I300I Factory Guideline Compliance: Factory Integration Maturity Assessment (FIMA) for 300 mm Production Equipment: Version 4.01

International SEMATECH
Technology Transfer # 98023468C-TR

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This document is a revised version of the pre-existing FIMA version 4.0 release. This version has been modified into a modular format to allow for segregated assessments of 300 mm equipment sub-assemblies and other associated focus areas. This document contains procedures, inquiries, and corresponding pass/fail criteria to be used during an equipment maturity assessment (EMA) to evaluate compliance to the guidance, standards, and requirements detailed in the *I300I Factory Guidelines: Version 4.0*. It describes the assessment method as well as the pass/fail criteria; a worksheet for performing the assessment is also included.

Keywords: 300 mm Wafers, Wafer Size Conversion, Equipment Performance, Productivity Analysis

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1 EXECUTIVE SUMMARY

The International 300 mm Initiative (I300I) first published guidelines for 300 mm process tool mechanical interfaces for wafer lot delivery, buffering, and loading in September 1996. Since then, revisions and expansions of these guidelines were published in June and December 1997, as well as in July 1998. The latest version of the *I300I Factory Guidelines* (Version 4.0) includes enhancements to computer integrated manufacturing (CIM), minienvironment, non-product wafer, and facilities-related guidelines. This version continues to embody I300I member company consensus requirements for 300 mm wafer and/or carrier handling and equipment interfaces. Consequently, the *I300I Factory Guidelines* forms the basis of what member companies must ensure equipment suppliers have incorporated into their equipment.

This document is titled *I300I Factory Guideline Compliance: Factory Integration Maturity Assessment for 300 mm Production Equipment* (or FIMA). FIMA provides the methodologies for assessing the level of compliance of 300 mm production or metrology equipment with the *I300I Factory Guidelines*. With this revision, the material has been reorganized and updated to provide assessment methods in a modular format directed at equipment subsystems.

Guideline compliance assessment results help IC manufacturers to predict the compatibility of equipment with material handling systems and to plan the overall productivity of their factories. As a key aspect of equipment maturity, it influences equipment selections by I300I member companies. Compliance is assessed during the equipment maturity assessment step of the I300I equipment demonstration process (I300I *Demonstration Test Method* [DTM]).

The FIMA process can be used to evaluate equipment compliance to the *I300I Factory Guidelines*. Results summary worksheets, which are included in the document, can be filled out during each assessment to record the results of specific assessment items, along with conclusions about the level of guideline compliance. This summary data can be submitted to International SEMATECH, where it will be entered into a central database for member companies to analyze and to use to support equipment or product selections.

Please note that this document is now Revision 4.01. There were no revisions 2.0 or 3.0 FIMA documents. This release of the FIMA is affiliated with the *I300I Factory Guidelines – Version 4.0*.

2 INTRODUCTION

2.1 What is this Document?

This document is an assembly of procedures, intelligent inquiry questions, and corresponding pass/fail criteria for assessing production equipment compliance with the *I300I Factory Guidelines* (Version 4.0) and the referenced SEMI Standards (see Appendix E). The *I300I Factory Guidelines* define the position of the I300I members on key productivity and factory integration issues.

2.2 Why is this Document Provided?

The purpose of this compliance document is to address how equipment should be measured against the guideline requirements. Consequently, this document can help clarify the *I300I Factory Guidelines* requirements by describing how guideline-compliant equipment should look. It enables suppliers to better prepare their equipment for maturity assessment and performance demonstrations. To achieve the overall guideline compliance of their equipment, production equipment suppliers can also use this document when assessing compliance of their own suppliers' equipment and components.

2.3 What Approach?

The primary approach in this document is to give clarifying information to suppliers of 300 mm production metrology and interface equipment. It describes the fundamental *I300I Factory Guidelines* requirements and provides references to other sections, to the actual *I300I Factory Guidelines*, and to the SEMI standards where detailed requirements are located. It also provides methods for measuring the equipment's compliance with each guideline requirement.

The secondary approach of the document is as a guide and worksheet for collecting data and recording results during an equipment maturity assessment (EMA) for production equipment. The level of guideline compliance indicates the test phase level of the equipment. Update reports on previous assessments (i.e., action items and/or non-compliance status) can also be useful in determining the test phase level of the equipment.

2.4 How Should It Be Used/Deployed?

Equipment suppliers are encouraged to incorporate the included pass/fail criteria in their own test plans when preparing for the first stage of demonstration testing (i.e., the EMA). FIMA is the document to follow during an EMA for guideline compliance. This assessment can be conducted at the equipment suppliers' sites.

FIMA provides two approaches, intelligent inquiry and physical tests, for assessing equipment or product. The appropriate responses to the stated success criteria for each assessment type are "Pass" or "Fail." It is also appropriate to respond with a "Yes" or a "No." In that case, a "Yes" is considered to be equivalent to a "Pass", and a "No" is considered to be a "Fail." The resulting responses (Pass, Fail, Yes, or No) should be recorded as each line item assessment is completed. It is important to note that, in the case of the intelligent inquiry sections, sample questions are posed to help determine if the guideline has been met. A "No" response to any one of the sample questions does not necessarily imply that the guideline "Fails." Compliance to the guideline is based on the answers provided to the sample and any other questions that may be asked during an assessment. If an assessment criterion is not met, the reason why should be noted in the comment space.

2.5 Conventions for This Document

- Titles of referenced documents and quotations of referenced documents are indicated by *italics*.

3 FACTORY GUIDELINE COMPLIANCE OVERVIEW

3.1 Why Should a Supplier Establish a Standards and Guidelines Compliance Program?

Global joint guidance and standards for critical items are universally considered essential for making the transition to 300-mm wafers most efficiently and economically. Some benefits that may be derived from developing standard and guideline-compliant equipment may be, but not limited to, the following:

- The end user gets what they want and need.
- Suppliers are not forced to develop “custom” equipment as in previous wafer size transitions.
- Communication is enhanced through common and shared learning.

3.2 How Should a Supplier Establish a Standards and Guidelines Compliance Program?

Semiconductor equipment suppliers could best develop standard and guideline-conformant equipment through focused programs to address the challenge of developing compliant equipment. A thorough understanding of the compliance process is required to achieve success and to ensure that the best equipment is available for the end user. A flowchart of the compliance process is presented in Figure 1.

The process begins with a search for the standards and guidelines that are applicable to the equipment being developed. As product development continues, design engineers are tasked with understanding the requirements of the industry or end users that apply to the designs they are responsible for creating. Further on, product assessments (i.e., FIMA) are performed to measure the level of conformance of the design. This process continues until there is an agreed-to satisfaction with the level of compliance required by the equipment end user.

3.3 How Should a Supplier Prepare for an Assessment?

Equipment suppliers can prepare for assessment in several ways to reduce the assessment time and improve the assessment results. First, suppliers can perform their own testing according to the direction given in the FIMA document. Second, the supplier can develop a list of concerns, issues, and questions during their own testing and forward these to the assessor before he/she arrives. If this is a re-assessment or a new assessment on a new version of the equipment type, forward information updates on action items from the previous assessment(s) and references to the associated non-compliance. Third, the supplier can assemble a folder/package of information and results from the supplier tests. Include information regarding equipment layouts (with overall dimensions) and installation notes.

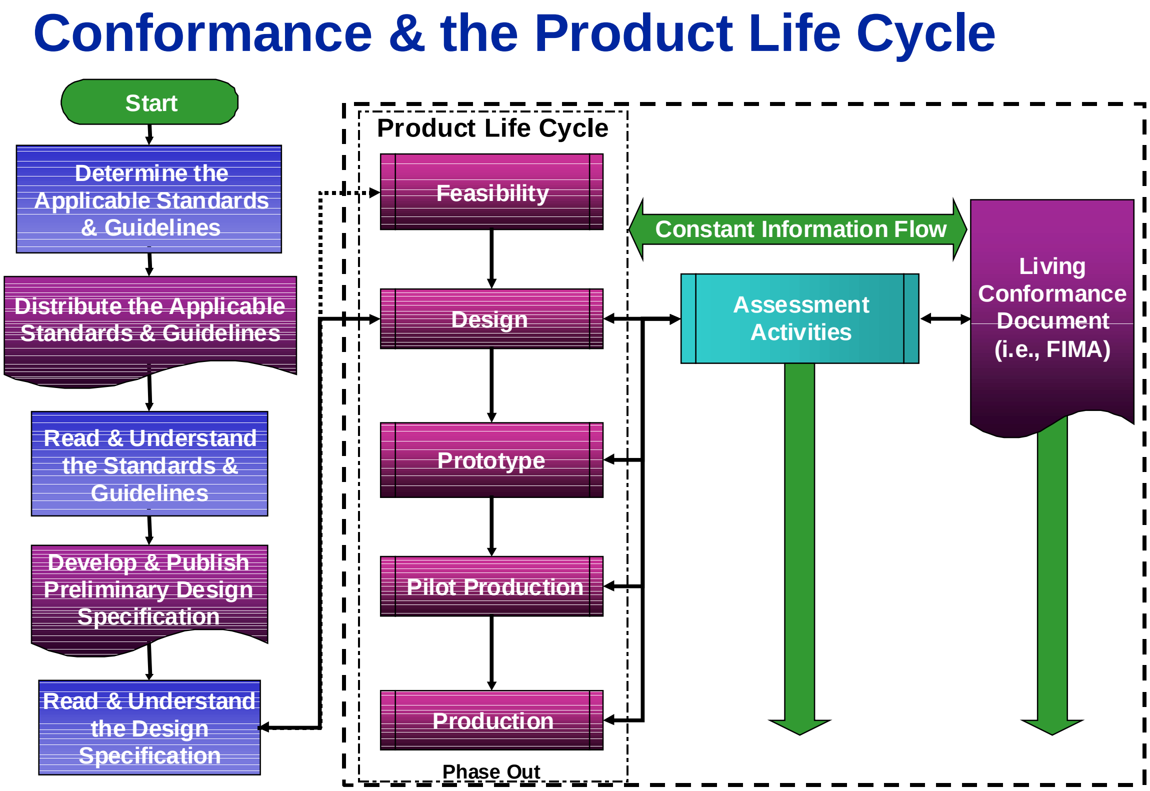

Figure 1 The Conformance Flowchart

Before the planned assessment date, it is recommended that the supplier also provide the following information to the assessor:

- Questions regarding the assessment procedures, process, and requirements.
- The supplier's pre-assessment (i.e., self-assessment) including the pertinent filled-out assessment worksheet found at the beginning of each assessment section.
- The names, phone number, and email address of the proper contact owner of the guideline and standards compliance in the supplier's company.
- Any reference documents – i.e., specific standards and guidelines that the supplier's equipment design was based on. This should include dated reference documents.

3.4 What Are/Will Be the FIMA Outcome(s) and Deliverables?

Once the FIMA is scheduled, the supplier should use the appropriate worksheet to prepare its equipment and documentation to support its response (see Section 3.3) during the assessment. A worksheet is provided in each assessment section to capture the performance against success criteria and questions. To document overall pass/fail and level of compliance, this data can be summarized in the compliance results summary table (see Section 11).

The FIMA produces results that may have major impacts on equipment development. Expected outcomes and deliverable items are

- an understanding of nonconforming design approaches,
- a FIMA report, and
- a Figure of Merit (FOM).

The first two results are generally easy to understand while the last result, FOM, is not and requires a more detailed explanation. The FOM uses an algebraic algorithm to quantify the current level of conformance at the time of the assessment.

Each guideline requirement is individually assessed, and a summary conformance rollup is generated for the eight functional requirement areas. To pass each assessment section, all Pass/Fail criteria within that section must receive a “Pass.” These details provide information about the current level and progress of guideline conformance and act as an early communication vehicle to the International SEMATECH member companies.

The assessment results for specific equipment will be available only to the associated equipment supplier and the International SEMATECH member companies. Results will not be shared with other equipment suppliers.

4 MECHANICAL INTERFACES ASSESSMENT

4.1 Load Port Assessment

This section contains a compilation of all of the *I300I Factory Integration Guideline* items that directly and specifically pertain to the number, location, function, format, capabilities, and other requirements for SEMI E15.1 FOUP-compatible load ports.

4.1.1 Instrumentation/Tools/Prerequisites

- Any SEMI-compliant, 300-mm, 25-wafer, 10-mm pitch FOUP
- Metric scale/tape measure
- Kinematic coupling fixture (see Figure 2)
- Kinematic coupling shaped template (see Figure 3)
- Sample kinematic coupling pin (see Figure 4)
- Forklift exclusion zone blocks (see Figure 5)
- 10 mm lead-in gauge (see Figure 6)
- Metric feeler gauge set
- Spirit level
- Equipment footprint and layout drawings

