 FOUP thus minimizing impact to Tools, Load Port & EFEM, AMHS and manufacturing environment/facilities and yet efficient.
  - Scope:
    - Leverage 4570A FOUP standard document as the frame work. 450 H-MAC shall have the same envelope, factory integration and interoperability interfaces as the 450 FOUP while delivering the needs of the multiple applications. 450 H-MAC is an E-series NA PIC Standard.

      Note: H-MAC is a perimeter wafer support carrier and enables random access in the same envelope as the FOUP

      The H-MAC is focused on Silicon Manufacturing and Processed Wafer Shipping.
  - Responsible TF:
    - North America 450 mm Shipping Box TF under NA PIC Committee

Document 4760A

- **Mechanical Specification for 450 mm Shipping Box Used to Transport and Ship 450 mm Wafers**
  - Rationale:
    - 450 mm wafers are expected to be used for the next generation Fab. Standardization activity has been started for 450 mm in-fab carriers, Loadport and others.
      Develop and deliver 450mm Shipping Box Standards is requested
  - Scope:
    - Mechanical dimension and interface of 450mm Shipping Box without sacrificing wafer quality and protection during transportation and long keeping in storage
      - Standardization items are Similar to M31 for horizontal FOSB
      - Interoperability with 450 FOUP & 450 Loadport would be maintained in several features, however, the envelope of HFOSB, door thickness and door closing force would be specified for shipping box usage.
  - Responsible TF:
    - International 450 mm Shipping Box TF under Japan Silicon Wafer Committee

Document 4980

- **Revision to SEMI E154-0310, Mechanical Interface Specification for 450mm Load Port**
  - Rationale:
    - The 450mm Load Port standard was published by SEMI as E154 in February 2010 for 450 FOUP, but it did not comprehend the Shipping Box Carrier due to carrier design not being ready/finalized. Now the 450 NA Shipping Box TF has closed the design for the 450mm Multi Application Carrier (MAC) and the 450 International Shipping Box TF has close on the architecture design and is in the process of closing the remaining design parameters, the TF needs to get the load port document updated.
    - Load Port Yellow Ballot submission was approved the NA PIC Committee in the March 2010 SEMI Spring Meeting.
  - Scope:
    - 1. Comprehend 450 MAC and 450 FOSB maximum door thickness y58< 52.25mm dimension related changes in the 450 Load Port Standard (E154)
    - 2. Comprehend 450 MAC door closing force related changes in the 450 Load Port Standard (E154)
    - 3. Comprehend 450 FOSB door closing force related changes in the 450 Load Port Standard (E154)
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

Document 4981

- **Revision to SEMI E158-0710, Mechanical Specification for Fab Wafer Carrier Used to Transport and Store 450mm Wafers (FOUP) and Kinematic Coupling**
  - Rationale:
    - To align with the latest MAC design to enable compatibility and interoperability, as well as correct some errors that were discovered.
    - Now the 450 NA Shipping Box TF has closed the design for the 450mm Multi Application Carrier (MAC) and the 450 International Shipping Box TF has close on the architecture design (including envelope) and is in the process of closing the remaining design parameters, the TF needs to get the 450 FOUP document updated.
    - The 450 FOUP changes will be balloted as a line items per agreement by TF.
  - Scope:
    - 1. Correct errors in document per agreement in TF
    - 2. Update design to get it aligned with the 450mm MAC design per agreement in TF
    - Note: No change to the 450 FOUP wafer pitch.
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

Document 4982

- **New Standard: Mechanical Interface Specification for 450mm FOSB Load Port**
  - Rationale:
    - The International 450mm Shipping Box Task Force (450 ISB TF) responsible for the development of the 450mm FOSB standard has decided that the FOSB door closing force required is 390N and the clamping force associated with it is 190N per clamp feature both of which are excessive compared to the FOUP and MAC closing and clamping forces, such that the FOSB cannot be accommodated in the same load port standard and needs to have its own standard per the agreement in the IPIC TF.
    - Additionally the force requirements are specified in the carrier standards, thus to avoid confusion and reduce risk for load port standard, 450 IPIC TF has decided it is best to address the needs for the FOSB in a separate document.
  - Scope:
    - Develop a Load Port standard that is built on the 450mm FOUP Load Port standard (E154) with the following items as the only requirement difference:
    - 1. Door Closing Force which is specified in the 450mm FOSB ballot
    - 2. Clamping force which is specified in the 450mm FOSB ballot
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

