

# ISMI 450mm Guidelines

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## 1 Inside IC Fab Wafer Physical Contact Guidelines

The inside IC fab wafer physical contact guidelines apply only to the inside IC maker Fab environment. The detailed guidelines are as follows:

- 450mm wafer to transport carrier contact:
  - No edge contact beyond what is minimally required to constrain the wafers in x, y and z dimensions
  - Additional backside contact of wafers that minimizes wafer sag and eliminates handling marks is desirable
- Contact by 450mm wafer handling devices [e.g., end effectors] is preferred on the backside of the wafer and outside the 3 mm edge exclusion space

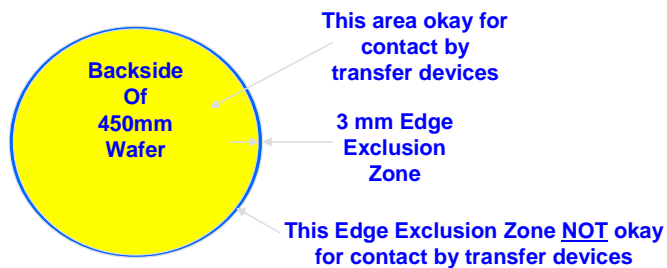
- Edge contact in all other areas of the fab should be reduced and eliminated wherever possible

Figure 1 shows the bottom view of the 450mm wafer. The blue line is the 3 mm Edge Exclusion Zone. The yellow zone is the backside area for contact by transfer devices.

## Inside IC Fab Wafer Physical Contact Guideline Clarification to ISMI Unified Guideline #2.

**Note: This guideline applies to inside IC maker Fab environment**

- 450mm wafer to transport carrier contact:**
  - No edge contact beyond what is minimally required to constrain the wafers in x, y and z dimensions – See Drawing 1
  - Additional backside contact of wafers that minimizes wafer sag and eliminates handling marks is desirable
- Contact by 450mm wafer handling devices [e.g., end effectors] is preferred on backside of the wafer and outside the 3 mm edge exclusion space**



- Edge contact in all other areas of the fab should be reduced and eliminated wherever possible**



**Figure 1 Inside IC Fab Wafer Physical Contact Guidelines**

ISMI member companies believe that some of the most harmful defects affecting edge yield in 300mm are related to thin films and/or etch excesses and particles at the wafer edge, then deteriorate in later processes. Wafer edge contact through support by carriers or edge handling by end effectors can aggravate/accelerate this deterioration.

Figure 2 shows the side view of the 450mm wafer. 450mm carrier wafer constraints are permitted to contact wafer edge only in the blue color zone area (508  $\mu\text{m}$  from the wafer edge). The carrier cannot touch at the 3 mm edge exclusion area. It is permitted to support and handle the 450mm wafer in the pink color area (3 mm from the wafer edge).