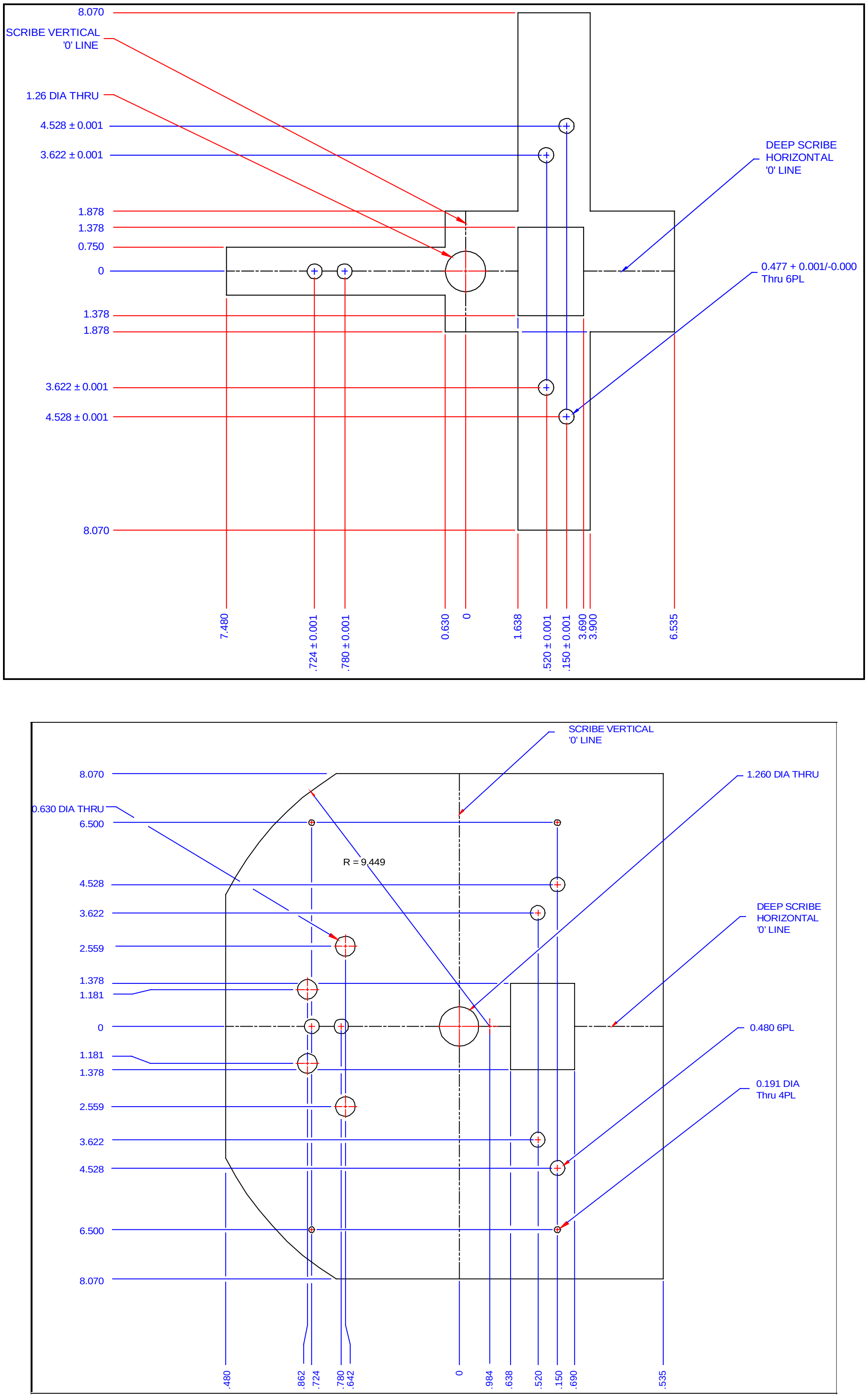

Figure 2 Kinematic Coupling Fixtures

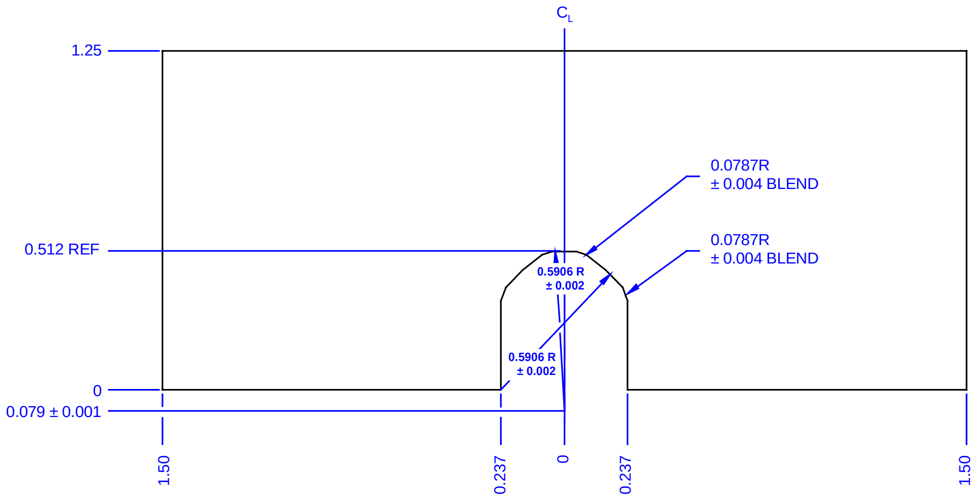

Figure 3 Kinematic Coupling Shaped Template

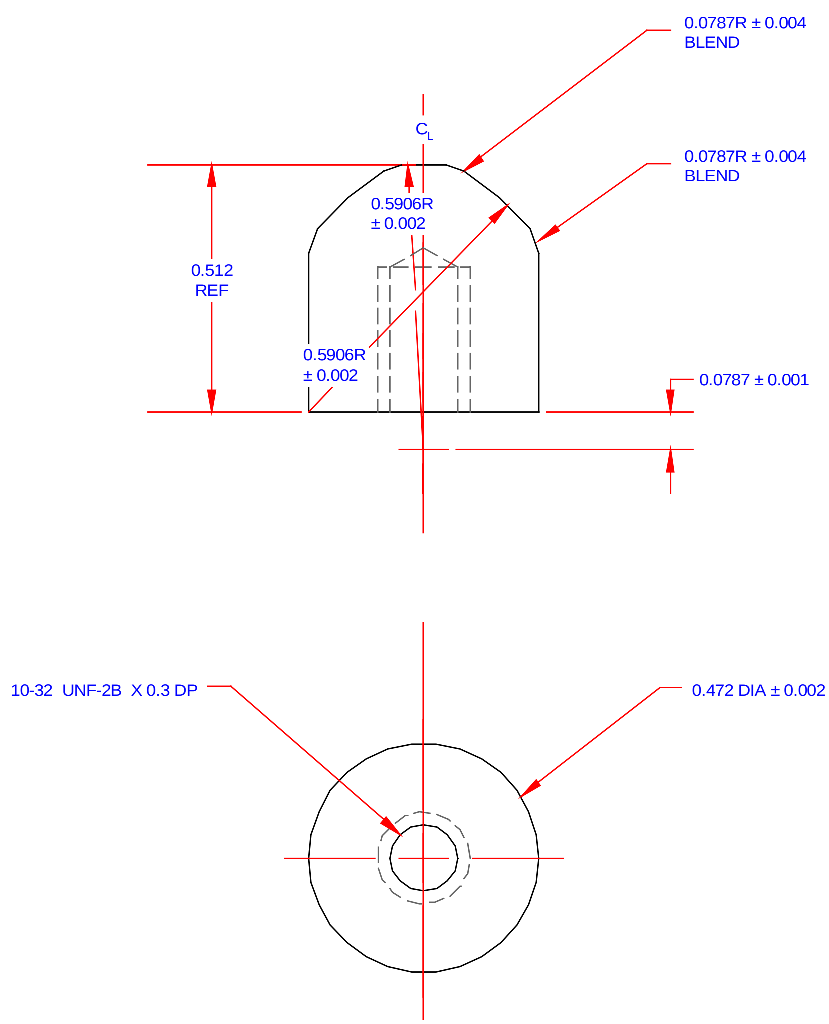

Figure 4 Sample Kinematic Coupling Pin

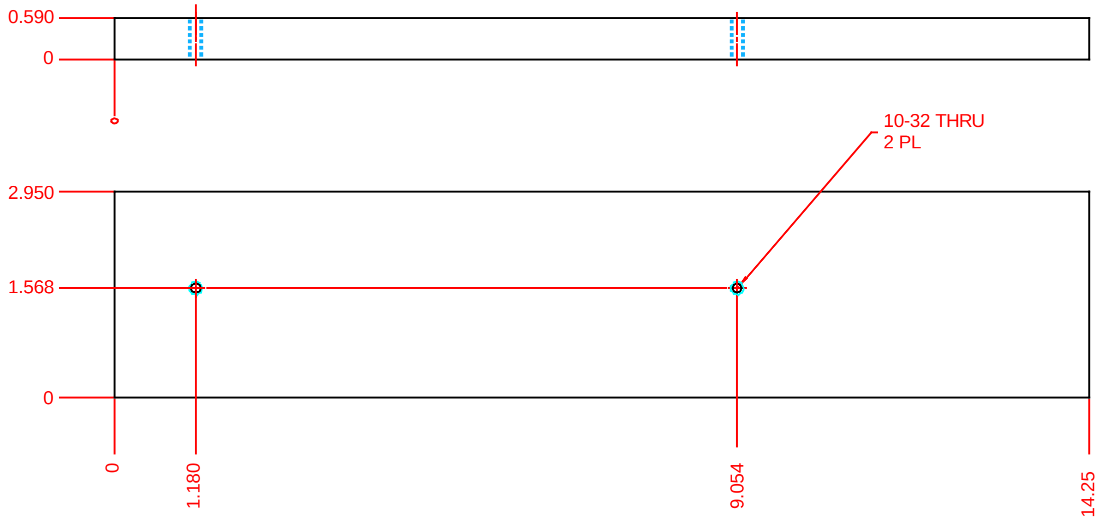

Figure 5 Forklift Exclusion Zone Blocks

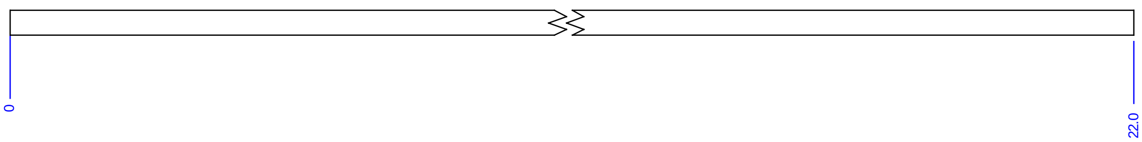

Figure 6 10 mm Lead-In Gauge

4.1.2 Load Port Physical Testing

The following procedures are designed for use on the equipment being evaluated to quantify the physical status and performance to key selected guidelines. They should be performed comprehensively and sequentially, with the output and results logged on the worksheet at the beginning of Section 4.1.

4.1.2.1 FOUP Compatibility – 300 mm process/metrology equipment must be designed to support the front opening unified pod (FOUP). The base equipment design must accept 25-wafer FOUPs and be configured for 13- or 25-wafer FOUPs (GL 2.1.1, GL 2.1.2, GL 2.3.1, GL 2.4.3). (Note: 25-wafer FOUPs are generally preferred and should be preferentially supplied.)

1) Visually inspect the equipment to determine FOUP compatibility
2) Determine if the equipment is configured for 13- or 25-wafer FOUPs.
3) Visually inspect that the equipment base design is structured to accommodate 25-wafer FOUPs in size, spacing, frame design, and other relevant areas.
   - Pass Criteria:
     i) The equipment is designed to support FOUPs.
     ii) The equipment is configured for either 13- or 25-wafer FOUPs.
     iii) The base equipment design accepts 25-wafer FOUPs.

- Fail Criteria:
  - i) IF: The equipment is not designed to support FOUPs.
  - ii) OR: The equipment is not configured for 13- or 25-wafer FOUPs.
  - iii) OR: The base design does not accept 25-wafer FOUP capacity.

4.1.2.2 Minimum Load Port Requirement – All in-line (in processing route) 300 mm process, metrology, and probe/testing equipment must have a minimum of two E15.1 load ports to meet the buffering requirement. Offline (not in process route) and/or low use metrology equipment can be configured with one E15.1 load port. In all cases, the primary load ports must all be on one side (clean bay aisle side) of the equipment to support automated material handling system (AMHS). (GL 2.6.2, GL 2.6.4, GL 2.9.1)

1) Determine if the equipment is "in-line" or "offline" equipment.
2) Document the number of primary E15.1 load ports.
3) Visually inspect that the primary load ports are all on the clean bay aisle side.
   - Pass Criteria: For offline (metrology) equipment, ≥ 1 primary E15.1 load port on the clean aisle side.
   - Pass Criteria: For in-line (process and metrology) equipment, ≥ 2 primary E15.1 load ports on one side to the clean aisle.
   - Fail Criteria:
     - i) IF: Inline equipment with <2 primary E15.1 load ports.
     - ii) OR: The primary load ports on more than one side of the equipment.
     - iii) OR: The primary load ports are not on the clean aisle side.

4.1.2.3 Permitted Auxiliary Load Ports – 300 mm process/metrology equipment may have special purpose auxiliary load ports. These load ports can be of two types: Dedicated "OHT to buffer" load ports (which are required to be on the same side as the primary load ports, aligned for OHT, and E15.1-compliant except for the 900 mm height requirement), and a single "auxiliary exception lot/wafer" load port (allowed to be on an adjacent side, E15.1 compliant, and configured for PGV interface). The auxiliary load ports are optional and careful consideration should be given to the footprint, maintainability, and cost impact of installing them on equipment. (GL 2.4.1.1, GL 2.9.2, GL 2.9.2.1)

1) Visually inspect the equipment to determine if there are any auxiliary load ports installed.
2) Document the number, type, and location of any auxiliary load ports.
3) Investigate the manual settings and software for the dedicated OHT to buffer load port(s) to see if any other operational mode can be selected or activated, such as manual or PGV.
4) Evaluate the location and alignment of the dedicated OHT to buffer load port(s) in relation to the primary load ports.
   - Pass Criteria: For dedicated OHT to buffer load ports.
     - i) The load port(s) are limited to dedicated function between the OHT and buffer.
     - ii) The load port(s) are located on the same side (clean bay aisle side) as the primary load ports.

   iii) The load port(s) datum planes are aligned with the primary load ports for OHT service.

- Pass Criteria: For exception lot/wafer load port.
   i) There is ≤ 1 exception lot/wafer load port.
- Fail Criteria:
   i) IF: The dedicated OHT to buffer load port(s) allows the selection of other interface modes, such as PGV.
   ii) OR: The dedicated OHT to buffer load port(s) are not located on the same side as the primary load ports.
   iii) OR: The FOUP datum plane of the dedicated OHT to buffer load port(s) is not aligned with the primary load ports.
   iv) OR: There is more than one auxiliary exception lot/wafer load port.

4.1.2.4 Load Port Features – Each SEMI E15.1 load port for 300 mm must include the following functions: bi-directional operation so that each load port can interchangeably act as an input or output port, kinematic coupling to ensure positive placement and positioning of the FOUP, exclusion zones for ID reader(s) (for the FOUP/carrier and wafer) as part of the design to allow for the implementation of a variety of technology solutions, discrete FOUP present and FOUP in position sensors for positive operational control, and a configuration to handle FOUPs with 10 mm pitch in size, position, and transfer mechanisms. (GL 2.4, GL 4.2.1, GL 3.1.6.3, GL 4.2.6, GL 3.1.6.2, GL 2.2.4, GL 4.2.5, GL 2.2.2)

1) Determine if the equipment has an internal buffer.
2) If it does not, then bi-directional load port functionality will be tested during slot-to-slot carrier integrity testing in Section 6.2.1; no further testing is required here.
3) If the equipment does include an internal buffer, perform the following steps:
   a) Evaluate the equipment ability to use the same port bi-directionally as follows:
      i) Place a FOUP with at least one wafer on load port #1 (LP1).
      ii) Using the standard operating method, have the lot moved into the buffer.
      iii) Using the standard operating method, initiate wafer processing.
      iv) When wafer processing is complete, the processed FOUP must be automatically returned back to load port #1 (LP1).
      v) Repeat steps i) through iv) for each load port (for 1 to N), ensuring that in each case the FOUP is returned to the originating load port and that each port is capable of acting as a load and unload port, and record the results.
   b) Evaluate the equipment’s ability to use different available ports interchangeably as follows:
      i) Place a FOUP with at least one wafer on load port #1 (LP1).
      ii) Using the standard operating method, have the lot moved into the buffer.
      iii) Once the FOUP has been moved into the buffer, make LP1 unavailable by placing another FOUP on the load port.
      iv) Using the standard operating method, initiate wafer processing.

   v) When wafer processing is complete, the processed FOUP must be automatically returned back to an available load port.
   vi) Repeat steps i) through v) for a sample of load port combinations to ensure that the equipment is capable of interchangeably using available load ports for load and unload, and record the results.

c) Pass Criteria:
   i) If the equipment does not have an internal buffer and passes slot-to-slot carrier integrity testing as defined and evaluated in Section 6.2.1.
   ii) If the equipment does have an internal buffer:
      a) Every load port is capable of accepting a FOUP as input, loading that lot to the buffer, after processing return the lot to the same load port as output positioned at the load port pickup point.
      b) The equipment is capable of interchangeably using any available load port as a load or unload position.

d) Fail Criteria:
   i) IF: The equipment does not have internal buffering and failed the slot-to-slot carrier integrity test in Section 6.2.1.
   ii) OR: The equipment does have internal buffering, but one or more of the load port positions cannot act as both an input and an output (same load port, same FOUP).
   iii) OR: The equipment does have internal buffering, but one or more of the load port positions cannot act as an interchangeable input and output (any port in to any port out).

4) Inspect the kinematic coupling alignment to the equipment, ensuring that the FOUP door is parallel to the equipment boundary and load face plane at the time of loading. Figure 7 shows examples of improperly oriented FOUPs. Figure 8 shows examples of correctly oriented FOUPs.

5) Evaluate the kinematic coupling placement orientation using the following steps:
   a) Place the kinematic coupling fixture on load port #1 (LP1).
   b) Does the fixture mate with the coupling correctly?
   c) Does the fixture front (straight 16-inch) surface align parallel with the equipment boundary?
   d) Can the fixture rest flush with the horizontal datum plane?
   e) Repeat steps a) through d) for each load port (for 1 to N), documenting the results.

6) Inspect the finish of the kinematic coupling pins using the following steps:
   a) Visually compare the finish of the load port kinematic coupling pins on load port #1 to the finish of the kinematic coupling fixture or if necessary the sample kinematic coupling pin.
   b) The finish of the load port pins should be visually equivalent to the fixture or sample pin.
   c) Repeat the above steps for each load port (for 1 to N), documenting the results.

7) Evaluate the shape and dimensions of the kinematic coupling pins using the following steps:
   a) Place the kinematic coupling shaped template on each of the pins in load port #1.
   b) Is it the right dimensions (diameter and height)?
   c) Is it the right shape (taper and rounding)?
   d) If necessary, use the sample kinematic coupling pin for comparison.
   e) Repeat steps a) through d) for each load port (for 1 to N) and document the results.

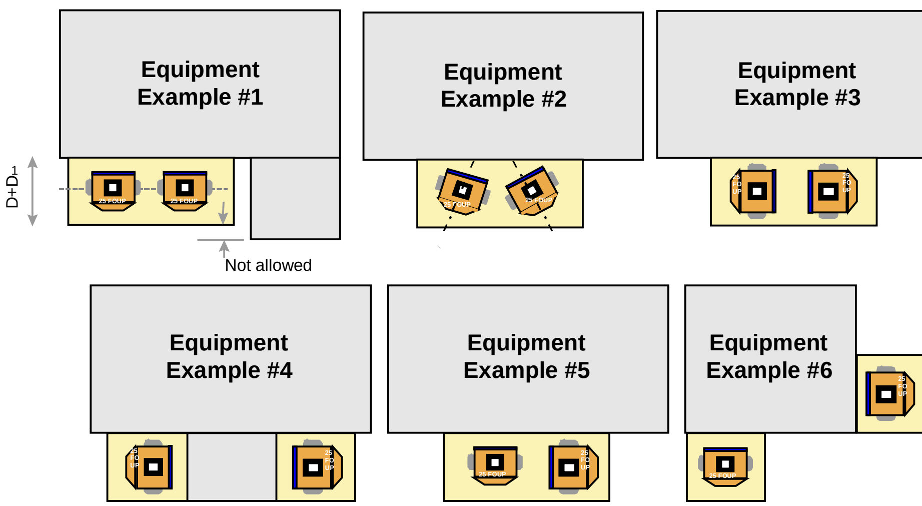

Figure 7 Example of Improper FOUP Orientations at Time of Loading

Some Loadport designs that MEET Standards

Note: Sketches below show loadport orientation at time of FOUP Load/Unload

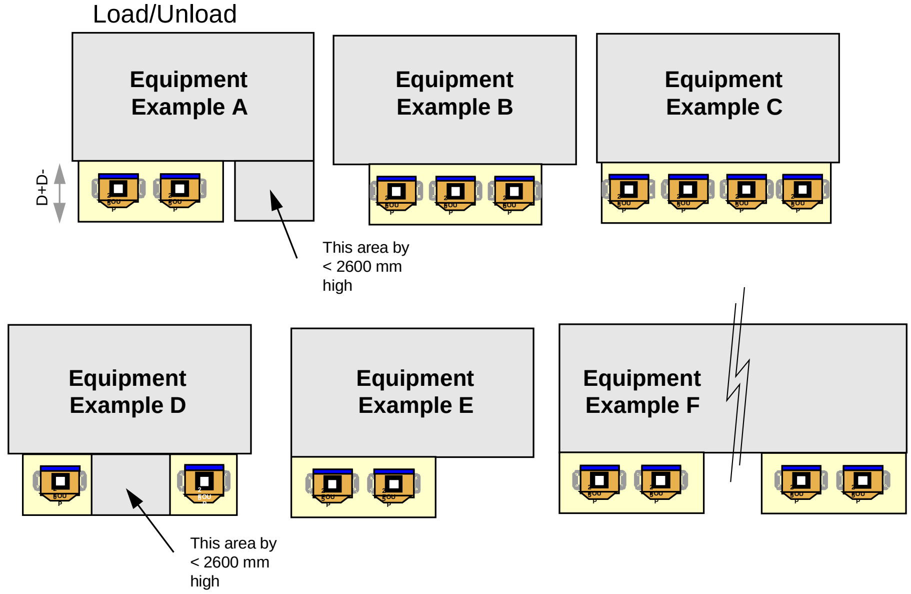

Figure 8 Example of Acceptable FOUP Orientations at Time of Loading

- Pass Criteria:
  - i) The kinematic coupling alignment orientation places the FOUP door parallel to the equipment boundary.
  - ii) Every load port mates with the kinematic coupling fixture correctly.
  - iii) At every load port the kinematic coupling fixture rests flush with the horizontal datum plane.
  - iv) At every load port the finish on the kinematic coupling pins is visually equivalent to the finish of the kinematic coupling fixture or the sample kinematic coupling pin.
  - v) At every load port the shape and dimensions of the kinematic coupling pins is correct as measured by the kinematic coupling shaped template and in comparison to the sample coupling pin.
- Fail Criteria:
  - i) IF: The kinematic coupling alignment orientation does not place the FOUP door(s) parallel to the equipment boundary.
  - ii) OR: Any load port does not mate with the kinematic coupling fixture correctly.
  - iii) OR: At any load port the kinematic coupling fixture does not rest flush with the horizontal datum plane.
  - iv) OR: Any of the coupling pins at any of the load ports do not have the correct finish.
  - v) OR: The shape and dimensions of any of the coupling pins at any of the load ports is not correct.

8) Inspect each load port against design parameters to ensure that an exclusion zone has been reserved for the installation of a FOUP ID reader/writer according to SEMI E15.1. Using a metric scale, collect the following measurements (as illustrated in Figure 9).
   a) For fixed buffer (i.e., load ports only) equipment
      - i) For read-only carrier ID technologies the exclusion zone must allow the reader to be oriented to scan a FOUP when the carrier is at the pickup position (i.e., load/unload position).
      - ii) Verify that the volume width, W4 times 2, for the advance mechanism at the load/unload position is ≥ 150 mm.
      - iii) Verify that the volume height, H4 (80 mm), for the ID reader exclusion volume at the load/unload position, plus H3 (15 mm) is ≥ 95 mm.
      - iv) For load ports with read/write capability: The exclusion zone must allow the read/writer to be oriented to scan a carrier when the carrier is at the FIMS position. The load port must have the capability to lock the FOUP in place while writing to the ID.
      - v) Verify that the volume width, W4 times 2, for the advance mechanism for reader/writing at the FIMS (docked) position is ≥ 70 mm.
      - vi) Verify that the volume height, H4 (30 mm), for the ID reader exclusion volume at the FIMS (docked) position, plus H3 (0) is ≥ 30 mm.