Document 5108

- New auxiliary document: Overview guide to SEMI standard for 450mm wafer
  - Rationale:
    - This document is intended to help users and suppliers of 450mm carriers and production equipment to understand the complex interdependence among the SEMI standards for 450mm Wafer, Carrier and physical interface and to determine which standards apply to which products.
  - Scope:
    - This document describes how the SEMI standards for 450mm work to together.
    - This document is the following configuration.
      1. Publish list
      2. Overview for 450mm SEMI standards
      3. 450mm/300mm Comparison table
      4. Overview of 300mm SEMI standards(Reference)
  - Responsible TF:
    - 450 mm IPIC TF under PIC Committee

Document 4814

- **Specification for Frame Cassette for 450 mm Wafer**
  - Rationale
    - Equipment suppliers and IC makers have identified a need to develop standards for die prep factory interfaces to support 450mm equipment development and prototyping
  - Scope
    - Develop specification for the Frame Cassette used for dicing and die bonding processes and shipping. The specifications include:
    - Dimension of tape frame
    - Mechanical strength of tape frame (Modulus of elasticity, etc.)
    - Mechanical interface with process equipment
    - Others
  - Responsible TF
    - Japan 450 mm Assembly and Test Die Preparation TF under Assembly & Packaging Committee

SEMI G88-0211

- **Specification for Tape Frame for 450 mm Wafer**
  - Rationale
    - Equipment suppliers and IC makers have identified a need to develop standards for die prep factory interfaces to support 450mm equipment development and prototyping.
  - Scope
    - Develop specification for the tape frame used for dicing and die bonding processes and shipping. The specifications include:
    - Dimension of tape frame
    - Mechanical strength of tape frame (Modulus of elasticity, etc.)
    - Compatibility with dicing tapes
    - Mechanical interface with process equipment
    - Others
  - Responsible TF
    - Japan 450 mm Assembly and Test Die Preparation TF under Assembly & Packaging Committee

Document 4965

- **Specification for Load Port for 450mm Frame Carrier**
  - Rationale
    - Equipment suppliers and IC makers have identified a need to develop standards for die prep factory interfaces to support 450mm equipment development and prototyping.
  - Scope
    - Standardize the dicing process, die bonding process and the load port specification of the cassette forφ450 mm frame(used for shipping)
      1. The frame cassette of manufacturing unit and the mechanical interface
      2. Mechanical interface with manufacturing unit and handling device such as PGV
      3. Other
  - Responsible TF
    - Japan 450 mm Assembly and Test Die Preparation TF under Assembly & Packaging Committee

Standards Staff Contacts for PIC, Silicon Wafer, and Assembly & Packaging

North America

(PIC)
Ian McLeod
imcleod@semi.org
408.943.6996

(Silicon Wafer)
Kevin Nguyen
knguyen@semi.org
408.943.7997

Japan

(PIC, Packaging)
Hirofumi Kanno
hkanno@semi.org
81.3.3222.5862

(Silicon Wafer)
Akiko Yamamoto
ayamamoto@semi.org
81.3.3222.5855

Europe

Carlos Lee
clee@semi.org
32.2.289.6497

Backup

450 mm Wafer Documents Revision History – Silicon Wafer TC

Document #	Description	Status
4442	Specification for 450 mm Diameter Mechanical Handling Polished Wafers	Published as M74-1108
4624B	Specification for Developmental 450 mm Diameter Polished Single Crystal Silicon Wafers	Published as M76-0710

450 mm Wafer Documents Revision History – PIC TC

Document #	Description	Status
4570B	New Standard: Mechanical Specification for Fab Wafer Carrier Used to Transport and Store 450 mm Wafers (450 FOUP) and Kinematic Coupling	Published as E158-0710
4599B	New Standard: Mechanical Interface Specification for 450 mm Load Port	Published as E154-0310
4688B	Mechanical Specification for 450 mm AMHS Stocker to Transport Interface	Published as E156-0710
4981	Revision to SEMI E158, Mechanical Specification for Fab Wafer Carrier Used to Transport and Store 450 mm Wafers (450 FOUP) and Kinematic Coupling	Published as E158-1110
4980	Revision to SEMI E154, Mechanical Interface Specification for 450 mm Load Port	Published as E154-1110