# Carrier to Wafer Edge Profile

## Permitted Wafer Constraint Area

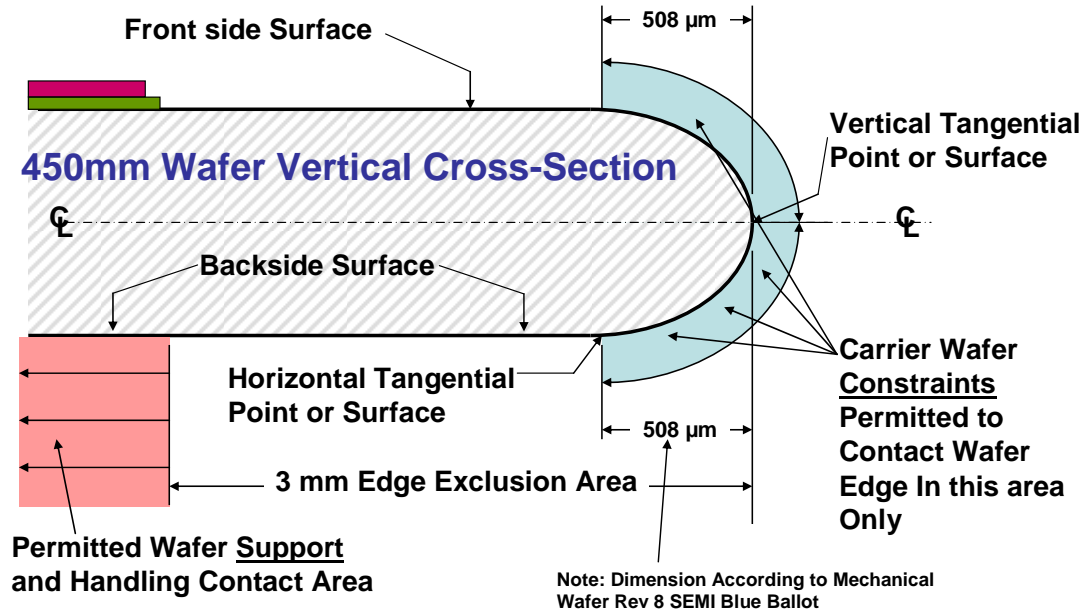


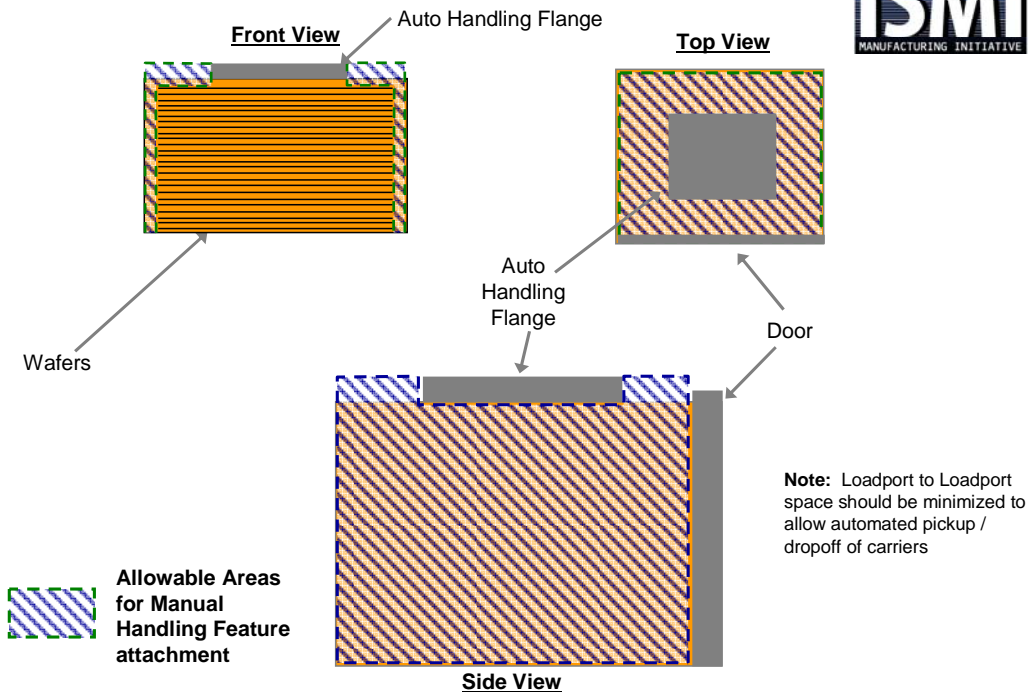
Figure 2 Permitted 450mm Wafer Constraint Area

## 2 450mm FOUP Manual Handling Design Guideline

Manual handling solutions of 450mm In-Fab 25 wafer capacity carriers (FOUP) inside the clean room:

- 450mm FOUP design must make provisions for safe, ergonomic manual handling on an infrequent, anomaly basis.
- Carrier features to enable manual handling must be temporary and removable
- Any features required to affix temporary handles to carriers must not increase the overall volume of the carrier.
- If using the top of the carrier to affix temporary handles, the solution should be integrated with the automated handling flange
- When attached to the carrier, manual handling features must not allow automated handling of the carrier
- No additional clearance requirements may be generated by either affixed or temporary handling features to enable manual handling
- Clearances for manual handling may overlap with clearances required for automated handling (e.g., OHV chimney)

## Graphical Explanation of Manual Handling Design Guideline



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**Figure 3 Graphical Explanation of Manual Handling Design Guideline**

Note: Manual Handling = handling of a carrier by a person without any mechanical assistance; i.e., picking up the carrier by hand.

### 3 450mm Carrier Guideline Additional Updates

In response to the 450mm Carrier Guidelines clarification to the SEMI IPIC task force, the 450mm guidelines and standards team developed the 450mm Carrier Survey and sent it to ISMI member companies. The survey was focused on carrier purge retention, carrier ID, carrier pocket, and wafer pitch/ carrier height. The summary of ISMI member company survey feedback results is shown in Figure 4.