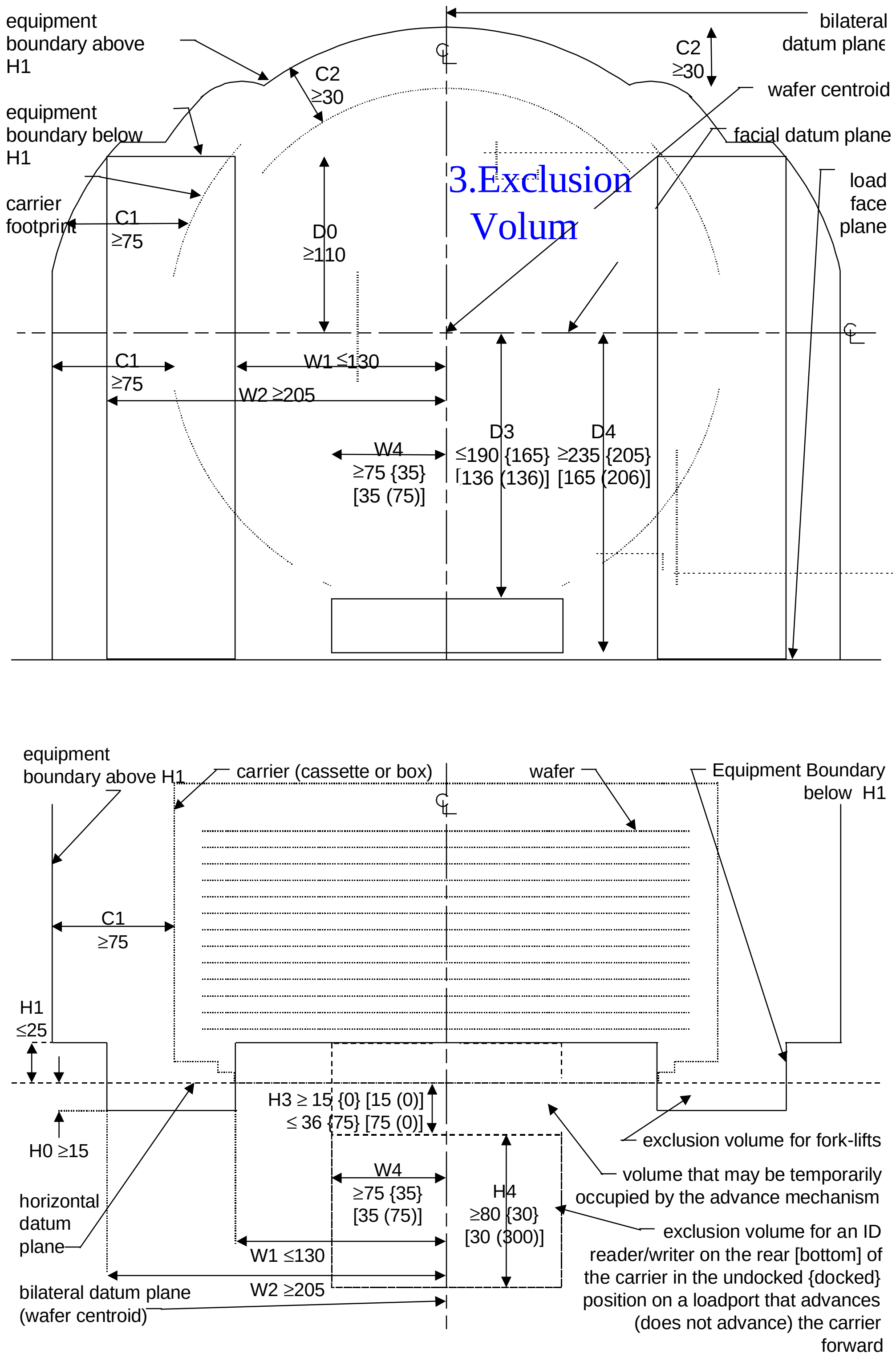

Figure 9 Exclusion Volumes for ID Readers/Writers

- Pass Criteria:
  - i) There is an identified design exclusion zone for a carrier ID reader at every load port.
  - ii) For read-only carrier ID technologies the exclusion zone is positioned to allow carrier reading at the load port load/unload pickup position with the correct exclusion zone height/width dimensions as in ii) and iii) of section a) above.
  - iii) For read/writer carrier ID technologies the exclusion zone is positioned to allow carrier read/writing at the FIMS position with the correct exclusion zone height/width dimensions as in v. and vi. of section a) above.
  - iv) For read/writer carrier ID technologies the load port provides a lock down feature to lock the carrier in place at the FIMS position while writing to the ID.
  - v) The exclusion zone does not infringe on any other critical clearance or space requirements for the load port as defined in SEMI E15.1.
- Fail Criteria:
  - i) IF: The equipment does not have an identified, designed-in exclusion zone at each load port for the installation/addition of an FOUP/wafer ID reader.
  - ii) OR: The exclusion zone does not allow the reader to read the FOUP ID at the load station pickup point.
  - iii) OR: The exclusion zone does not allow the read/writer to read/write the FOUP ID at the FIMS position
  - iv) OR: The exclusion zone does not meet critical dimensions, as described in section a) above.
  - v) OR: The load port does not provide a lock down feature to lock down the carrier at the FIMS position while writing to the ID
  - vi) OR: The exclusion zone infringes on any other critical dimension, clearance, or space requirement as defined in SEMI E15.1.

b) For internal buffer equipment
  - i) For read-only carrier ID technologies the exclusion zone must allow the reader to be oriented to scan a FOUP when the FOUP is at the pickup position (i.e., load/unload position).
  - ii) Verify that the volume width, W4 times 2, for the advance mechanism at the load/unload position is ≥ 150 mm.
  - iii) Verify that the volume height, H4 (80 mm), for the ID reader exclusion volume at the load/unload position, plus H3 (15 mm) is ≥ 95 mm.
  - iv) For carrier ID writing the internal buffer must support an internal position for the ID writer equipment at all internal FIMS port locations within the buffer. The internal buffer/FIMS port must have the capability to lock the FOUP in place while writing to the ID.

- Pass Criteria:
  - i) There is an identified design exclusion zone for a carrier ID reader at every load port.
  - ii) For read-only carrier ID technologies the exclusion zone is positioned to allow carrier reading at the load port pickup position with the correct exclusion zone height/width dimensions as in ii) and iii) of section b) above.
  - iii) For read/writer carrier ID technologies the internal buffer supports an internal position for the ID write equipment at all internal FIMS port locations within the buffer.
  - iv) For read/writer carrier ID technologies the load port provides a lock down feature to lock the carrier in place at each internal FIMS port location while writing to the ID.
  - v) The exclusion zone does not infringe on any other critical clearance or space requirements for the load port as defined in SEMI E15.1.
- Fail Criteria:
  - i) IF: The equipment does not have an identified, designed-in exclusion zone at each load port for the installation/addition of an FOUP ID reader.
  - ii) OR: The exclusion zone does not allow the reader to read the FOUP ID at the load station pickup point.
  - iii) OR: The exclusion zone does not allow the read/writer to read/write the FOUP ID at the internal buffer FIMS port location.
  - iv) OR: The exclusion zone does not meet critical dimensions, as described in section b) above
  - v) OR: The load port does not provide a lock down feature to lock down the carrier at the internal buffer FIMS port location while writing to the ID
  - vi) OR: The exclusion zone infringes on any other critical dimension, clearance, or space requirement as defined in SEMI E15.1.

9) Each load port must have separate and distinct (i.e., independently operating) sensors for presence and placement. This is important for product safety reasons, because a FOUP could be present on a load port without being properly positioned, creating a jeopardy situation for loading/unloading. Evaluate the presence, position, and function of the FOUP present and FOUP position sensors using the following steps:

   a) Place a FOUP correctly on load port 1 (LP1).

   b) Is the FOUP present OK indicator light visible while standing facing the load port?

   c) Is the FOUP position OK indicator light visible while standing facing the load port?

   d) Are the indicator lights properly and visibly labeled?

   e) Position the FOUP off center to the right by approximately 7 cm. The FOUP present sensor light should turn ON, and the FOUP position sensor light should remain OFF.

f) Position the FOUP off center to the left by approximately 7 cm. The FOUP present sensor light should turn ON, and the FOUP position sensor light should remain OFF.

g) Position the FOUP off center forward (toward the equipment boundary) by approximately 3 cm. The FOUP present sensor light should turn ON, and the FOUP position sensor light should remain OFF.

h) Improperly position the FOUP by rotating it 90° counterclockwise. The FOUP present sensor light should turn ON, and the FOUP position sensor light should remain OFF.

i) Improperly position the FOUP by rotating it 90° clockwise. The FOUP present sensor light should turn ON, and the FOUP position sensor light should remain OFF.

j) Repeat steps a) through i) for each load port (for 1 to N), documenting the results.

- Pass Criteria:
  - i) The load port has discrete FOUP present and FOUP position sensors and corresponding indicator lights for each sensor.
  - ii) The FOUP present and position indicator lights are visible while standing facing the load port.
  - iii) The FOUP present sensor is active any time a FOUP is on the load port, whether it is positioned correctly or not.
  - iv) The FOUP position sensor accurately identifies correct and incorrect positioning.
- Fail Criteria:
  - i) IF: The load ports do not have discrete FOUP present and position sensors.
  - ii) OR: The FOUP present and position indicator lights are not visible while standing in front of the load port.
  - iii) OR: The FOUP present sensor does not accurately identify that a FOUP is present.
  - iv) OR: The FOUP position sensor does not accurately identify when a FOUP is in the correct position.

10) Observe that the load port(s), buffer, and transport mechanisms are compatible with FOUPs with 10 mm pitch using the following steps:

a) Place a SEMI compliant 300 mm 25-wafer 10 mm pitch FOUP on load port 1 (LP1).

b) During normal operation, observe that the physical dimensions of the load port, FOUP transport path, FIMS interface seal area, and any other mechanical clearance areas of the equipment design are compatible with the size of 10 mm pitch FOUPs.

c) During normal operation, observe the wafer transfer from the FOUP to the processing environment, evaluating the compatibility of the wafer transfer mechanisms to the FOUP 10 mm pitch.

- Pass Criteria:
  - i) The equipment mechanical clearances accommodate the size of a FOUP with 10 mm pitch.
  - ii) The wafer transfer mechanism is compatible with 10 mm wafer pitch.
- Fail Criteria:
  - i) IF: Any mechanical clearance in the FOUP transport/handling pathway touches any part of the 10 mm pitch FOUP.
  - ii) OR: Buffer positions are the wrong size for 10 mm pitch FOUPs.
  - iii) OR: The wafer transfer mechanism is not properly spaced for 10 mm pitch.
  - iv) OR: During wafer transfer the transfer mechanism causes or allows mechanical damage to the wafers because of pitch.

4.1.2.5 E15.1 Compliance – 300 mm process/metrology equipment load port(s) must meet the requirements of SEMI E15.1 in functionality, critical dimensions, and static testing, with a specific emphasis on the dimensions "D" and "D1." For load ports that are dedicated to OHT to buffer interface, an exemption is granted to the "H" dimension requirement to allow for this function. The spacing between load ports must accommodate the size and spacing to allow for the use of human handles. (GL 2.4.1, GL 2.10.2, GL 2.4.1.1, GL 2.3.5)

1) Ensure that the equipment has passed the kinematic coupling alignment to equipment requirements of Section 4.1.3.4, Step #4 before proceeding with this test.
2) Place the kinematic coupling fixture on each load port sequentially using a spirit level ensure that each load port is level.
3) Investigate the forklift exclusion zone using the following steps:
   a) Place the kinematic coupling fixture on load port 1 (LP1) and when it is correctly positioned, visually note its specific positioning.
   b) Remove the kinematic coupling fixture and attach the forklift exclusion zone blocks to the bottom.
   c) Place the kinematic coupling fixture with forklift exclusion zone blocks onto LP1, and visually examine that it is in the same position as previously (without the zone blocks).
   d) Note any features or dimensions that interfere with item c) above.
   e) Repeat steps a) through d) for each load port (for 1 to N), and record the results.
4) Verify the height of each load port using the following steps:
   a) If it is a primary load port or the auxiliary exception lot port.
      - i) Using a metric scale, measure the distance from the floor to the horizontal datum plane of LP1.
      - ii) Verify that the height "H" is equal to 900 mm.
      - iii) Verify that the height "H" can be adjusted between 890 mm and 910 mm.
      - iv) Repeat steps i) through iii) for each standard height load port (for 1 to N), and record the results.

b) If it is a dedicated OHT to buffer load port:
   i) Using a metric scale, measure the distance from the floor to the horizontal datum plane and record the height "H."
   ii) Place a 25-wafer FOUP on the buffer load port.
   iii) Use a metric scale to measure the distance from the floor to the top of the robot-handling flange on the FOUP.
   iv) Verify that the height "H2" is ≤ 2600 mm.
   v) Repeat step i) through iv) for each dedicated OHT to buffer load port (for 1 to N), and record the results.

5) Verify the critical dimensions of each E15.1 load port using the following steps:
   a) Place the kinematic coupling fixture on load port #1 (LP1).
   b) Using a metric scale and the reference markings on the kinematic coupling fixture, collect the following measurements (as illustrated in Figure 10 and Figure 7).
      i) "S" is the distance between load ports, measured between corresponding coupling pins to the right adjacent port.
      ii) "C1" is the side clearance space between one FOUP envelope (including human handles) and another, or to a vertical obstruction. It can be measured between the side edge of the kinematic coupling fixture and the nearest vertical obstruction or load port outer edge.
      iii) "C2" is the rear clearance space between the carrier envelope to a vertical obstruction. It can be measured between the front edge of the kinematic coupling fixture and the outer-most protrusion of the equipment (i.e., the closest vertical equipment surface parallel to the facial datum plane and above the E15.1 load port).
      iv) "H" is the allowable load height to the bottom of the carrier envelope (i.e., the distance from the floor to the horizontal datum plane, measured from the floor to the bottom of the kinematic coupling fixture).
      v) "H1" is the maximum height of a horizontal obstruction above the load height, "H" (900 mm), between the load face plane and the carrier envelope.
      vi) "H2" is the maximum height of any assembly or equipment element adjacent to the load port (outside of the OHT exclusion zone) and in front of the equipment boundary (i.e., into the cleanroom).
      vii) "D" is the distance from the facial datum plane to the load face plane, where the load face plane coincides with the equipment feature farthest into the cleanroom.
      viii) "D1" is the distance from the facial datum plane to the equipment boundary (i.e., the closest vertical equipment surface parallel to the facial datum plane and above the E15.1 load port).
      ix) Repeat step i) through viii) for each load port (for 1 to N), measuring every critical dimension and recording the results.

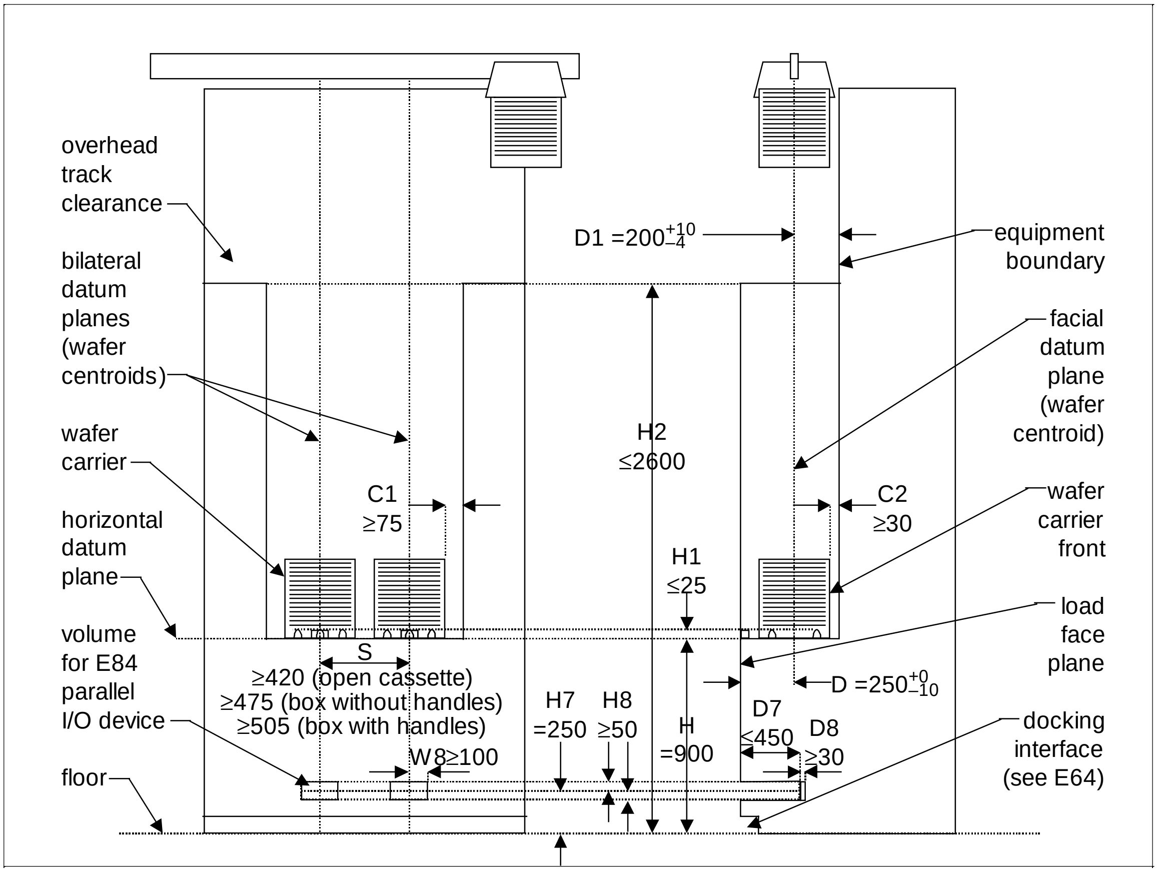

Figure 10 E15.1 Critical Dimension Reference

- Pass Criteria:
  - i) All load ports are level.
  - ii) The forklift exclusion zone is free of obstruction and correct.
  - iii) All primary and exception lot load port(s) height “H” = 900 mm.
  - iv) All primary and exception lot load port(s) adjustment range is 890 to 910 mm.
  - v) All dedicated OHT to buffer load ports height “H2” is ≤ 2600 mm.
  - vi) All load ports meet all critical dimension requirements as defined in paragraph 5 of the procedures.

- Fail Criteria:
  - i) IF: Any load ports are not level.
  - ii) OR: Any load port forklift exclusion zone is incorrect or has obstructions that prevent proper operation.
  - iii) OR: Any primary or exception lot load port height “H” is not 900 mm.
  - iv) OR: Any primary or exception lot load port adjustment range is larger than or outside the boundaries 890 mm to 910 mm.
  - v) OR: Any dedicated OHT to buffer load port height “H2” is > 2600 mm.
  - vi) OR: Any load port of any type does not meet the E15.1 critical dimension requirements as defined in paragraph 5 of the procedures and Figure 10.

4.1.2.6 FIMS Compliance – 300 mm process/metrology equipment that does not include an internal buffer requires that each load port have a dedicated door opening mechanism that must meet the requirements of the front-opening interface mechanical standard (FIMS). For equipment with internal buffering, FIMS interface(s) must be present at the position where the wafers are removed from the pod and enter the processing environment. The pod open/close functionality must be integrated so that the pod automatically engages the FOUP hold down and the front opening interface, and the functional cycle is fully automated. If the equipment requires load locks, the minimum number, bi-directional requirement, and relationship to the FIMS interface must be met. (GL 2.3.2, GL 2.6.2.1, GL 2.7.2.1, GL 2.7.2.2, GL 2.6.2.2)

1) Visually inspect the equipment to determine if it has an internal buffer.
2) For equipment without buffering, evaluate the functionality and compliance of the FIMS interface using the following steps:
   a) Note that there should be one FIMS interface for each load port.
   b) Place a FOUP on load port 1 (LP1).
   c) Ensure that both the FOUP present and position indicators are on.
   d) Before the FIMS keys attempt to unlock the FOUP door, test the load port clamping mechanism by gently pulling on the FOUP to make sure it cannot be removed from the load port.

e) When the pod has engaged the FIMS interface, and the FOUP door has been removed, evaluate the position of the FOUP-to-FIMS seal using the following steps:

i) Visually inspect the FOUP-to-FIMS mating to ensure that there are no visible gaps.

ii) If a gap is visually present use a feeler gauge to measure the size of the gap and record the value(s).

f) Visually observe that when the FOUP has engaged the FIMS interface, the FIMS registration pins mate correctly with the FOUP door. Check for missing, damaged, or misaligned FOUP doors. The equipment should not proceed with processing if the FOUP door does not mate properly.

g) Visually observe the FIMS door open cycle, using the following steps:

i) The FIMS keys must engage with the FOUP and unlock the FOUP door.

ii) The FOUP door should be removed from the FOUP and securely stored in a location that will not interfere with wafer transfer by a wafer-handling robot.

iii) Once the door is open, the FOUP must expose the wafers to a minienvironment controlled or active process area.

h) After the process cycle has completed and the wafers have been transferred back to the open FOUP, visually observe the FIMS door close cycle using the following steps:

i) The door must return to the FOUP opening, with good alignment.

ii) The FIMS interface should seal and lock the FOUP door, and disengage the door opener.

iii) The load port and FIMS interface should disengage, returning each of them to the position they held before the load cycle started.

iv) Once the load port had returned to the pickup point, verify that the clamping mechanism has disengaged by gently pulling on the FOUP, which should now be free to move.

i) Using a metric scale, verify that the load port dimensions “D” and “D1” are the same as previously assessed.

j) Repeat steps a) through h) for each load port (for 1 to N), documenting the results.

