E-Diagnostics Workshop

Creating Guidelines
I300I Lessons Learned

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I300I Guidelines Experience

- **“14 Point of Light” in 1996**
  - 1 page of simple sentences about how equipment should interface to factory
- **>1000 pages on line today**
  - Elaborated guidelines
  - Metrics
  - Vision documents
  - User and system requirements
  - Test methods
  - Interactive web-site for receiving member company interpretations of guidelines & standards
- **Some say, the most important thing I300I did**

Wafer Carrier Description -

1. 25 and 13 slot wafer carriers will be used.

2. Horizontal wafer transport, 10 mm pitch, kinematic coupling on wafer carriers per SEMI Documents 2470 and 2471.

3. Front-opening, unified cassette pod carrier, per SEMI Documents 2502 & 2472. One-piece cassette pod with sealed door on front, to be opened and closed automatically by process and metrology tools. Carriers should have provision for top robotic flange (required) and space-efficient human handles (optional).

- I300I demonstrations will use 25 wafer front opening pods **-Tool**

Material Handling Interfaces (Responsibility of Tool Suppliers) -

4. Process & Metrology Tool Compliance with SEMI E15.1 loadports design and access rules is required. This is true with or without minienvironments. Loadport interfaces must be compatible with front opening pods and open cassettes. Equipment loadport and wafer handling designs should be cost-effectively configurable for 25 or 13 wafer lots.

5. Tools shall be capable of receiving overhead carrier delivery, per SEMI E15.1, with necessary easement for delivery systems, to be defined by the E15.1 and Equipment Footprint and Height task forces. Additional capability to load to the top of a tool buffer may be desired if a vertical buffer is used.

6. Lot buffers shall be implemented by tool suppliers so tools can run non-stop between lots. In some cases (depending on tool throughput), in order to address variations in delivery, some companies will configure systems with buffers for Work in Process (WIP) sufficient for one hour of processing.

7. Tools shall have "integrated" mini-environment capability in first generation (Beta) tools. "Integrated" means pod door opening and closing mechanism, wafer load/unload from pod, with clean wafer environment maintained inside pods at loadports and during all wafer handling and processing in the tool.

8. Tools shall have the capability of loading wafers to and from the same slot in the same carrier to maintain wafer slot-to-slot integrity, to reduce quantities and space of tool loadports, and to simplify wafer lot tracking.

9. Tools shall be designed with primary wafer lot load ports on one side of the tool only, per SEMI 15.1. An auxiliary or optional port on an adjacent side maybe acceptable depending on the type of tool and its intended use.

10. Tools shall be designed for straight-line mounting (alignment of carrier loadports from tool to tool) and enabling of automated intrabay delivery system functionality (delivery from straight line overhead track system). SEMI E15.1 dimension D to be determined and fixed between tools.

11. Alternate location for user interface (operator controls and displays) should be provided to minimize the need for front operator access during automated intrabay delivery.

12. Tools should be designed to enable dense packing in bays without affecting maintainability.

13. In addition to SECS II / GEM-compliant communications capability, a link for material handling synchronization between transport and tool shall be provided per SEMI E23.

14. A standardized docking port for manual carts shall be provided for at tool loadports for times when operating staff need to load carriers to/from tools manually. (300 mm Cart to E15.1 Docking Interface Port, SEMI Document 2622) Reference: Approximately 6.8+ kg (15+ lbs) payload for twenty-five 300 mm wafers and front-opening unified pod.

7.4 Loadport

SEMI E15.1 loadport compliance is required for both wafer and frame carrier loadports on backend equipment. Wafer carrier loadports must also support SEMI E62 front-opening interface mechanical standard (FIMS). Frame carrier loadports may require modifications to SEMI E15.1 dimensions S and D1.

7.4.1 All backend equipment must have a minimum of a single loadport configuration compliant to E15.1 that enables all forms of carrier delivery including fully manual, PGV and fully automated solutions

7.4.2 Wafer carrier loadports are required to support SEMI E62 front-opening interface mechanical standard (FIMS). Frame carrier loadports do not have to support FIMS.