# 450mm Carrier Guideline Updates - Summary



Carrier Attribute	Guideline Detail	Comments
Purge retention	8-12 hours	
Carrier ID	Copy exactly 300mm (RFID+Bar code + human readable ID)	
Carrier 'pocket' on rear of carrier for manual use (eg; run card holder)	Copy exactly from 300mm	
Wafer Pitch / Carrier Height	No change (10mm goal)**, But ...	** Prioritize minimizing carrier height over absolute wafer pitch

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Figure 4 450mm Carrier Guideline Additional Updates

## 4 450mm FOSB Architecture Guideline Clarification

450mm wafer shipping boxes will be scaled up versions of the 300mm SEMI M31 FOSB (Front-Opening Shipping Box). This means that 450mm FOSBs will have the same handling features, capacity (25-wafer), shock and vibration performance capabilities of the 300mm FOSB, but scaled to safely ship standard 450mm wafers. The FOSB shall also meet the following detailed guidelines:

- FOSB shall have an Automated-shippable Door same as option defined in M31
- Physically fit within the dimensional envelope of the 450mm SEMI Standard FOUP
- Function and be interoperable with both 450mm SEMI Standard Loadports (including door opening functionality) and 450mm Automated Material Handling Systems (AMHS) equipment by incorporating all associated FOUP handling features (e.g., KC Pin Grooves, Info and Sensing Pads, Robotic Handling Flange, etc.)

## 5 450mm AMHS Guidelines

# ISMI 450mm AMHS Guidelines

- A. 450mm Transport and Storage system components shall be designed to maximize throughput capacity:
  1. Vehicle-based transport systems shall be designed to eliminate bottlenecks by maintaining travel speeds through curves, merge / diverge points, fire doors, etc.
  2. Conveyor-based transport systems shall be designed to eliminate bottlenecks through continuous flow designs and / or fast turn tables
  3. Stockers shall be designed to minimize overall cycle time, including I/O ports cycle-time and FOUP purging cycle times
  4. Hand-offs between transport systems, storage (stockers or distributed), and tools shall be designed to eliminate transport congestion & blockage
- B. Transport systems shall be designed for maximum layout flexibility:
  1. Tracks (vehicle-based or conveyor) shall be designed to eliminate design rule constraints: minimum section lengths, flexible curve profiles, minimum turn radius, etc.
  2. OHT systems shall be designed to maximize tool and loadport placement flexibility at curves, merge / diverge points, fire doors, etc.
- C. Transport systems shall be designed to enhance operational efficiency:
  1. OHT systems shall be designed for automated (very rapid) tool loadport alignment completion to enable tool placement/moves with minimum/zero interruption.
  2. Transport systems shall be designed for continuous operations: high reliability, no sensitivity to environmental variability, automated error recovery, zero long-downs
  3. AMHS install & commissioning durations must be sufficiently rapid to eliminate any need for manual carrier handling during factory startups and conversions
- D. AMHS control systems shall include algorithms that minimize Carrier Exchange Times (CET) at equipment loadports
- E. 450mm AMHS hardware designs must support the need for converting existing 300mm fabs to 450mm fabs. Fab building reuse from 300mm to 450mm must be assumed.


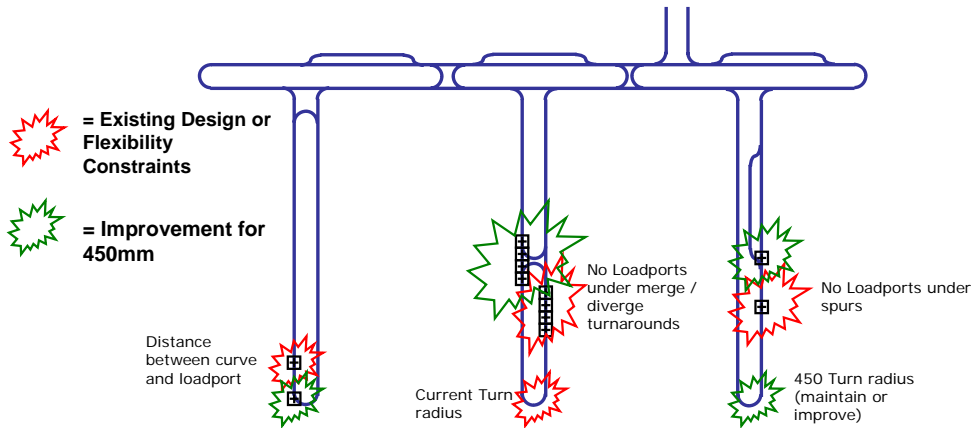


Figure 5 450mm AMHS Guidelines

The key 450mm AMHS Guidelines themes are as follows:

- Maximize AMHS throughput capacity
- Maximize layout flexibility and reduce design constraints (Figure 6)
- Reduce throughput bottlenecks (Figure 7)
- Minimize carrier exchange time at equipment loadport via control algorithms (Figure 8)
- Assume building re-use from 300mm to 450mm (Figure 9)

# Maximize Layout Flexibility and Reduce Design Constraints

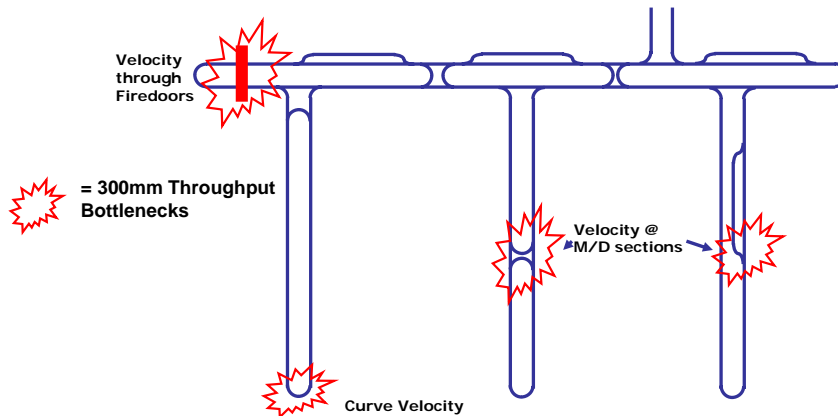


- Minimize current system constraints by improving flexibility of track design (eg; Minimal turn radius, smaller minimum track sections, more flexible curve profiles)
- Maximize flexibility of tool and loadport placement; Reduce “unusable” track – allow E84 loadports nearer to curves and under merge/diverge rails and bypass lanes

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Figure 6 Maximize Layout Flexibility and Reduce design Constraints

# Reduce Throughput Bottlenecks

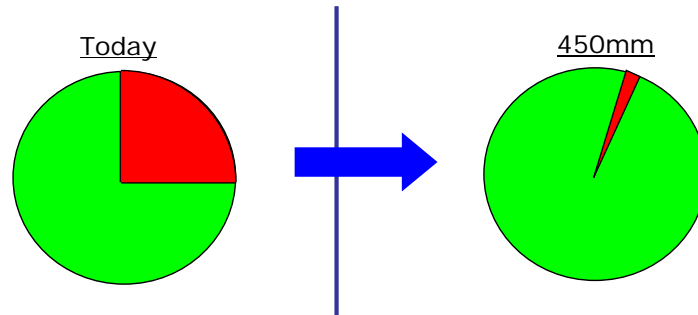


- Improve transport speed through curves, merge/diverge points, fire doors, etc.
- 450mm GOAL:** Vehicle velocity through current bottlenecks ~ Vehicle velocity on straight paths; Conveyor velocity at intersections ~ velocity on straight paths



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**Figure 7 Reduce Throughput Bottlenecks**