3) For equipment with internal buffering, evaluate the functionality and compliance of the buffer FIMS interface using the following steps:

a) Use the load port to place one or more FOUPs into the equipment buffer.

b) Use the equipment control system to move a FOUP to the buffer FIMS interface, visually observing that the transfer is without interruption or interference.

c) Visually observe that the buffer FIMS must engage a clamping mechanism to maintain dimensional stability during opening, transfer and closing.

d) When the pod has engaged the FIMS interface, evaluate the position of the FOUP-to-FIMS seal using the following steps:

   i) Visually inspect the FOUP-to-FIMS mating to ensure that there are no visible gaps.

   ii) If a gap is visually present use a feeler gauge to measure the size of the gap and record the value(s).

e) Visually observe that when the FOUP has engaged the FIMS interface, the FIMS registration pins mate correctly with the FOUP door.

f) Visually observe the FIMS door open cycle, using the following steps:

   i) The FOUP door should be removed from the FOUP and securely stored in a location that will not interfere with wafer transfer by a wafer-handling robot.

   ii) Once the door is open, the FOUP must expose the wafers to a minienvironment controlled or active process area.

g) Visually observe that during the process cycle the FOUP is handled and stored correctly using the following steps:

   i) The buffer FIMS should close the empty FOUP, using the following door close cycle:

      a) The door must return to the FOUP opening, with good alignment.

      b) The FIMS interface should seal and lock the FOUP door and disengage the door opener.

      c) The FOUP transfer mechanism and FIMS interface should disengage, returning each of them to the idle position they held before the load cycle started.

      d) Once the FOUP transfer mechanism had returned to the pickup point, verify that the clamping mechanism has disengaged by gently pulling on the FOUP, which should now be free to move.

h) After the process cycle has completed, visually observe that the equipment control system has retrieved the empty FOUP from the buffer (if stored there during processing) and positioned it at the buffer FIMS interface, having used the steps in f) to have the FOUP open and ready for post production wafers.

i) After the wafers have been transferred back to the FOUP from the processing environment, visually observe that the pod door is closed using the steps in g).

j) Visually observe that once the FOUP and FIMS interface have disengaged, the FOUP transfer mechanism returns the FOUP to a load port as output.

k) Using a metric scale, verify that the load port dimensions “D” and “D1” are the same as previously assessed after receiving the output FOUP from the buffer.

l) Repeat step a) through k) for each buffer FIMS interface (for 1 to N), documenting the results.

- Pass Criteria:
  - i) The clamping mechanism engages before the FIMS keys attempt to unlock the FOUP door.
  - ii) When the FOUP has engaged the FIMS, the registration pins mate correctly.
  - iii) The FOUP door is unlocked and stored securely out of the way.
  - iv) At no time are the wafers exposed to an uncontrolled environment outside the FOUP.
  - v) The FOUP door aligns and closes without any problem.
  - vi) The FOUP is returned to the initial point, and the clamping mechanism is disengaged.
  - vii) If the equipment includes buffering, the FOUP is returned to the load port for unloading.
- Fail Criteria:
  - i) IF: The clamping mechanism does not engage before the FIMS keys attempt to unlock the FOUP door.
  - ii) OR: When the FOUP has engaged the FIMS, the registration pins do not mate correctly.
  - iii) OR: The FOUP door not stored securely out of the way.
  - iv) OR: The wafers exposed to an uncontrolled environment outside the FOUP.
  - v) OR: The FOUP door does not aligns for closing.
  - vi) OR: The clamping mechanism does not disengage.
  - vii) OR: The FOUP does not return to the initial point.
  - viii) OR: If the equipment includes buffering, the FOUP does not return to the load port for unloading.

4) For equipment with load locks, evaluate the compliance of the load lock, load port and FIMS interface using the following steps:

a) For equipment with fixed buffer (i.e., no internal buffer):
   - i) Determine if there is a corresponding load lock for each load port/FIMS interface.
   - ii) Assess the FIMS interfaces according to section 2) a) through 2) f) above, using a FOUP at all load ports simultaneously.
   - iii) When the wafers are transferred from the FOUPs at each load ports/FIMS to the load locks, note whether the wafers are transferred to the corresponding or another load lock.

iv) Note whether each load port / load lock / FIMS interface groups operate independently of other load port / load lock / FIMS interface groups. (i.e., one load port / load lock / FIMS interface group can operate with the other load port and/or load lock empty or down.)

v) Complete assessment of the FIMS interfaces according to section 2) g) through 2) h).

b) For equipment with an internal buffer:

i) Determine if there is a corresponding load lock for each load port/FIMS interface.

ii) Assess the FIMS interfaces according to section 3) a) through l) above.

c) Determine if another method other than corresponding load port / load lock / FIMS interfaces with independent operation for each group has been used to provide continuous processing.

- Pass Criteria:

i) There is a corresponding load lock for each load port/FIMS interface.

ii) The load port/load lock/FIMS interface groups can operate independently from each other.

iii) The clamping mechanism engages before the FIMS keys attempt to unlock the FOUP door.

iv) The FOUP seals to the FIMS properly.

v) When the FOUP has engaged the FIMS, the registration pins mate correctly.

vi) The FOUP door is unlocked and stored securely out of the way.

vii) At no time are the wafers exposed to an uncontrolled environment outside the FOUP.

viii) The FOUP door aligns and closes without any problem.

ix) The FOUP is returned to the initial point, and the clamping mechanism is disengaged.

x) If the equipment includes buffering, the FOUP is returned to the load port for unloading.

- Fail Criteria:
  - i) IF: There is not a corresponding load lock for each load port/FIMS interface.
  - ii) OR: The load lock/load port/FIMS interface groups cannot operate independently of each other and there is not other equipment internal support mechanization for continuous processing.
  - iii) OR: The clamping mechanism does not engage before the FIMS keys attempt to unlock the FOUP door.
  - iv) OR: The FOUP seal to the FIMS leaves a visible or measurable gap.
  - v) OR: When the FOUP has engaged the FIMS, the registration pins do not mate correctly.
  - vi) OR: The FOUP door not stored securely out of the way.
  - vii) OR: The wafers exposed to an uncontrolled environment outside the FOUP.
  - viii) OR: The FOUP door does not aligns for closing.
  - ix) OR: The clamping mechanism does not disengage.
  - x) OR: The FOUP does not return to the initial point.
  - xi) OR: If the equipment includes buffering, the FOUP does not return to the load port for unloading.

4.1.3 Load Port Physical Testing Results

Complete the assessment information table below.

I300I Load Port Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Load Port Supplier	
Load Port Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

4.1.3.1 FOUP Compatibility: 300 mm process/metrology equipment must be designed to support the front opening unified pod (FOUP). The base equipment design must accept 25-wafer FOUPs and be configured for 13- or 25-wafer FOUPs. (GL 2.1.1, GL 2.1.2, GL 2.3.1, GL 2.4.3) (Note: 25-wafer FOUPs are generally preferred and should be preferentially supplied.)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Is the equipment FOUP compatible?		Yes	
Is the equipment configured for 13 or 25-wafer FOUPs? (note which)		13 or 25	
Does the base design accept 25-wafer FOUPs?		Yes	
		Overall Compliance	

Comments: ____

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4.1.3.2 Minimum Load Port Requirement: All in-line (in processing route) 300 mm process, metrology, and probe/testing equipment must have a minimum of two E15.1 load ports to meet the buffering requirement. Offline (not in process route) and/or low use metrology equipment can be configured with one E15.1 load port. In all cases, the primary load ports must all be on one side (clean bay aisle side) of the equipment to support automated material handling system (AMHS). (GL 2.6.2, GL 2.6.4, GL 2.9.1)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Is the equipment "in-line" or "offline?"		Either	
Number of primary load ports for in-line equipment?		≥ 2	
Number of primary load ports for offline equipment?		≥ 1	
Are the primary load ports on one side of the equipment, for clean bay aisle access?		Yes	
		Overall Compliance	

Comments: ____

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4.1.3.3 Permitted Auxiliary Load Ports: 300 mm process/metrology equipment may have special purpose auxiliary load ports. These load ports can be of two types: dedicated OHT to buffer load ports (which are required to be on the same side as the primary load ports, aligned for OHT, and E15.1-compliant except for the 900 mm height requirement) and a single auxiliary exception lot/wafer load port (allowed to be on an adjacent side, E15.1-compliant, and configured for PGV interface.) The auxiliary load ports are optional and careful consideration should be given to the footprint, maintainability, and cost impact of installing them on equipment. (GL 2.4.1.1, GL 2.9.2, GL 2.9.2.1)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Does this equipment have auxiliary load ports?		N/A	
Number of auxiliary dedicated OHT to buffer load ports?		N/A	
Number of auxiliary exception-lot load ports?		≤ 1	
Are the dedicated OHT load ports on same side of the equipment as the primary load ports?		Yes	
Are the dedicated OHT load ports' datum planes aligned with the primary load ports for OHT service?		Yes	
		Overall Compliance	

Comments: ____

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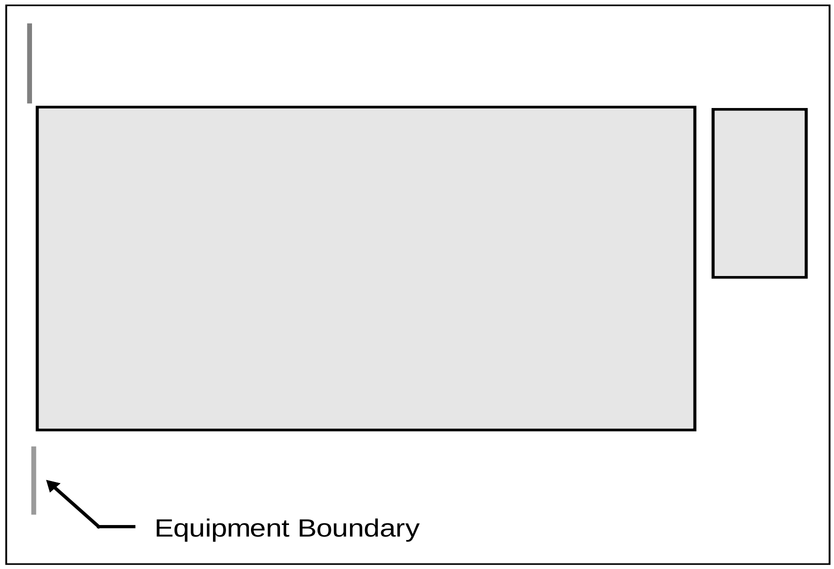
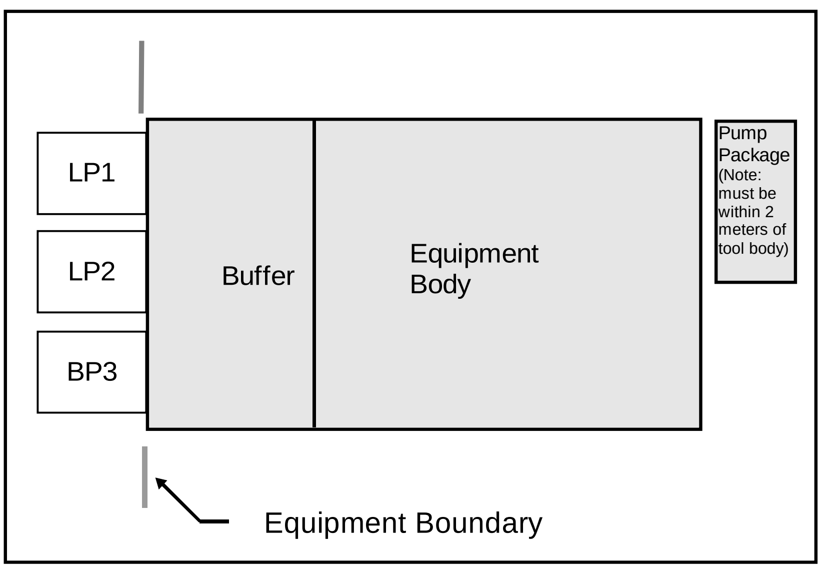
Label the primary load ports with a "LP" and the port number (i.e., LP1), the dedicated OHT load ports with "BP" and the port number (i.e., BP3), the auxiliary exception lot load port with "EP" (if such a port exists) and the port number (i.e., EP6). If the equipment has load locks, draw and label them with "LL" and the number (i.e., LL1), and label the buffer "Buffer" (see Figure 11).



To Be Filled Out During Assessment



Example of How Drawing Could be Filled Out and Labeled

Figure 11 Diagram the Location of all Equipment Load Ports and Buffer

4.1.3.4 Load Port Features: Each SEMI E15.1 load port for 300 mm must include the following functions: bi-directional operation so that each load port can interchangeably act as an input or output port, kinematic coupling to ensure positive placement and positioning of the FOUP, exclusion zones for ID reader(s) (for the FOUP/carrier and wafer) as part of the design to allow for the implementation of a variety of technology solutions, discreet FOUP present and FOUP in position sensors for positive operational control, and be configured to handle FOUPs with 10 mm pitch in size, position and transfer mechanisms (see Figure 10). (GL 2.4, GL 4.2.1, GL 3.1.6.3, GL 4.2.6, GL 3.1.6.2, GL 2.2.4, GL 4.2.59, GL 2.2.2)

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
For equipment without buffering, does the load port meet bi-directional operation as tested in Section 6.2.1?							Yes	
For equipment with buffering, does the load port meet bi-directional requirements unloading to the same port?							Yes	
For equipment with buffering, does the load port meet bi-directional requirements unloading to a different port?							Yes	
Does the kinematic coupling position the FOUP so the door is parallel to the equipment boundary?							Yes or N/A, if the tool has an internal buffer	
Does the load port mate (i.e., pin and hole alignment) with the kinematic coupling fixture correctly?							Yes	
Is the finish on the kinematic coupling pins correct?							Yes	
Are the kinematic coupling pins the correct size and shape?							Yes	
Does the FOUP present sensor exist and work correctly?							Yes	
Does the FOUP off center left test pass?							Yes	
Does the FOUP off center right test pass?							Yes	
Does the FOUP off center forward test pass?							Yes	
Does the FOUP off center clockwise test pass?							Yes	
Does the FOUP off center counterclockwise test pass?							Yes	
Does the FOUP position sensor work correctly?							Yes	
Does the load port operate compatibly with FOUPs that have 10 mm pitch?							Yes	
For Fixed Buffer Equipment (i.e., load ports only)								
Does the load port design include an exclusion zone for an FOUP ID reader?							Yes	
Is the ID reader exclusion zone positioned to allow the ID reader to **read** FOUPs at the pickup position?							Yes	

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
Does the ID reader exclusion zone infringe on any other critical dimension of the load port?							No	
Does the load port incorporate an ID reader only or ID reader/writer?							N/A	
Measure dimension "W4" (≥ 75 mm for reader only and ≥ 35 mm for reader/writer) times 2, on the load port.							≥ 150 mm for reader only and ≥ 70 mm for reader/ writer	
Measure dimension "H4" (≥ 80 mm fore reader only and ≥ 30 mm for reader/writer) plus "H3" (≥15 mm for reader only and ≥ 0 mm for reader/writer), on the load port.							≥ 95 mm for reader only and ≥ 30 mm for reader/ writer	
Does the load port provide a lock down feature to lock the FOUP in place at the FIMS position while writing?							Yes if ID writer used	
For Internal Buffer Equipment								
Does the load port design include an exclusion zone for an FOUP ID reader?							Yes	
Is the ID reader exclusion zone positioned to allow the ID reader to **read** FOUPs at the pickup position?							Yes	
Does the ID reader exclusion zone infringe on any other critical dimension of the load port?							No	
Does the load port incorporate an ID reader only or ID reader/writer?							N/A	
Measure dimension "W4" (≥ 75 mm for reader only) times 2, on the load port.							≥ 150 mm for reader only	
Measure dimension "H4" (≥ 80 mm fore reader only) plus "H3" (≥15 mm for reader only), on the load port.							≥ 95 mm for reader only	
Does the internal buffer provide an internal position for a ID reader/writer at the FIMS port locations within the buffer?							Yes if ID writer used	
Does the load port provide a lock down feature to lock the FOUP in place at the FIMS position while writing?							Yes if ID writer used	
							Overall Compliance	

* Enter the appropriate load port ID's using the notation from the layout diagram in additional columns.

Comments: ____

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4.1.3.5 E15.1 Compliance: 300 mm process/metrology equipment load port(s) must meet the requirements of SEMI E15.1 in functionality, critical dimensions and static testing, with a specific emphasis on the dimensions "D" and "D1." For load ports that are dedicated to an OHT interface, an exemption is granted to the "H" dimension requirement to allow for this function. The spacing between load ports must accommodate the size and spacing to allow for the use of human handles (see Figure 10). (GL 2.4.1, GL 2.10.2, GL 2.4.1.1, GL 2.3.5)

Dimension Reference

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
Is the load port level?							Yes	
Is the forklift exclusion zone correct?							Yes	
Measure dimension "H" on standard height ports							900 mm	
Is the height adjustment range for "H" correct?							890 mm to 910 mm	
Measure dimension "H" on OHT height ports							N/A	
Measure dimension "H2" on OHT height ports							≤ 2600 mm (to top of FOUP)	
Measure dimension "S" between ports							≥ 505 mm	
Measure dimension "C1" on the load port							≥ 75 mm	
Measure dimension "C2" on the load port							≥ 30 mm	
Measure dimension "H1" on the load port							≤ 25 mm	
Measure dimension "D" on the load port							250 mm +0/-10	
Measure dimension "D1" on the load port							200 mm +10/-4	
							Overall Compliance	

* Enter the appropriate load port ID's using the notation from the layout diagram in additional columns.

Comments: ____

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4.1.3.6 FIMS Compliance: 300 mm process/metrology equipment that does not include an internal buffer requires that each load port have a dedicated door opening mechanism that must meet the requirements of the FIMS standard. For equipment with internal buffering, FIMS interface(s) must be present at the position where the wafers are removed from the pod and enter the processing environment. The pod open/close functionality must be integrated so that the pod automatically engages the FOUP hold down and the front opening interface, and the functional cycle is fully automated. If the equipment requires loadlocks, the minimum number, bi-directional requirement, and relationship to the FIMS interface must be met. (GL 2.3.2, GL 2.6.2.1, GL 2.7.2.1, GL 2.7.2.2, and GL 2.6.2.2)

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
Is there one FIMS interface for each load port?							Yes	
OPENING: Does the FOUP clamping mechanism engage prior to the FIMS door key?							Yes	
OPENING: Visually inspect the FOUP to FIMS mating surfaces for visible gaps							N/A	N/A
OPENING: Measure any visible gaps and record value							N/A	N/A
OPENING: Do the FIMS registration pins engage properly							Yes	
OPENING: Does the FIMS key engage and unlock the door properly?							Yes	
OPENING: Is the FOUP door securely stored out of the wafer transfer path?							Yes	
OPENING: With the FOUP door open, are the wafers exposed only to active process or minienvironment areas?							Yes	
CLOSING: Does the door return to the FOUP well aligned?							Yes	
CLOSING: Does the FIMS seal, lock and disengage from the door properly?							Yes	
CLOSING: Do the FOUP and FIMS return to the proper resting-place?							Yes	
CLOSING: Does the clamping mechanism disengage properly?							Yes	
After the cycle is complete, measure “D”							250 mm +0/-10	
After the cycle is complete, measure “D1”							200 mm +10/-4	
For equipment with buffers, record if after wafer transfer, the empty FOUP is returned to buffer?							N/A	
For equipment with buffers, is the empty FOUP retrieved and positioned properly for unloading at the buffer port?							N/A	

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
For equipment with buffers, after processing is the FOUP transferred to an output load port?							Yes	
For equipment with load locks, is there a corresponding load lock for each load port?							Yes	
For equipment with load locks, can the load port / load lock / FIMS interface operate independently?							Yes	
Overall Compliance								

* Enter the appropriate load port ID's using the notation from the layout diagram in additional columns.