7.4.3 Frame carrier loadports may require increased loadport spacing (Dimension S in SEMI E15.1). The clearance dimension of C1 must be maintained.

7.4.4 Frame carrier loadports may require increased distance from the wafer centroid to the vertical equipment boundary (Dimension D1 in SEMI E15.1). The clearance dimension of C2 must be maintained.

7.4.5 Loadports must allow for cost-effective reconfiguration to handle either 13 or 25 capacity carriers. Simultaneous use of 13 and 25 capacity carriers is not required.

7.4.6 Frame carrier loadports may provide the option to handle two 13 capacity carriers in a stacked configuration provided that the single carrier configurations still comply to SEMI E15.1.

Applicable SEMI Standards

SEMI E15.1 – 300 mm Equipment Loadport

SEMI E62 – Front-Opening Interface Mechanical Standard

SEMI E63 – Box Opener/Loader to Tool Standard (BOLTS)

Plus:

- Many drawings
- Best Practices docs
- Operations docs

4.1 Production Equipment Guidelines
4.1.1 Single Communication Link
4.1.2 Compliance to Communication Standards
4.1.3 Utilization and Reliability Management
4.1.4 Reliable Data Collection
4.1.5 Variable Parameter Support
4.1.6 Fault-Free Date Transitions (i.e., Year 2000)
4.1.7 Mechanical Dry Run
4.1.8 Prod
4.1.9 Actu
4.2 Loadp
4.2.1 Bi-di
4.2.2 Inter
4.2.3 Carri
4.2.4 Pers
4.2.5 Carrier Sensors at E15.1 Loadport
4.2.6 Carrier ID Reader at E15.1 Loadport
4.2.7 Carrier ID Reader for Internal Buffer Equipment
4.2.8 Carrier ID Reader for Fixed Buffer Equipment
4.2.9 Loadport Backward Compatibility
4.3 Production Equipment Material Handling Guidelines
4.3.1 Exclusive Access Mode and Mode Change Timing
4.3.2 Equivalent Handshaking for Carrier Hand-off
4.3.3 Software-Based Interlocking to Prevent Simultaneous OHT and PGV Operations
4.3.4 Independent Control of Material Handling and Wafer Processing
4.3.5 Processing Order Control for Equipment Buffer
4.3.6 Carrier Transfer Control of Internal Buffer Equipment
4.3.7 Internal Buffer Capacity Notification
4.3.8 FOUP Open and Close Notification
4.4 Production Equipment Material Management Guidelines
4.4.1 Slot Number and Loadport Number Assignment
4.4.2 Empty Carrier Management
4.4.3 Carrier Slot Verification
4.4.4 Host Control of Wafer Process Order
4.4.5 Slot and Carrier Integrity
4.4.6 Additional Wafer Control After Processing or Measurement
4.4.7 Multi-Module Wafer Tracking Events
4.5 Production Equipment Single Wafer Control Guidelines
4.5.1 Recipe and Variable Parameter Change Between Wafers
4.5.2 Process Parameter Change Between Wafers
4.6 AMHS Equipment Guidelines
4.6.1 Interoperable AMHS Equipment (Interbay and Intrabay)
4.6.2 AMHS Equipment Performance Information
4.7 Factory Systems Guidelines
4.7.1 Factory Systems
4.7.2 AMHS Framework
4.7.3 Production Equipment Integration
4.7.4 Scheduler/Dispatcher

4.3 Production Equipment Material Handling Guidelines
4.3.1 Exclusive Access Mode and Mode Change Timing
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4.3.3 Software-Based Interlocking to Prevent Simultaneous

Page of text and diagrams

Summary

- **Must start simple**
  - Gain consensus
  - Begin supplier dialogue
  - Use standards where available
    - Note improvements needed
- **Preach it!**
- **Collect industry input**
  - Refine concepts
  - Add elaborations
    - Increase consensus / Reduce confusion
    - But...member company differentiation increases with increasing complexity and implementation time variance
  - Begin considering assessment methods early
- **Stay with it, even if it hurts**
  - Better in the long run
- **But…be careful about evolution**
  - Need to improve communication about changes
  - Special interests should avoid changing standards during critical development periods
  - Need <u>trusted</u> implementation roadmap