## Minimize Carrier Exchange Time at Equipment Loadports via Control Algorithms



**Carrier Exchange Time** = Time from Lot removal to Time of next Lot Placement on a given loadport

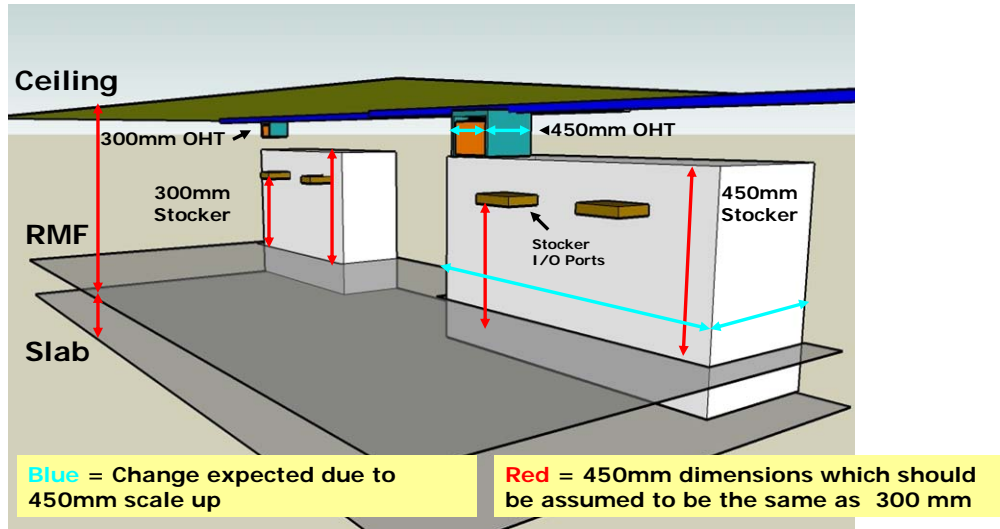
-  = Idle Loadport when WIP is available
-  = Loadport is Occupied (Work in progress or lot waiting to process)

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**Figure 8 Minimize Carrier Exchange Time at Equipment Loadport via Control Algorithms**

## 6 Building Re-Use from 300mm to 450mm

### Assume building re-use from 300mm to 450mm



**450mm AMHS Hardware designs must support the need for converting existing 300mm factories, while meeting all applicable safety clearances.**

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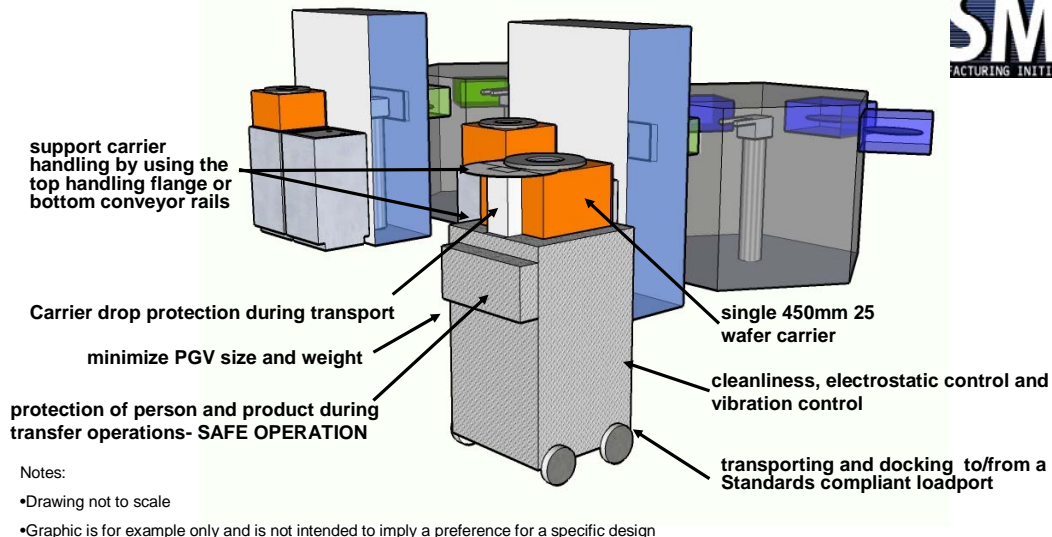
Figure 9 Assume Building Re-use from 300mm to 450mm

## 7 450mm PGV Guidelines

- 450mm PGV is a vehicle designed to transport, dock and transfer a single 450mm 25 wafer carrier to / from a SEMI Standard load port.
- The PGV design must provide protection for product including cleanliness, electrostatic control and drop protection for clean room operation equivalent to 300mm designs.
- The PGV design must provide protection for persons during transfer, transport and docking operations (SEMI S2, SEMI S8)
- The PGV shall be able to support carrier handling by using the top handling flange of the carrier or using the forklift exclusion zones.
- Creative design of PGV is needed to minimize PGV size and weight

In Figure 10, the team represents the PGV concept to facilitate communication with suppliers. However, it does NOT represent the 450mm PGV specific requirement.

## 450mm Person Guided Vehicle (PGV) Guideline



•ISMI has developed PGV Guidelines to enable safe handling of 450mm carriers during early development prior to the availability of AMHS;  
•ISMI is interested in engaging in discussions with interested suppliers for 450mm PGV capability

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Figure 10 450mm PGV Guidelines