Comments: ____

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4.1.4 Load Port Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion and supporting documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

4.1.4.1 Equipment designs must allow cost-effective conversion of equipment from 13- to 25-wafer carriers. (GL 2.1.3)

Sample Questions:

a) Is there a documented conversion procedure?
b) Is there a consolidated and costed conversion parts kit?
c) What is the cost estimate for conversion in materials and labor?

Comments: ____

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4.1.4.2 Equipment with internal buffers must allow loading/unloading of exception lots in the same manner as production lots using FOUP and E15.1* load ports. (GL 3.1.2)

Sample Questions:

a) How does your equipment handle exception lots in the buffer?

b) Do they follow the normal production protocol via the primary load ports and interface?

c) What percentage of load port duty cycle or buffer capacity did you assume for exception lot handling?

d) What assumptions did you base exception lot handling on for equipment design?

Comments: ____

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4.1.4.3 Equipment Suppliers must design, demonstrate, and ensure that load ports are interoperable with multiple suppliers of wafer carriers/pods and AMHS systems. (GL 2.3.3)

Sample Questions:

a) How have you ensured interoperability with FOUPs?

b) How have you ensured interoperability with AMHS systems?

c) What verification methods did you use?

d) What were the results?

Comments: ____

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4.1.4.4 All pods are required to have a robotic handling flange; therefore, process/metrology equipment must be compatible with this pod shape and size. (GL 2.3.4)

Sample Questions:

a) Does your load port and/or buffer setup move the pod flange inside of the equipment boundary?

b) If so, do you have an exclusion zone for the robotic flange in the movement path?

c) What is the minimum dimension of the vertical flange clearance in the transfer path?

d) Where is that minimum clearance?

Comments: ____

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4.2 Interfaces for Material Delivery Assessment

This section contains elements of the *I300I Factory Guideline* regarding the requirements for the interfaces between the material delivery equipment and the production equipment. Much of these requirements involve feature/attributes of equipment load ports and, therefore, compliance may cite assessment procedures in Section 4.1 on load ports.

4.2.1 Interfaces for Material Delivery Instrumentation/Tools/Prerequisites

None.

4.2.2 Interfaces for Material Delivery Physical Testing

4.2.2.1 OHT Exclusion Zone – All in-line 300 mm process/metrology equipment must be able to accept delivery from OHT systems. The equipment design must include exclusion zones for OHT delivery. (GL 2.5.1, GL 2.5.1.1, GL 2.5.2, GL 2.5.3)

1) Visually evaluate the AMHS exclusion zone using the following steps:

   a) Verify that there are no obstructions in the OHT chimney (see Figure 12 and Figure 13) extending vertically along the equipment boundary from the top of the FOUP to the ceiling.

   b) Verify that no assembly or part of the equipment infringes on the OHT chimney, such as the user interface, door opener registration pins, lightstack, handles, EMO button, etc.

2) Determine that the equipment supports concurrent interface with OHT as well as floor-based delivery systems.

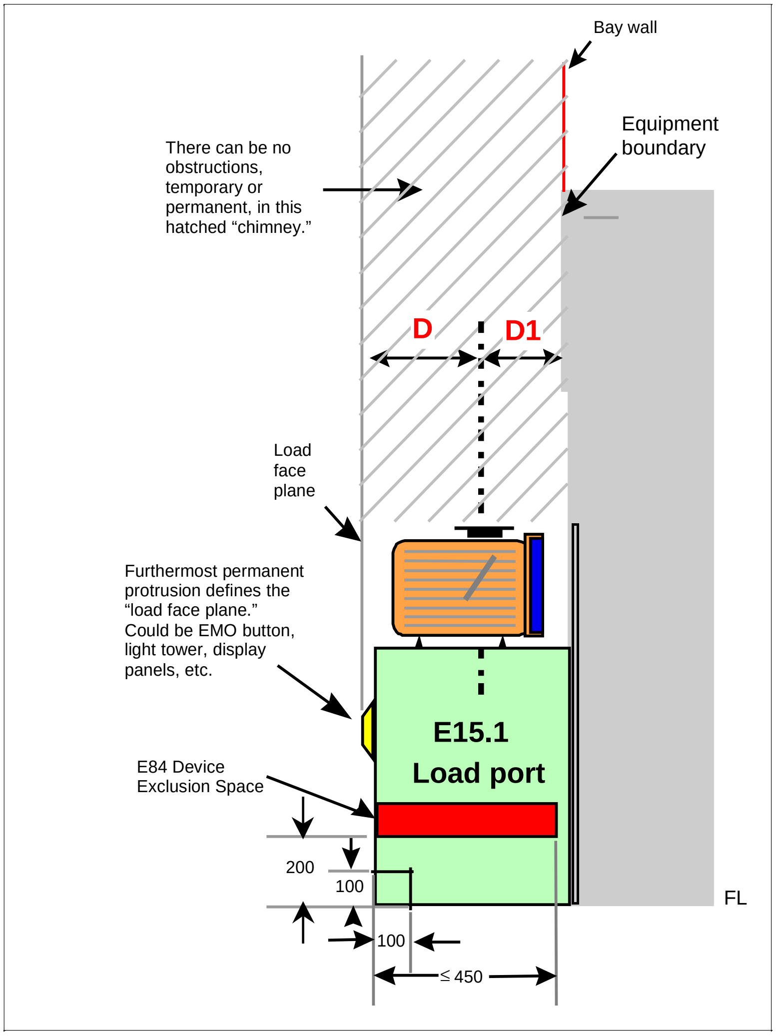

Figure 12 OHT Chimney Exclusion Zone

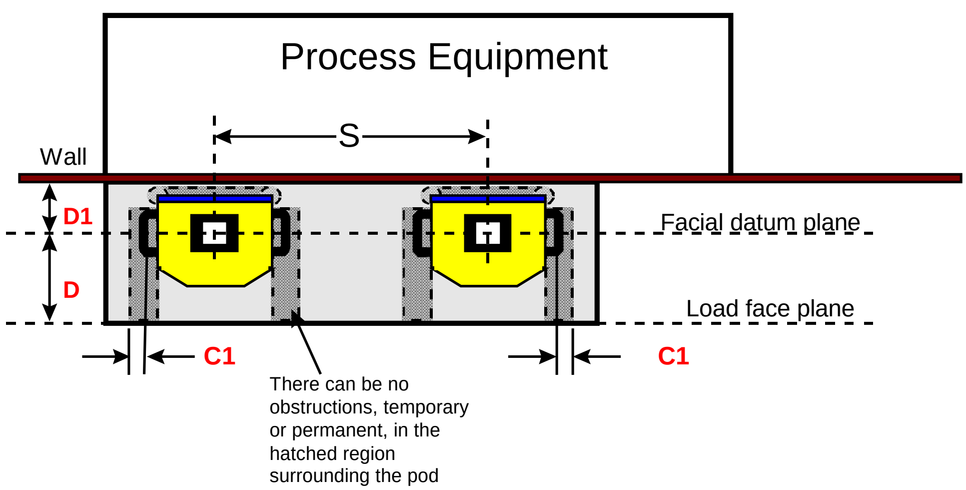

Figure 13 Top View of OHT Chimney Exclusion Zone

- Pass Criteria:
  - i) The OHT chimney extends vertically along the equipment boundary from the top of the FOUP to the ceiling without any infringements or obstructions.
  - ii) The equipment supports concurrent interface with OHT and floor-based systems.
- Fail Criteria:
  - i) IF: The OHT chimney does not extend vertically to the ceiling without any infringements or obstructions.
  - ii) OR: The equipment does not support concurrent interface with OHT and floor-based systems.

4.2.2.2 Cart Docking Interface – All in-line 300 mm process/metrology equipment must be able to accept delivery from floor based transport systems. The equipment design must include exclusion zones for PGV interface delivery. The E15.1 load ports must include load face plane alignment marks or labels to facilitate easy equipment alignment. (GL 2.5.1, GL 2.14.1, GL 2.14.2, and GL 2.14.3)

1) Visually evaluate the AMHS exclusion zone using the following steps:
   a) Verify that there are no potential obstructions between the load face plane and the position of any potential floor-based delivery system (see Figure 14).
   b) Inspect the load face plane for temporary (e.g., retractable keyboards, maintenance panels, keys, or diskette) and permanent obstructions (e.g., keyboards, user interface screens, light stacks, EMO buttons, etc) (see Figure 14).
2) Using a metric scale and visual inspection, verify the critical dimensions of the cart docking exclusion zone using the following steps:
   a) Measure the cart docking interface exclusion zone height, “Lh” ≥ 100 mm (see Figure 14).
   b) Measure the cart docking interface exclusion zone depth, “Ld” ≥ 100 mm (see Figure 14).
   c) Measure the photocoupled device exclusion zone height, nominally ≥ 300 mm (see Figure 14).
   d) Visually verify that the cart docking interface exclusion zone extends the full equipment width and is free of obstructions (see Figure 15). Note: Equipment features (i.e. tool leveling supports, wiring harnesses, etc) should not encroach upon or compromise the cart docking exclusion zone.
   e) Visually verify that the cart docking interface area is free of trip hazards.

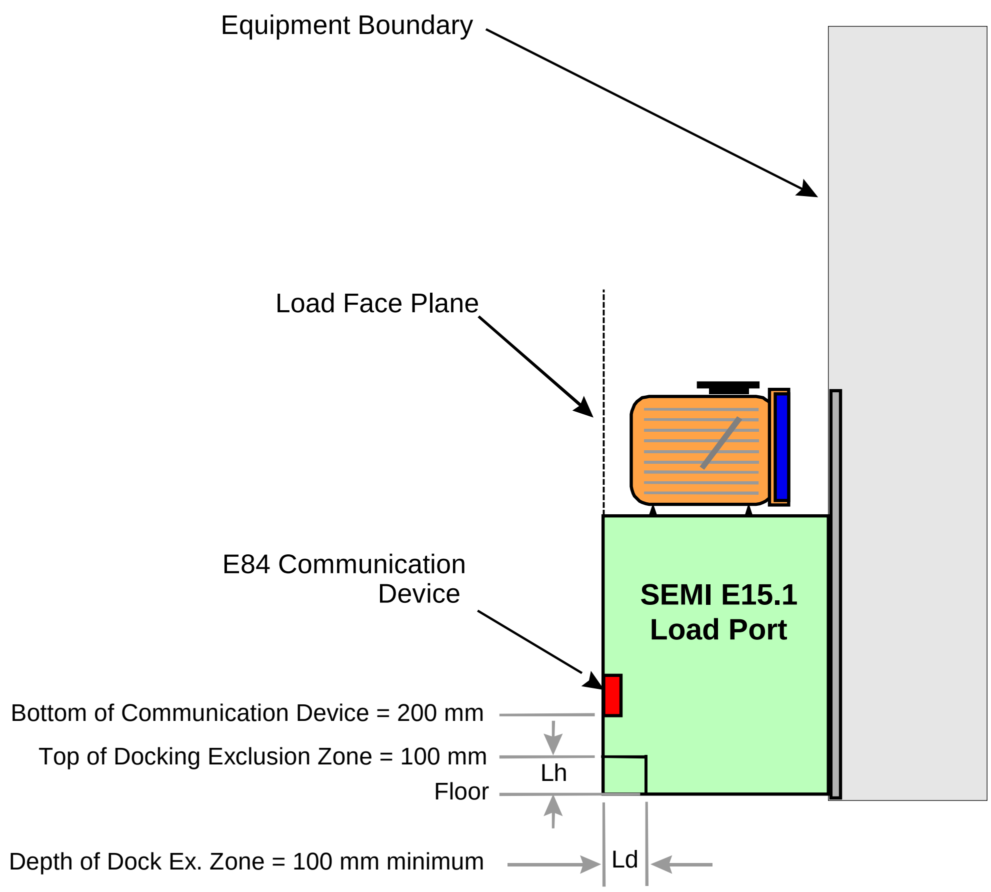

Figure 14 Side View of Cart Docking Exclusion Zone

- Pass Criteria:
  - i) The load face plane is free of potential temporary and permanent obstructions that may interfere with floor based delivery systems.
  - ii) The cart docking interface exclusion zone height, "Lh" ≥ 100 mm.
  - iii) The cart docking interface exclusion zone depth, "Ld" ≥ 100 mm.
  - iv) The photocoupled device exclusion zone height is nominally from 200 mm to 300 mm above floor, "H7" ± "H8".
  - v) The cart docking interface exclusion zone extends the full equipment width.
  - vi) The cart docking interface exclusion zone is free of trip hazards.

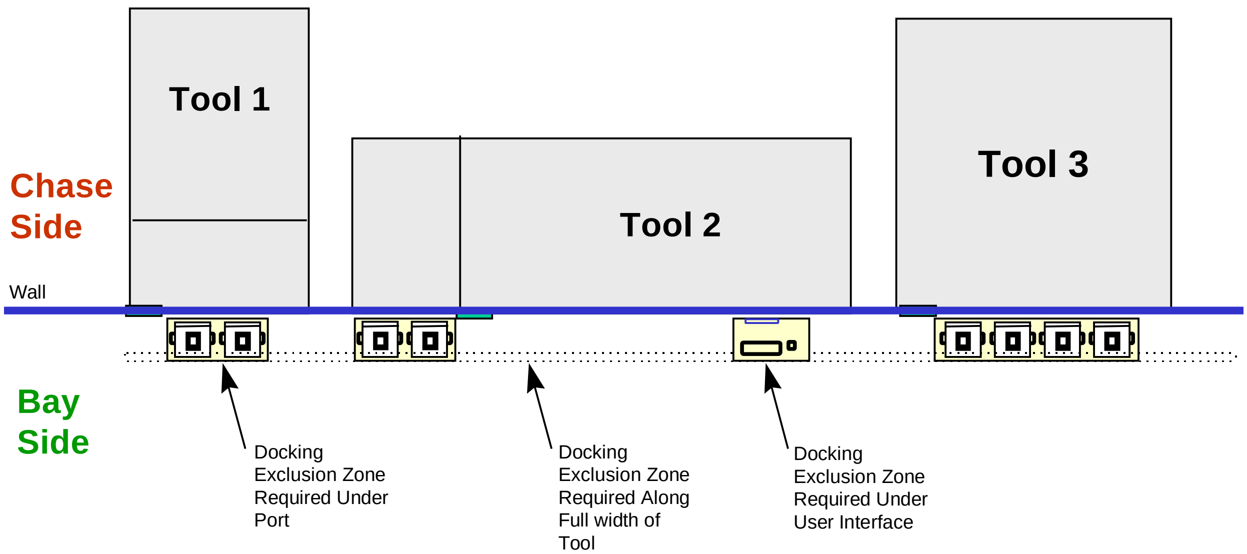

Figure 15 Exclusion Zone Extending the Full Width of Equipment is Required

- Fail Criteria:
  - i) IF: The load face plane has any potential temporary and permanent obstructions that may interfere with floor based delivery systems.
  - ii) OR: The cart docking interface exclusion zone height, “Lh” < 100 mm.
  - iii) OR: The cart docking interface exclusion zone depth, “Ld” < 100 mm.
  - iv) OR: The photocoupled device exclusion zone height does not include the vertical space from 200 mm to 300 mm above the floor.
  - v) OR: The cart docking interface exclusion zone does not extend the full equipment width.
  - vi) OR: The cart docking interface exclusion zone is not free of trip hazards.

4.2.2.3 Photocoupled Interface – All in-line 300 mm process/metrology equipment must include photocoupled devices (refer to SEMI Draft 2913A) at each load port and as a parallel I/O capability for OHT interface (see Figure 16). (GL 2.13.3, GL 2.13.3.1, GL 4.2.2).

1) Visually evaluate the photocoupled interface using the following steps:
   a) Visually inspect each load port to verify that the equipment has a photocoupled sensor/connection for interface communication to the transport device at each port.
   b) Visually inspect that there is an photocoupled sensor/connection for interface communication to the OHT transport device or a connection for installation that meets the parallel I/O requirements.

- Pass Criteria:
  - i) The equipment has a photocoupled sensor at each load port.
  - ii) There is a photocoupled sensor or a connection for installation of that sensor that meets the parallel I/O requirement for communication to the OHT transport device.

- Fail Criteria:
  - i) IF: The equipment does not have a photocoupled sensor at each load port.
  - ii) OR: The equipment does not have a photocoupled sensor or connection for installation that meets the parallel I/O requirement for communication to the OHT transport device.

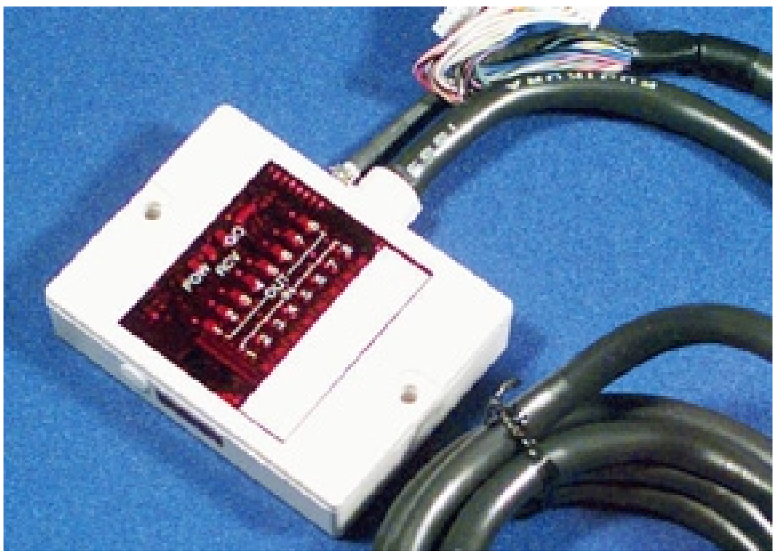

Figure 16 Example of a Photocoupled Device

4.2.2.4 Equipment Installation Alignment – All in-line 300 mm process/metrology equipment must be able to accept delivery from floor-based and OHT systems. The E15.1 load ports must include load face plane (front most surface of equipment, including load ports – see Figure 12) alignment marks or labels to facilitate easy equipment alignment. A variety of alignment and positioning distances and relationships must be evaluated to facilitate equipment alignment. (GL 2.10.1, GL 2.10.1.1, GL 2.10.1.2, GL 2.10.2)

1) Visually inspect that a mark or label on the load ports identifies the load face plane.
2) Using equipment drawings, evaluate the footprint dimensions for installation alignment using the following steps
   a) Record the distance between the load face plane and the equipment datum point, Ay, from the equipment drawings provided by the supplier (see Figure 17).

b) Record the distance between each bilateral datum plane and the equipment datum point; Bx1, Bx2, Bx3, Bx4 from the equipment drawings provided by the supplier, if applicable (see Figure 17).

c) Record the distance between the equipment outside boundary and the equipment datum point; Ax, from the equipment drawings provided by the supplier, if applicable (see Figure 17).

d) Record the distance between the facial datum plane, equipment boundary and the equipment datum point, By and Cy, from the equipment drawings provided by the supplier (see Figure 17).

e) Ensure that the drawing number, revision number, and revision date are recorded for each of the drawings used above.

- Pass Criteria:
  - i) A procedure exists that allows for easy alignment of the tool and load ports.
- Fail Criteria:
  - i) IF: A procedure does not exist that allows for easy alignment of the tool and load ports.

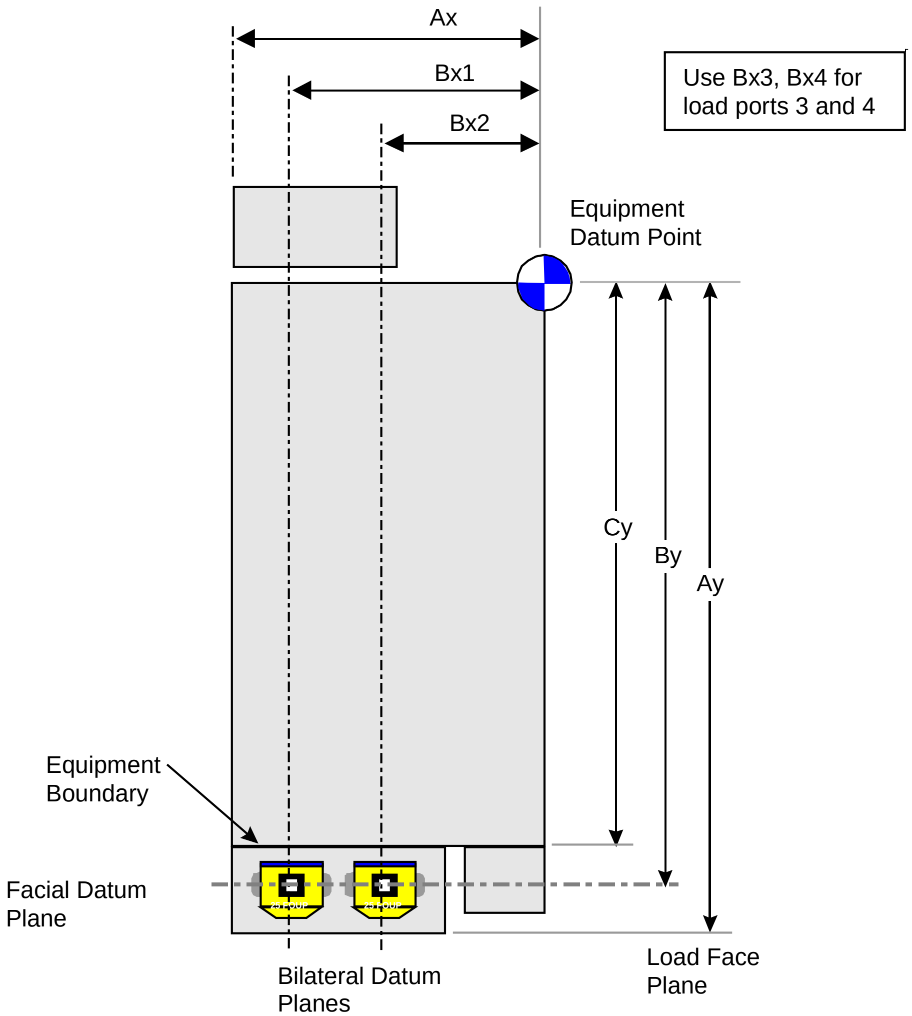

Figure 17 Datum Point Reference

4.2.3 Interfaces for Material Delivery Physical Testing Results

Complete the assessment information in the table below.

I300I Interfaces for Material Delivery Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Supplier	
Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

4.2.3.1 OHT Exclusion Zone: All in-line 300 mm process/metrology equipment must be able to accept delivery from overhead hoist transport (OHT) systems. The equipment design must include exclusion zones for OHT delivery. (GL 2.5.1, GL 2.5.1.1, GL 2.5.2, and GL 2.5.3)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
No obstructions in the OHT easement chimney.		Yes	
No equipment infringements to OHT easement chimney.		Yes	
		Overall Compliance	

Comments: ____

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4.2.3.2 Cart Docking Interface: All in-line 300 mm process/metrology equipment must be able to accept delivery from floor-based transport systems. The equipment design must include exclusion zones for PGV interface delivery. (GL 2.5.1, GL 2.14.1, GL 2.14.2, GL 2.14.3)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
The load face plane is clear for floor based AMHS access?		Yes	
Measure the cart docking exclusion zone dimension “Lh”.		≥ 100 mm	
Measure the cart docking exclusion zone dimension “Ld”.		≥ 100 mm	
Measure the photocoupled sensor exclusion zone dimension per SEMI E15.1.		200 mm to 300 mm (minimum)	
Cart docking exclusion zone runs across the full equipment width? Note: Equipment features (i.e. tool leveling supports, wiring harnesses, etc) should not encroach upon or compromise the cart docking exclusion zone.		Yes	
Cart docking exclusion zone free of trip hazards?		Yes	
		Overall Compliance	

Comments: ____

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4.2.3.3 Photocoupled Interface: All in-line 300 mm process/metrology equipment must include photocoupled devices at each load port and as a parallel I/O capability for an OHT interface. (GL 2.13.3, GL 2.13.3.1, GL 4.2.2)

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
Is there an exclusion zone identified for a photocoupled (or equivalent) device?							Yes	
Does each load port have a photocoupled device attached?							Yes	
Do any I/O, software, and/or wire runs exist on the primary load ports? Note in comment section below.							N/A	
Is there a photocoupled device or connection for each load port meeting the parallel I/O requirement for OHT interfaces?							Yes	
							Overall Compliance	

* Enter the appropriate load port ID’s using the notation from the layout diagram in additional columns.

Comments: ____

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4.2.3.4 AMHS Installation Alignment: All in-line 300 mm process/metrology equipment must be able to accept delivery from floor-based and OHT systems. The E15.1 load ports must include load face plane alignment marks or labels to facilitate easy equipment alignment. A variety of alignment and position distances and relationships must be evaluated to facilitate equipment alignment. (GL 2.5.1, GL 2.10.1, GL 2.10.1.1, GL 2.10.1.2)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Do you have a procedure that facilitates alignment of the tool and load ports?		Yes	
Obtain the equipment dimension “Ay.”		N/A	
Obtain the equipment dimension “By.”		N/A	
Obtain the equipment dimension “Cy.”		N/A	
Obtain the equipment dimension “Ax” (equipment width).		N/A	
Record the drawing number used for equipment dimensions.		N/A	
Record the drawing revision number.		N/A	
Record the drawing revision date.		N/A	

Assessment Detail	LP1*	LP2	LP3	LP4	LP5	LP6	Pass/Fail Criteria	Compliance
Obtain the equipment dimension “Bx_” for each of the load ports, including auxiliary ports.							N/A	
Overall Compliance								

* Enter the appropriate load port ID’s using the notation from the layout diagram in additional columns.

Comments: ____

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4.2.4 Interfaces for Material Delivery Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions below serve as the basis to begin these discussions. The questions also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

4.2.4.1 Load Ports must be capable of physical connection and use by overhead hoist transport (OHT) and floor-based (manual and/or automated) material delivery systems. Design considerations should be in place that prohibits simultaneous access of the load port at any given time. (GL 2.5.1.)

Sample Questions:

a) Are the primary load ports capable of supporting both OHT and PGV interface?

b) Are the primary load ports capable of supporting both AGV and PGV interface?

c) What design considerations are present that disallow simultaneous access of the load port at any given time?

d) What approach or solution did you use?

e) Has the capability been demonstrated?

f) What were the results?

Comments: ____

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4.2.4.2 Equipment that includes vertical buffers may include supplemental load ports at the top dedicated to OHT to buffer transfer. (GL 2.5.4)

Sample Questions:

a) Does your equipment design include supplemental OHT to buffer load ports?

b) If so, how many?

c) Are these ports E15.1*-compliant except for the 900 mm height requirement?

Comments: ____

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4.2.4.3 Alignment of equipment for OHT is based on the alignment of the equipment front face. It must be possible to line up the load face plane of all load ports of all equipment along one side of a bay to support ground based transport vehicle delivery. The load face plane must be identified by a mark or label on load ports to allow for easy alignment of equipment. (GL 2.10.1)

Sample Questions:

a) What are the tool and load port alignment procedures?

b) What is the method and are all required marks, fixtures, etc. available?

Comments: ____

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5 BUFFERING ASSESSMENT

This section contains a compilation of all of the I300I Factory Guideline items that directly and specifically pertain to the requirement for and evaluation of the size of process material buffering, to ensure continuous processing. It requires that the previous evaluation sections be completed as a precursor.

5.1 Buffering Instrumentation/Tools/Prerequisites

- Equipment footprint and layout drawings.

5.2 Buffering Physical Testing

5.2.1 Requirement for Buffering – 300 mm in-line process/metrology equipment is required to handle and store enough production material at the local level to ensure continuous (non-stop) processing capability for a 25 minute worst case AMHS delivery scenario (i.e., 95% of all lots will be delivered in 25 minutes or less). The minimum acceptable solution is two E15.1 primary load ports, with additional load port(s) or internal buffer requirements being identified through analysis of throughput rate, batch size, material/empty FOUP/exception lot handling, and other capability/implementation variables. The requirements for the handling/storage of empty FOUPs, exception lots, and non-production wafers should not be overlooked. The width of the load ports or buffer must not exceed the maximum width of the equipment (GL 2.6.2). Note: These requirements are based on the “process chamber” being at a 100% duty cycle.

> **NOTE:** The buffer calculations use the variables defined in the *I300I Factory Integration Guidelines*. The variables must be used as defined for correct results. Any additional variables are defined in the procedure where it is used.

1) Visually determine that the equipment meets the minimum requirement of two primary E15.1 load ports, in a “1 + 1” (in process + queue) layout.
2) Visually determine that the width of the installed load ports or buffer does not exceed the maximum width of the equipment.
3) Determine if the equipment needs more than the minimum of two primary load ports, using the following steps:
   a) Record the equipment process throughput in wafers per hour (WPH).
   b) Record the wafer capacity of the FOUP being used as Bsize.
   c) Determine that the process batch size is ≤ Bsize.
   d) Calculate the number of AMHS deliveries required per hour (DR) using the formula WPH/Bsize = DR.
   e) If DR ≤ 2.4, then no additional load ports or buffering is required beyond the minimum.

4) For equipment that requires more than the minimum two primary load ports, but does not include internal buffering, determine if the continuous processing capability is met using the following steps:
   a) For equipment with process batch sizes less than the FOUP load size:
      i) Record the number of primary load ports (#P).
      ii) Calculate the number of AMHS deliveries required per hour (DR) using the formula WPH/Bsize = DR.
      iii) Calculate the number of worst case AMHS deliveries possible (DP) using the formula DP = 60 (min/Hr)/25 (min) * (#P - 1) or DP = 2.4 * (#P – 1).
      iv) If DR is ≤ DP, then the number of primary load ports meets or exceeds the design requirement.
   b) For equipment with process batch sizes larger than the FOUP load size:
      i) Record the number of primary load ports (#P).
      ii) Calculate the number of lots per process batch (X) using the formula X = L/Bsize, where L = process batch size in wafers per process batch.
      iii) Calculate the number of full process batches (BP) supported by the number of primary load ports using the formula BP = #P/X, rounding down to the nearest integer.
      iv) Calculate the number of worst case AMHS batch deliveries possible (DPb) using the formula DPb = (2.4/1 - 1/2.4) * (BP - 1) or DPb = 2 * (BP - 1).
      v) Calculate the number of AMHS batch deliveries required per hour (DRb) using the formula DRb = (WPH/L).
      vi) If DRb is ≤ DPb, then the number of primary load ports meets or exceeds the design requirement.
5) For equipment with at least the minimum two load ports and internal buffering, evaluate the size of the wafer buffer in the worst case delivery time (DT = 25 minutes) scenario using the following steps:
   a) Record the number of internal buffer positions available for lots in process and in internal buffer production queue (B). Load Port positions NOT included.
   b) Calculate the number of lots per process batch (X) using the formula X = L/Bsize.
   c) Determine and record the number of batches in process simultaneously, IPX.
   d) Calculate the queue (Y), or number of lots that can be processed during 1 average delivery time period (DT), where Y = X * N, with N (number of batches processed during 1 average delivery time period, DT) calculated as below:
      i) N = (DT * WPH)/(L * 60) rounded up to the nearest integer, and
      ii) Using worst-case (wc) delivery time DT=25 min, Nwc = WPH/(L * 2.4), rounded up to the nearest integer.
   e) Calculate the worst-case buffering requirements (Br) using the formula Br = (X * IPX) + (X * Nwc).
   f) If B ≥ Br, then the buffer size meets or exceeds the design requirements.

NOTE: Any equipment that has only two primary load ports must use a process batch size equal to or smaller than the number of wafers in one FOUP (Bsize).

NOTE: In the two load port case, only one port is available for interaction with the AMHS, so the worst case delivery rate is equal to the 1 hour divided by the worst case delivery time, i.e., 60 min/25 min = 2.4 deliveries per hour.

NOTE: For equipment that has more that two primary load ports, but no internal buffer, the delivery rate is an independent multiple of the two load port rate, modified by the batch size. So if the process batch size for the equipment is ≤ Bsize, then the delivery rate (DR) would be: # not in process ports * 2.4. For equipment with a process batch size > Bsize, determine the number of port locations required for one batch, then divide the number of load ports available by the number of ports required for each batch (rounding down to a whole integer) to determine virtual batch ports (BP), and apply a linked dependent multiple of 2.4 to the virtual batch port combinations available, DPb = (2.4/1 - 1/2.4) * (BP - 1) or DRb = 2 * (BP - 1). The expression (2.4/1 - 1/2.4) represents a reduction in delivery rate based on the probability of worst case delivery interaction to deliver a partial rather than a full batch.

- Pass Criteria:
  - i) If the equipment has the required minimum of two E15.1 load ports in a "1 + 1" layout.
  - ii) The equipment has two load ports that meet the buffering requirement, or
  - iii) The equipment has more than two load ports and no internal buffer, but the number of load ports meets the buffering requirement, or
  - iv) The equipment has an internal buffer in addition to the two or more load ports, and the size of the buffer meets the buffering requirement.
  - v) The width of the installed load ports or buffer does not exceed the maximum width of the equipment.

- Fail Criteria:
  - i) IF: The equipment does not have the minimum required load ports.
  - ii) OR: The two load ports do not meet the buffering requirement, and no other solution has been designed in (see below).
  - iii) OR: The number of load ports installed without an internal buffer does not meet the buffering requirement.
  - iv) OR: The internal buffer size does not meet the buffering requirement size.
  - v) OR: The width of the installed load ports or buffer exceeds the maximum width of the equipment.

5.2.2 Buffer FIMS Compliance – 300 mm equipment, that includes an internal buffer in the design, is required to include at least two bi-directional FIMS interfaces between the buffer and the active process area or other equipment internal support mechanism *for continuous processing/duty cycle* and to incorporate an operator-selectable local or maintenance mode so that lots can be removed from the buffer in case equipment fails (GL 2.6.2.1, GL 3.2.1.3)

1) Verify that the internal buffer includes at least two bi-directional FIMS interfaces or other equipment internal support mechanism for continuous processing/duty cycle, using the following steps:
    a) Visually inspect the internal buffer, and document the number of FIMS interfaces.
    b) Verify that the FIMS interfaces meet compliance requirements and are bi-directional as tested in Section 4.1.3.6, paragraph 3.
    c) Determine if other equipment, in lieu of two FIMS interfaces, has been incorporated to support continuous processing.
2) Verify that the control system includes a local/maintenance mode for the internal buffer using the following steps:
    a) Visually inspect the user interface for a clearly identified buffer local/maintenance mode.
    b) Evaluate if the local/maintenance mode is available on all user interfaces, including the auxiliary.
3) Evaluate the operation of the buffer local/maintenance mode using the following steps:
    a) Use the control system to enter the local/maintenance mode, recording the number of steps required to enter the mode.
    b) Evaluate if the local/maintenance mode supports single step operation.
    c) Evaluate if the local/maintenance mode supports semi-automated operation.
    d) Verify the operation of the local/maintenance mode by using it to move material from the buffer to one or more load ports.

- Pass Criteria:
    i) The internal buffer has at least two bi-directional FIMS interfaces.
    ii) The buffer FIMS interfaces meet the compliance criteria in section 4.1.2.6, paragraph 3.
    iii) The control system includes a local/maintenance mode for use in unloading the buffer during equipment failure.
    iv) The local/maintenance mode is available on the primary user interface as a minimum.
    v) The local/maintenance mode supports both single step and semi-automated operation.
    vi) The local/maintenance mode is able to move lots to the load port for disposition.

- Fail Criteria:
  - i) IF: The internal buffer has < two FIMS interfaces.
  - ii) OR: The FIMS interfaces are not bi-directional
  - iii) OR: The FIMS interfaces do not meet compliance criteria in Section 4.1.3.6, paragraph 3.
  - iv) IF: The equipment does not have a buffer local/maintenance mode.
  - v) OR: The local/maintenance mode is not available at the primary user interface.
  - vi) OR: The local maintenance mode does not allow single step and semi-automated operation.
  - vii) OR: During testing it is unable to move a lot from the buffer to a load port.

5.2.3 Buffer Kinematic Couplings Compliance –Inspect the kinematic couplings at each internal FIMS interface port employed inside internal buffers. (GL 2.2.4, GL 4.2.7)

1) Evaluate the kinematic coupling placement orientation using the following steps:
   a) Place the kinematic coupling fixture on an internal FIMS port location.
   b) Does the fixture mate with the coupling correctly?
   c) Can the fixture rest flush with the horizontal datum plane?
   d) Repeat steps a) through c) and internal FIMS port location, documenting the results.
2) Inspect the finish of the kinematic coupling pins using the following steps:
   a) Visually compare the finish of the kinematic coupling pins at the internal FIMS port #1 to the finish of the kinematic coupling fixture or if necessary the sample kinematic coupling pin.
   b) The finish of the kinematic coupling pins should be visually equivalent to the fixture or sample pin.
   c) Repeat the above steps for each internal FIMS port (for 1 to N), documenting the results.
3) Evaluate the shape and dimensions of the kinematic coupling pins using the following steps:
   a) Place the kinematic coupling shaped template on each of the pins in internal FIMS port #1.
   b) Is it the right dimensions (diameter and height)?
   c) Is it the right shape (taper and rounding)?
   d) If necessary, use the sample kinematic coupling pin for comparison.
   e) Repeat steps a) through d) for each load port (for 1 to N), documenting the results.

- Pass Criteria:
  - i) Every internal FIMS port location mates with the kinematic coupling fixture correctly.
  - ii) At every internal FIMS port location the kinematic coupling fixture rests flush with the horizontal datum plane.

iii) At every internal FIMS port location the finish on the kinematic coupling pins is visually equivalent to the finish of the kinematic coupling fixture or the sample kinematic coupling pin.

iv) At every internal FIMS port location the shape and dimensions of the kinematic coupling pins is correct as measured by the kinematic coupling shaped template and in comparison to the sample coupling pin.

- Fail Criteria:

i) IF: Any internal FIMS port location does not mate with the kinematic coupling fixture correctly.

ii) OR: At any internal FIMS port location the kinematic coupling fixture does not rest flush with the horizontal datum plane.

iii) OR: Any of the coupling pins at any of the internal FIMS ports do not have the correct finish.

iv) OR: The shape and dimensions of any of the coupling pins at any of the internal FIMS port location is not correct.

5.2.4 Simple, Reliable Buffers – 300 mm equipment internal buffer design, compliant with E15.1 easement space requirements, must be simple and reliable as well as consume minimal footprint (GL 2.6.5, GL 2.12.1, GL 2.12.5).

1) Determine and document the total number of FOUP storage bins in the internal buffer.
2) Determine and document the number of FOUP movement mechanisms in the buffer.
3) Determine and document the average number of movement axes per FOUP movement mechanism.
4) Calculate the number of FOUP movement mechanisms per FOUP storage bin.
5) Determine and document the number of maintenance access panels and doors on the non-load port sides of the buffer.
6) Determine and document the number of maintenance access panels and doors on the load port sides of the buffer.
7) Estimate the percentage of maintenance tasks that require access at the load port side of the buffer.
8) Using equipment footprint and layout drawings, evaluate the following buffer dimensions and ratios:
   a) Record the number of FOUP storage locations per buffer, Nlb.
   b) Record the maximum buffer width, "Wb."
   c) Record the maximum buffer depth, "Db."
   d) Record the maximum buffer height, "Hb."
   e) Calculate the maximum footprint per internal buffer, Ab = Wb * Db.
   f) Calculate the maximum buffer footprint area per equipment, Abt = Wb * Db *Nb, where Nb is the number of buffers in the equipment design.
   g) Record the total equipment footprint area, At = Wt * Dt.
   h) Calculate the ratio of buffer footprint to equipment footprint area = Abt/At.

i) Calculate the ratio of FOUP storage locations to the buffer footprint = Nlb*Nb/Abt.

j) Record the total test time of the buffer design.

k) Record the number of failures during testing of the buffer design.

l) Calculate the buffer MTBF from testing, MTBF = Test time/Test Failures.

- Pass Criteria: There are no pass criteria for this section. The purpose is to collect data to allow for various post assessment analysis methods.

- Fail Criteria: There are no fail criteria for this data collection section.

5.3 Buffering Physical Testing Results

Complete the assessment information table below.

I300I Buffering Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Supplier	
Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

5.3.1 Requirement for Buffering: 300 mm in-line process/metrology equipment is required to handle and store enough production material at the local level to ensure continuous (non-stop) processing capability for a 25 minute worst case AMHS delivery scenario (i.e., 95% of all lots will be delivered in 25 minutes or less). The minimum acceptable solution is two E15.1 primary load ports, with additional load port(s) or internal buffer requirements being identified through analysis of throughput rate, batch size, material/ empty FOUP/exception lot handling, and other capability/implementation variables. The requirements for the handling/storage of empty FOUPs, exception lots, and non-production wafers should not be overlooked. The width of the load ports or buffer must not exceed the maximum width of the equipment. (GL 2.6.2)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Does this equipment have a minimum of 2 primary E15.1 load ports in a “1 + 1” layout? (Note: 1 primary load port required for offline metrology tools)		Yes	
The installed/combined width of the installed load ports or the buffer do not exceed the maximum width of the equipment.		Yes	
For two primary load ports only, record WPH (wafers/hour).		N/A	N/A
For two primary load ports only, record Bsize (wafers/lot).		N/A	N/A
Do the two primary load ports meet the buffering requirement?		DR ≤ 2.4	
For equipment with more than two primary E15.1 load ports, load size ≤ Bsize, and no buffer: record the number of primary load ports.		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size ≤ Bsize, and no buffer: record WPH		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size ≤ Bsize, and no buffer: record Bsize		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size ≤ Bsize, and no buffer, do the number of load ports meet the buffering requirement? Record DR (=WPH/Bsize) and DP [=2.4*(#P-1)].		DR is ≤ DP	
For equipment with more than two primary E15.1 load ports, load size > Bsize, and no buffer: record the number of primary load ports.		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size > Bsize, and no buffer: record WPH		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size > Bsize, and no buffer: record Bsize		N/A	N/A
For equipment with more than two primary E15.1 load ports, load size > Bsize, and no buffer, do the number of load ports meet the buffering requirement? Record DRb [=WPH/process batch size] and DPb [=1.9 *(BP-1)]		DRb is ≤ DPb	
For equipment with internal buffering: record the number of buffer positions available (B)		N/A	N/A
For equipment with internal buffering: record the number of wafers per process batch (L)		N/A	N/A
For equipment with internal buffering: Calculate the lots per process batch (X) [=L/Bsize]		N/A	N/A

Assessment Detail	Results	Pass/Fail Criteria	Compliance
For equipment with internal buffering: record the number of batches in process (IPX) simultaneously		N/A	N/A
For equipment with internal buffering: Calculate the number of lots that can be processed during 1 average delivery time (Y) [=X*(DT*WPH)/(L*60)]. For DT = 25 min, Y=X*WPH/(L*2.4)		N/A	N/A
For equipment with internal buffering, does the buffer size meet the buffering requirements? Record Br [=(X*IPX)+(X*Nwc)], where Nwc =WPH/(L*2.4)		B ≥ Br	
Overall Compliance			

Comments: ____

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5.3.2 Buffer FIMS Compliance: 300 mm equipment that includes an internal buffer in the design is required to include at least two bi-directional FIMS interfaces between the buffer and the active process area or other equipment internal support mechanism ***for continuous processing/duty cycle*** and to incorporate an operator-selectable local or maintenance mode so that lots can be removed from the buffer in the case of an equipment failure. (GL 2.6.2.1, GL 3.2.1.3)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
How many bi-directional FIMS interfaces does the internal buffer have? Record the number of FIMS interfaces.		≥ 2	
Does the internal buffer FIMS interfaces meet the compliance and are bi-directional as tested in Section 4.1.3.6, paragraph 3?		Yes	
Does the control system include a local/maintenance mode for buffer operation?		Yes	
Document the number of steps required to enter local/maintenance mode.		N/A	
Does the local/maintenance mode support single step operations?		Yes	
Does the local/maintenance mode support semi-automated operation?		Yes	
Does the local mode adequately allow for movement to the load ports in case of an equipment failure?		Yes	
Overall Compliance			

Comments: ____

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5.3.3 Buffer Kinematic Couplings Compliance: Kinematic couplings at each internal FIMS interface port must meet standards requirements. (GL 2.2.4, GL 4.2.7)

Assessment Detail	FIMS 1	FIMS 2	FIMS 3	FIMS 4	FIMS 5	FIMS 6	Pass/Fail Criteria	Compliance
Does the load port mate (i.e., pin and hole alignment) with the kinematic coupling fixture correctly?							Yes	
Is the finish on the kinematic coupling pins correct?							Yes	
Are the kinematic coupling pins the correct size and shape?							Yes	

Comments: ____

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5.3.4 Simple, Reliable Buffers: 300 mm equipment internal buffer design, compliant with E15.1 easement space requirements, must be simple and reliable as well as consume minimal footprint (GL 2.6.5, GL2.12.1, GL 2.12.5)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Document the number of FIMS interfaces in the buffer.		≥2	
Buffer FIMS interfaces meet compliance requirements and are bi-directional as tested in Section 4.1.3.6, paragraph 3.		Yes	
Determine and document the total number of FOUP storage bins in the internal buffer.		N/A	N/A
Determine and document the number of FOUP movement mechanisms in the buffer.		N/A	N/A
Determine and document the average number of movement axes per FOUP movement mechanism.		N/A	N/A
Calculate the number of FOUP movement mechanisms per FOUP storage bin.		N/A	N/A
Determine and document the number of maintenance access panels and doors on the non-load port sides of the buffer.		N/A	N/A
Determine and document the number of maintenance access panels and doors on the load port sides of the buffer.		N/A	N/A
Estimate the percentage of maintenance tasks requirement access at the load port side of the buffer.		N/A	N/A
Record the number of FOUP storage locations per buffer, Nlb.		N/A	N/A
Record the maximum buffer width, “Wb”.		N/A	N/A
Record the maximum buffer depth, “Db”.		N/A	N/A
Record the maximum buffer height, “Hb”.		N/A	N/A

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Calculate the maximum footprint per internal buffer, Ab = Wb * Db. Calculate the maximum buffer footprint area per equipment, Abt = Wb * Db *Nb.		N/A	N/A
Record the total equipment footprint area, At = Wt * Dt.		N/A	N/A
Calculate the ratio of buffer footprint to equipment footprint area = Abt/At.		N/A	N/A
Calculate the ratio of FOUP storage locations to the buffer footprint = Nlb*Nb/Abt.		N/A	N/A
Record the total test time of the buffer design.		N/A	N/A
Record the number of failures during testing of the buffer design.		N/A	N/A
Calculate the buffer MTBF from testing, MTBF = Test time/Test Failures.		N/A	N/A
Overall Compliance			

Comments: ____

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5.4 Buffering Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

5.4.1 Equipment designs must support the handling of sufficient process material (WIP) to ensure continuous (non-stop) processing with a 25-minute worst case delivery time (i.e., 95% of all lots will be delivered in 25 minutes or less). This need may be met by the load ports or by the incorporation of both load ports and an internal buffer. (GL 2.6.1)

Sample Questions:

a) Does your equipment require a buffer?
b) What model and assumptions did you use to evaluate the continuous processing requirement for your equipment?
c) What size and configuration of buffer is integrated into the equipment design?
d) Does the equipment managing and store the empty carriers while the associated wafers are being processed?
e) Has the buffer capacity been verified with a variety of run rates and process recipes?
f) What were the results?

Comments: ____

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5.4.2 Equipment that processes wafers in large batches, such as furnaces, wet benches, implanters and litho tracks, may require buffering sizes beyond the minimum requirement. (GL 2.6.3.1)

Sample Questions:

a) Does your equipment process batches larger than one lot size?
b) What impact does batch sizes have on buffer size for your equipment? For partial lots? For exception lots?
c) How does batch sizes effect the storage capacity for empty FOUPs?

Comments: ____

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5.4.3 Continuous processing requires that the first wafer of a lot begins processing before or immediately after the last wafer of the previous lot finishes processing. (GL 2.6.1.1)

Sample Questions:

a) Is there a processing station/module delay between wafers of different lots/batches beyond that normally associated with load and/or transfer overhead?
b) Does such an interaction occur when the equipment is fully loaded, i.e. every load, process station, transfer mechanism and unload position is full or in use?
c) Have various scenarios been tested to verify this capability?
d) What were the results?

Comments: ____

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5.4.4 The recipe associated with a wafer lot must be loaded and ready to run before processing the first wafer of that lot, including when other lots and recipes are in process. (GL 2.6.1.2)

Sample Questions:

a) Is there a processing delay between wafers of different lots/batches beyond that normally associated with load/transfer overhead when the lots/batches are run on different process recipes?
b) How does your control system handle/manage running more than one process recipe simultaneously?
c) What is the maximum number of process recipes that can be simultaneously running in the equipment?
d) Does running multiple recipes simultaneously effect efficiency or run rate?
e) Has this capability been demonstrated?
f) What were the results?

Comments: ____

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5.4.5 The equipment buffer must be designed to accommodate all wafers required for continuous processing (including non-production wafers, baffles, dummy wafers for furnaces, etc.) not just production wafers. (GL 2.6.1.3)

Sample Questions:

a) What routine requirements for non-production wafers are there for this equipment?
b) What number of positions or percentage of the buffer size is designed for non-production wafer handling?
c) How does the requirement for non-production wafers in the buffer affect the product wafer capacity and its ability to meet the continuous processing requirement?
d) Has the integration of non-product wafers into the processing stream been effectively demonstrated?
e) What were the results?

Comments: ____

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5.4.6 The equipment must manage all carriers at the load ports or within the internal buffer, including empty carriers while the associated wafers are being processed. (GL 4.11)

Sample Questions:

a) What is the maximum number of empty FOUPs the buffer is designed to support?
b) What is the maximum number of lots that can be simultaneously in process?
c) How does the number of empty FOUPs in the buffer affect the product wafer capacity and its ability to meet the continuous processing requirement?
d) How does the control system track and manage empty FOUPs in the buffer?

Comments: ____

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5.4.7 Equipment may use positions in the buffer to store exception wafer types 1–5 as described in the guidelines, which include particle test wafers, monitor wafers, equipment-related wafers, metrology reference/standards wafers, and dummy wafers. (GL 3.1.2.1)

Sample Questions:

a) What method is used to accommodate and handle exception lots in the equipment buffer?

b) What is the maximum number of exception lots the buffer is designed to support?

c) Does your control system distinguish between types of exception lots?

d) If so, what is the design support limit for each type?

e) How does the number of exception lots in the buffer affect the product wafer capacity and its ability to meet the continuous processing requirement?

Comments: ____

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5.4.8 The size of the internal buffer for a equipment should comprehend the need for all exception lot type handling and/or storage in addition to the production and empty FOUP requirements. (GL 3.1.5)

Sample Questions:

a) Were exception lots comprehended in sizing the buffer in the design?

b) Did this requirement add to the buffer size?

c) If so, how much? What method was used to determine this size?

Comments: ____

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5.4.9 Equipment that includes vertical buffers are required to have a robust, structured error and/or failure recovery capability designed in. (GL 2.6.7)

Sample Questions:

a) Is the top of the equipment buffer above the load port level?
b) If so, what design approach and method were selected to provide robust recovery support?
c) Describe the structured approach to recovery and the conditions covered.
d) Has the recovery capability been adequately tested?
e) What were the results?

Comments: ____

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5.4.10 If process/metrology equipment fails, the equipment should reposition the FOUP at the load port pick-up point. (GL 3.2.1.2)

Sample Questions:

a) Does the equipment include a designed-in capability to reposition FOUPs at the load port during equipment failure? What is the approach or method?
b) Does the equipment include a designed-in capability to allow AMHS handling during equipment failure? What is the approach or method?
c) Has a formal analysis of failure mechanism impact on these capabilities been conducted? A risk assessment?
d) What were the results?

Comments: ____

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6 EQUIPMENT CAPABILITY REQUIREMENTS ASSESSMENT

This section summarizes functions to be included in the equipment design and required by the *I300I Factory Integration Guideline* so that the needs of 300 mm factories can be met, specifically in CIM and integrated factory systems.

6.1 Equipment Capability Instrumentation/Tools/Prerequisites

- Four SEMI-compliant FOUPs marked for identification.
- Seventy-five wafers marked for identification.

6.2 Equipment Capability Requirement Physical Testing

6.2.1 Slot and Carrier Integrity and Alignment – 300 mm process/metrology equipment designs must include the capability and programmable option to return wafers to the same slot in the same physical carrier from which they were removed. Additionally, during the wafer transfer, notch alignment of the wafers must be maintained, through active pre-alignment or positive positional controls (GL 1.1.10, GL 1.4.1, GL 2.8.1, GL 2.8.2, GL 4.4.5)

1) Create four test lots, using the following steps:
   a) For 25-wafer FOUPs:
      i) Lot A = 25 wafers
      ii) Lot B = 25 wafers
      iii) Lot C = 10 wafers
      iv) Lot D = 15 wafers
   b) For 13-wafer FOUPs:
      i) Lot A = 13 wafers
      ii) Lot B = 13 wafers
      iii) Lot C = 5 wafers
      iv) Lot D = 9 wafers
2) Use the appropriate lot size to test that the wafers are returned to the same slot in the same FOUP using the following steps:
   a) For equipment without internal buffers:
      i) Use the test lots in the following order: A, B, C, D, A, B.
      ii) Place lots on every load station.
      iii) Use the control system to begin normal operational processing.
      iv) Visually inspect that the correct wafer is returned to the correct slot of the correct FOUP.
      v) When a lot has been completed, remove it and replace it with the next sequential lot.
      vi) Visually verify that the transition between lots is smooth and without additional overhead or setup time, allowing the first wafer of the next lot to immediately follow the last wafer of the previous lot.

vii) Continue testing until two lots per load port or a maximum of six lots has been cycled.

b) For equipment with internal buffers:

i) Use the test lots in the following order: A, B, C, D, A, B.

ii) Use the control system to move all four lots into the buffer.

iii) Use the control system to begin normal operational processing.

iv) Visually inspect that the correct wafer is returned to the correct slot of the correct FOUP.

v) When a lot has been completed, normal buffer operation should sequence the lots correctly or i.e., (same order/sequence as FOUPs were entered into the system).

vi) Visually verify that the transition between lots is smooth and without additional overhead or setup time, allowing the first wafer of the next lot to immediately follow the last wafer of the previous lot.

vii) Continue testing until two lots per FIMS interface or a maximum of six lots have been cycled.

3) Visually verify that notch alignment is performed, or investigate that a positive notch position control system is in use.

- Pass Criteria for equipment with and without internal buffer:

i) The equipment returned each wafer to the correct slot of the correct FOUP.

ii) There was no interruption to continuous flow processing between lots.

iii) The equipment performed notch alignment or used a positive notch position control system.

iv) For equipment with buffers, the control system correctly sequenced the lots in processing them from the buffer.

- Fail Criteria:

i) IF: A wafer was returned to the wrong slot.

ii) OR: A wafer was returned to the wrong FOUP.

iii) OR: There was an interruption in continuous processing between lots.

iv) OR: There was no pre-alignment or control for notch position

v) OR: The equipment buffer did not sequence the lots in the right order.

6.2.2 User Interfaces – The 300 mm process/metrology equipment primary user interface must be at the front of the equipment, and the design must include an option for an alternative user interface <u>connection</u> that is functionally equivalent to the primary at the rear of the equipment. These user interfaces must be configured to be mutually exclusive; that is, only one station can have active control of the equipment at any given time (GL 2.11.1, GL 2.11.2)

1) Verify that the primary user interface is at the front of the equipment.

2) Determine if the primary user interface is separate (standalone) from the rest of the equipment.

3) Visually verify that the primary user interface is easily accessible to the user and that no part of the equipment will interfere with the user's interaction with the UI controls.
4) Verify that the equipment has an auxiliary user interface connection at its rear.
5) Verify that the auxiliary user interface is functionally equivalent to the primary interface, with all functions and screens present and enabled.
6) Visually verify that the auxiliary user interface is easily accessible to the user and that no part of the equipment will interfere with the user's interaction with the UI controls.
7) Verify that the operation of the user interfaces is mutually exclusive by attempting to use both stations simultaneously.

- Pass Criteria:
  - i) The primary user interface is on the front of the equipment.
  - ii) There is an auxiliary user interface connection at the rear of the equipment.
  - iii) The auxiliary user interface is functionally equivalent to the primary UI.
  - iv) Each of the interfaces is easily accessible to the user and no part of the equipment will interfere with the user's interaction with the UI controls.
  - v) The user interfaces operated mutually exclusively.

- Fail Criteria:
  - i) IF: The primary user interface is not on the front of the equipment.
  - ii) OR: There is no auxiliary user interface connection at the rear of the equipment.
  - iii) OR: The auxiliary user interface is not functionally equivalent to the primary UI.
  - iv) OR: Either UI is not easily accessible or is obstructed by part of the equipment.
  - v) OR: The use of the UIs is not mutually exclusive.

6.2.3 Mini-environments – 300 mm process/metrology equipment must have mini-environment integrated into the equipment design at a fundamental level, so that first generation equipment includes it as a standard, and wafer and operational cleanliness is universally maintained. The clean wafer environment must meet the process needs and maintained inside pods at the load ports and during all wafer handling and processing. (GL 2.7.1, GL 2.7.2, GL 2.7.2.3, GL 2.7.3.2, 2.7.6, 2.7.9, 2.7.10, 2.7.13, 2.7.14, 2.7.15)

1) Verify that the FOUP to FIMS seal passed Section 4.1.3.6, paragraphs 2e and/or 3d.
2) Verify minienvironment coverage for all exposed wafer areas.
3) Verify that FOUP storage (internal FOUP buffers) and internal exposed wafer storage areas do not share the same environment.
4) Check frame and panel surfaces for finish integrity, smoothness, scratches, and defects.
5) Verify materials used for wall and frame.
6) Verify the minienvironment has no bare metal surfaces. All surfaces must be anodized, painted using powder coat paint, or stainless steel.

7) Check component joints, connections and corners for strength, integrity, tightness and smoothness.

8) Check operation of seals on doors, hinges, latches and removable panels.

9) Verify operation and ease of adjustment of relief grilles and baffles (dampers) for adjusting air balance and over-pressurization.

10) Verify minienvironment dimensions.

    a) Dimensions – must be no larger than and included in the equipment footprint.

    b) Height – cannot exceed 3500 mm.

11) Verify that electrical services for the minienvironment fan/filter unit are incorporated in the equipment electrical service and are not separate.

12) Verify filter type: Efficiency of filter = 99.99995% at 0.1 µm particle size.

13) Determine if the minienvironment meets the process requirements of the equipment and that there is adequate lighting that is compatible with the process performed. Also verify that the lighting does not degrade minienvironment performance.

14) Verify filter material is solvent and acid resistant, and boron free (e.g., PTFE).

15) Verify that filter challenge testing used PSL spheres.

16) Determine the existence of any differential pressure visual indicators on the equipment.

17) Verify that the equipment does not require any air duct connection from a ceiling air handling system.

18) Determine if the minienvironments have been tested and meet the performance requirement, as defined in Appendix G, Minienvironment Parametric Test Methods.

    - Pass Criteria:

        i) FOUP to FIMS seal passed Section 4.1.2.6, paragraphs 2e and/or 3d.

        ii) Minienvironment covers all exposed wafer areas.

        iii) FOUP storage (internal FOUP buffers) and internal exposed wafer storage areas do not share the same environment.

        iv) Frame and panel surface integrity is good.

        v) Materials used for the walls and frames are compatible with the environment.

        vi) The minienvironment is designed with low outgassing materials and compounds?

        vii) The minienvironment has no bare metal (non-stainless steel) surfaces.

        viii) Component joints are acceptable.

        ix) All operational seals are acceptable.

        x) Adjustment and relief grilles (dampers) operate correctly.

        xi) The minienvironment is designed to allow for ease of airflow adjustment through the minienvironment.

xii) The minienvironment dimensions are contained inside the equipment footprint.

xiii) The minienvironment height is ≤ 3500 mm.

xiv) Minienvironment utilities are incorporated into the equipment design.

xv) The minienvironment uses the proper filter ≥ 99.99995% efficient at 0.1 µm particle size.

xvi) The minienvironment meets the process needs.

xvii) Minienvironment filter is made of material that is solvent and acid resistant, and without boron.

xviii) The filter challenge testing used PSL spheres.

xix) The minienvironment does not require a separate air supply duct connection from a ceiling air handling system.

xx) A port is present that allows test measurement probes to be placed within the minienvironment.

xxi) The minienvironment has been tested and meets the performance requirements of Appendix G, Minienvironment Parametric Test Methods.

- Fail Criteria:

i) IF: FOUP to FIMS seal did not pass Section 4.1.2.6, paragraphs 2d and/or 3m.

ii) Minienvironment does not cover all exposed wafer areas.

iii) FOUP storage and internal exposed wafer storage areas share the same environment.

iv) Frame and panel surface are scratched or damaged.

v) Materials used for the walls and frames are not compatible with the environment.

vi) The minienvironment is not designed with low outgassing materials and compounds?

vii) The minienvironment has bare metal (non-stainless steel) surfaces.

viii) Component joints are misaligned or unacceptable.

ix) All operational seals are compromised, missing, or unacceptable.

x) Adjustment and relief grilles (dampers) do not operate easily or correctly.

xi) The minienvironment is not designed to allow for ease of airflow adjustment through the minienvironment.

xii) The minienvironment dimensions are not contained inside the equipment footprint.

xiii) The minienvironment height is > 3500 mm.

xiv) Minienvironment utilities are not incorporated into the equipment design, but are separately routed.

xv) The minienvironment uses a filter < 99.99995% efficient at 0.1µm particle size.

xvi) The minienvironment does not meet the process needs.

xvii) Minienvironment filter is acid and solvent resistant, or contains boron.

xviii) The filter challenge testing used DOP or mineral oil only.

xix) The minienvironment requires a separate air supply duct connection for air supply from a ceiling air handling system.

xx) A port is not present that allows test measurement probes to be placed within the minienvironment.

xxi) The minienvironments have not been tested and/or do not meet the performance required by Appendix G, Minienvironment Parametric Test Methods.

6.3 Equipment Capability Requirements Physical Testing Results

Complete the assessment information table below.

I300I Equipment Capability Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Supplier	
Model	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

6.3.1 Slot and Carrier Integrity and Alignment: 300 mm process/metrology equipment designs must include the capability and programmable option to return wafers to the same slot in the same physical carrier from which they were removed. Additionally, during the wafer transfer, notch alignment of the wafers must be maintained, through active pre-alignment or positive positional controls. (GL 1.4.1, GL 2.8.1, GL 2.8.2)

Assessment Detail	**Results**	**Pass/Fail Criteria**	**Compliance**
Document the number of load ports on the equipment.		In-line ≥ 2 Off-line ≥ 1	
For equipment without internal buffering, did the wafers return to the same slot?		Yes	
For equipment without internal buffering, did the wafers return to the same FOUP?		Yes	
For equipment with internal buffering, did the wafers return to the same slot?		Yes	
For equipment with internal buffering, did the wafers return to the same FOUP?		Yes	
In all cases, did the first wafer of the next lot follow the last wafer of the old lot smoothly and without additional overhead or setup time?		Yes	
For equipment with internal buffering, did normal buffer operation sequence the lots correctly?		Yes	
For equipment with internal buffering, when the lot was completed processing was it returned to a load port for unloading?		Yes	
Does the equipment perform notch pre-align?		Yes or see next	
Does the equipment provide positive notch position control during transfer and processing? If not Yes in previous		Yes	
		Overall Compliance	

Comments: ____

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6.3.2 User Interfaces: 300 mm process/metrology equipment primary user interface must be at the front of the equipment, and the design must include an option for an alternative user interface connection that is functionally equivalent to the primary at the rear of the equipment. These user interfaces must be configured to be mutually exclusive; that is, only one station can have active control of the equipment at any given time. (GL 2.11.1, GL 2.11.2)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Is the primary user interface on the front of the machine?		Yes	
Is the primary user interface a stand-alone unit, separate from the rest of the machine?		N/A	
Is the primary user interface easily accessible to the user and free of obstacle and interference?		Yes	
Does the equipment have an auxiliary user interface connection at the rear of the equipment?		Yes	
Is the auxiliary user interface functionally equivalent to the primary user interface in function, access and control?		Yes	
Is the auxiliary user interface easily accessible, with no obstruction or interference with its use?		Yes	
Is the operation of the user interfaces mutually exclusive, so that only one is in control at a time?		Yes	
Overall Compliance			

Comments: ____

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6.3.3 Mini-environments: 300 mm process/metrology equipment must have mini-environments integrated into the equipment design at a fundamental level, so that first generation equipment includes it as a standard, and wafer and operational cleanliness is universally maintained. The clean wafer environment must be maintained inside pods, at the load ports, and during all wafer handling and processing. (GL 2.7.1, GL 2.7.2, GL 2.7.2.3, GL 2.7.3.2, GL 2.7.6, GL 2.7.9, GL 2.7.10, GL 2.7.13, GL 2.7.14, GL 2.7.15)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Did the FOUP to FIMS seal pass Section 4.1.3.6?		Yes	
Does a controlled minienvironment cover all exposed wafer handling and transfer areas?		Yes	
Are the internal FOUP buffer storage and handling area (if they exist) and the open wafer storage and handling areas separated from each other?		Yes	

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Are the frame and panel surface finishes free of damage and acceptable?		Yes	
Are the wall and frame materials compatible with the process environment and acceptable for minienvironment applications?		Yes	
Is the minienvironment designed with low outgassing materials and compounds?		Yes	
Is there any bare metal (non-stainless steel) showing in the minienvironment area?		No	
Are the component joints, connections and corners tight, smooth and well sealed?		Yes	
Are all door, hinge, latch and removable panel seals operational and in good shape?		Yes	
Are the relief grilles and baffles easily adjustable?		Yes	
Is the minienvironment designed to allow for ease of airflow adjustment through the minienvironment?		Yes	
Do the minienvironment dimensions meet requirements?		Yes	
Record the minienvironment height.		≤ 3500 mm	
Are electrical services for the minienvironment including fan/filter units designed into the equipment power supply? No separate power feed is required?		Yes	
Is the filter element the right type and efficiency?		≥99.99995 % @ 0.1µ	
Is the filter membrane material acid and solvent resistant and free of boron? (e.g., PTFE)		Yes	
Did filter challenge testing use *PSL spheres*?		Yes	
Does the minienvironment require a separate air supply duct connection from a ceiling mounted air handling system?		No	
Are there any visible differential pressure gauges on the minienvironment? Note indication of pressure drop across filter and blower operation in comment section below.		N/A	
Is a port present that allows for test measurement probes to be placed within the minienvironment.		Yes	
		Overall Compliance	

Comments: ____

6.4 Equipment Capability Requirement Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions below serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

6.4.1 All 300 mm process/metrology equipment must support a maximum edge exclusion of 3 mm. The desired edge exclusion is 0. (GL 1.1.9)

Sample Questions:

a) What, if any, edge exclusion is required by this equipment?

b) Why does the process require an edge exclusion zone?

c) Has process conformance to 3 mm been verified? How?

d) What were the results?

Comments: ______________________________

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6.4.2 300 mm process/metrology equipment should incorporate electrical voltage dropout immunity compliant to the SEMI Draft Doc. 2844A. (GL 1.3.2.3)

Sample Questions:

a) Does this equipment have voltage dropout immunity designed in?

b) By what method?

c) Describe any testing that has been performed which demonstrates compliance to SEMI Draft Doc. 2844A?

d) Are test results available that demonstrate compliance to SEMI Draft Doc. 2844A

e) Has testing been performed using SEMI F42-Test Method for Semiconductor Processing Equipment Voltage Sag Immunity?

f) What verification testing has been done?

g) What were the results?

Comments: ______________________________

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6.4.3 300 mm process/metrology equipment should incorporate some designed-in level of immunity to fluid and exhaust pressure drop and/or flow drop. This means a tolerance for a limited range of variation in fluid and exhaust pressure and/or flow without causing process impacts, or machine interlocks and downtime. (GL 1.3.2.4)

Sample Questions:

a) Does this equipment have fluid pressure/flow drop immunity designed in?
b) Does this equipment have exhaust pressure/flow drop immunity designed in?
c) By what methods?
d) What verification testing was done
e) What were the results?

Comments: ____

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6.4.4 300 mm equipment must include design considerations for any vibration requirements beyond current 200 mm factory requirements. This includes the attenuation of any generated vibration and additional isolation from the 200 mm factory baseline. (GL 1.3.4, 2.7.16)

Sample Questions:

a) Does this equipment produce or is it sensitive to vibration?
b) What design considerations have been evaluated or included specifically related to vibration control and isolation?
c) What verification testing was done, and what were the results?

Comments: ____

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6.4.5 300 mm process/metrology equipment must be designed to dissipate electrical static charge (ESC) from wafer and/or carriers at any load ports and material handling areas. (GL 1.3.5)

Sample Questions:

a) Does this equipment include the designed-in capability to dissipate electrical static charge from load ports?

b) Does this equipment include the designed-in capability to dissipate electrical static charge from the wafer handling components and areas?

c) Other than grounding, what methods of ESC dissipation are incorporated into this equipment?

d) What verification testing was done, and what were the results?

Comments: ____

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6.4.6 The equipment supplier is responsible for providing any “internal wafer carrier(s)” (i.e., process carriers) required to perform wafer processing and to provide the necessary wafer transfer mechanism between the internal carrier and the standard FOUP. (GL 2.3.6)

Sample Questions:

a) Does this equipment use a process carrier during normal operation?

b) What is the maximum number of process carriers required for fully loaded continuous processing operation?

c) What is the maximum number of process carriers that the equipment is capable of storing, using, or managing?

Comments: ____

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6.4.7 "Internal wafer carrier(s)" required to perform wafer processing may have any technically appropriate pitch between wafers, alignment methodology, or other characteristic that the supplier deems appropriate. (GL 2.2.3)

Sample Questions:

a) Does this equipment use a commercial or proprietary design for the process carrier?
b) Describe the specifications and features of the process carrier.
c) Has this process carrier been characterized for repeated process usage? What method was used?
d) What were the results?

Comments: ____

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6.4.8 To be compatible with typical facilities distribution systems, point of use gas delivery systems internal to 300 mm processing equipment should be designed to performance specifications in SEMI E49.9. Where possible, systems should contain standardized components that allow for modularity and interchangeability. (GL 1.3.6.1)

Sample Questions:

a) Does this equipment include an internal point-of-use gas delivery system?
b) If so, does it meet the requirements of E49.9 for performance specifications?
c) What method was used to verify this conformance?
d) What were the results?
e) Do the gas distribution systems use modular interchangeable components?
f) Are they from commercial, widely available sources?
g) What percentage of components are standard designs? What percentage are custom or special designs?
h) Has the interchangeability of components been verified? What method was used?
i) What were the results?

Comments: ____

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6.4.9 To be compatible with typical facilities distribution systems, point-of-use ultrapure water and liquid chemical delivery systems internal to 300 mm processing equipment should be designed to performance specifications in SEMI E49.3. Point-of-use solvent delivery systems internal to 300 mm processing equipment should be designed to performance specifications in SEMI E49.5. Where possible, systems should contain standardized components that allow for modularity and interchangeability. (GL 1.3.6.2)

Sample Questions:

a) Does this equipment include internal point-of-use ultrapure water or liquid chemical delivery systems?

b) If so, does it meet they requirements of E49.3 for performance specifications?

c) What method was used to verify this conformance?

d) What were the results?

e) Does this equipment include an internal point-of-use solvent delivery system?

f) If so, does it meet the requirements of E49.5 for performance specifications?

g) What method was used to verify this conformance?

h) What were the results?

i) Do the liquid distribution systems use modular interchangeable components?

j) Are they from commercial, widely available sources?

k) What percentage of components are standard designs? What percentage are custom or special designs?

l) Has the interchangeability of components been verified? What method was used?

m) What were the results?

Comments: ____

6.4.10 Where possible, standardized equipment interfaces for support equipment should be used. Specifically for equipment with vacuum pumps, standard interface connections should be used. Therefore, vacuum pump interfaces should conform to SEMI E73 for Turbomolecular Pumps and SEMI E74 for Dry Pumps. (GL 1.3.6.3)

Sample Questions:

a) Does this equipment have support equipment?
b) Does the support equipment conform to standardized equipment interfaces?
c) Describe how SEMI E73 and/or E74 were used to implement the design of vacuum pump interfaces in this equipment?
d) What method was used to verify the conformance?
e) Were there any exceptions?

Comments: ____

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6.4.11 300 mm equipment designs must include the capability to internally handle and/or store exception wafer types 1–5 as defined in the guideline, which include particle test wafers, monitor wafers, equipment-related wafers, metrology reference/standards wafers, and dummy wafers. (GL 3.1.1)

Sample Questions:

a) Does the equipment design include the ability to internally handle and/or store exception wafer types 1–5?
b) What method or approach was used to provide this capability?
c) How was the capability tested?
d) What were the results?

Comments: ____

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6.4.12 I300I supports and recommends the use of advanced process control and in situ sensors (GL 1.1.7.1)

Sample Questions:

a) Does the equipment use a fixed set-point strategy for process control?

b) If so, describe how power, pressure, gas flow, temperature, and other similar parameters are fixed to a single value called for in the recipe?

c) Does the equipment include in situ sensors, in-line sensors, or integrated metrology tools in addition to the traditional list of measured parameters, such as RF forward power, RF reflected power, temperature, gas flow rates, reliability, availability, maintainability, etc?

d) What in situ sensors have been characterized and can that characterization data be made available (especially those sensors that reduce non-product wafers such in-situ sensors and film thickness sensors)?

e) How does your control system use in situ data to modify the behavior of the process?

f) Have any of these capabilities been demonstrated?

g) If so, what were the results?

Comments: ____

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6.4.13 300 mm equipment must include the designed-in capability to identify FOUPs containing or suspected of containing broken, damaged, cross-slotted, etc. wafers and return those FOUPs to the load port pick-up point for disposition. (GL 3.1.3)

Sample Questions:

a) Does the equipment have the designed-in capability to identify FOUPs containing broken, damaged, cross-slotted, etc. wafers?

b) What approach or method is used for this capability?

c) Once such a FOUP is identified, is the equipment designed to deliver it back to the load port pick-up point?

d) Has this capability been adequately tested?

e) What were the results?

Comments: ____

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6.4.14 300 mm equipment designs should include operator-selectable modes (e.g., local/manual, automated, etc.) to return wafers to the appropriate FOUPs in case of equipment failure. These selectable modes must be commensurate with personnel, equipment, and product safety requirements. (GL 3.2.1.1)

Sample Questions:

a) Does the equipment design include operator-selectable modes for returning wafers to the appropriate FOUP in case of equipment failure?

b) What method or approach was used to provide this capability?

c) Does the method support slot and carrier integrity requirements?

d) Has the capability been tested? To what extent and in what conditions?

e) What were the results?

Comments: ____

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6.4.15 During equipment failures, the equipment should reposition FOUP(s) at the load port pickup point to allow handling by AMHS. (GL 3.2.1.2)

Sample Questions:

a) Does the equipment design include the capability to reposition FOUP(s) to the load port pick-up point in case of equipment failure?

b) What method or approach was used to provide this capability?

c) Does the method support AMHS interface during equipment failure?

d) Has the capability been tested? To what extent and for what conditions?

e) What were the results?

Comments: ____

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6.4.16 Equipment with internal buffering must have operator-selectable maintenance or local mode(s) to allow lots to be retrieved and placed back on the load port in case of equipment failure. No particular retrieval order is required. (GL 3.2.1.3)

Sample Questions:

a) Does the equipment have operator-selectable maintenance or local mode(s) to allow retrieval of lots in case of equipment failure?

b) Is this capability automated or single step?

c) Are there sufficient interlocks to prevent equipment, FOUP, and wafer damage during the retrieval of lots to the load port?

d) Has this capability been tested? In what conditions?

e) What were the results?

Comments: ____

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6.4.17 300 mm process/metrology equipment control systems must include the designed-in capacity to collect and analyze equipment productivity performance metrics. Data collection must be compliant with SEMI E58 automated reliability, availability, and maintainability system (ARAMS) requirements, and analysis must support SEMI E10 reliability, availability, and maintainability (RAM) statistics, overall equipment efficiency (OEE) metrics, and intrinsic equipment efficiency (IEE) measures. (GL 1.1.2.1)

Sample Questions:

a) Does the control system include designed in ARAMS data collection capability?

b) Does this capability include all of the state models and decision/handling points required? What are the exceptions?

c) Does the control system include analytical procedures for E10 RAM statistics from the collected ARAMS data?

d) Does the control system include analytical procedures for OEE metrics from the collected ARAMS data?

e) Does the control system include analytical procedures for IEE metrics from the collected ARAMS data?

f) Is all of the data and analytical output capable of being communicated to the host system?

Comments: ____

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6.4.18 All 300 mm process/metrology equipment must be designed so that when facing the front of the equipment, load port numbers are assigned sequentially from the left, with the left most being “1,” incrementally to the right. The equipment must also be configured so that the slot number for each carrier is assigned incrementally from the bottom, so that the bottom wafer is “1,” counting sequentially to the top of the carrier. (GL 4.5)

Sample Questions:

a) Facing the front of the equipment is the left most load port #1?

b) Are the load ports numbered incrementally to the right?

c) Is the equipment designed to identify the bottom slot of the carrier as #1?

d) Does the equipment identify slot number counting sequentially from the bottom to top of the carrier?

e) Do auxiliary load ports conform to these requirements?

Comments: ____

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6.4.19 Minienvironments for 300 mm equipment must be capable of very high-speed recovery after scheduled maintenance and unscheduled maintenance downtime events. The equipment must be able to recover and attain processing level cleanliness inside the minienvironment and wafer movement paths within one minute after the equipment has been re-introduced into production status. (GL 2.7.4)

Sample Questions:

a) Is the minienvironment designed for high-speed recovery?

b) Is it able to attain processing levels of cleanliness within one minute?

c) How long does it take for environmental (temperature and humidity) stability to be achieved?

Comments: ____

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6.4.20 The integrated minienvironment must be designed so a FOUP engaged and opened at the FIMS interface will not degrade minienvironment performance. (GL 2.7.2.1)

Sample Questions:

a) Is the minienvironment designed to maintain expected performance levels as the FOUP is engaged and opened at the FIMS interface?

b) Did any testing performed address a static mode with no FOUP?

c) Did any testing performed address a FOUP with the door in an opened position?

d) Did any testing performed address a situation where the FOUP/FIMS interface was engaged?

e) What were the results?

Comments: ____

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6.4.21 The integrated minienvironment must be designed to maintain differential pressure (positive relative to factory cleanroom ambient pressure) during all static and operational equipment conditions. Internal air pressure and balance must be adjustable using means such as variable speed control fans, grilles, baffles, louvers, and/or other measures as necessary. (GL 2.7.7)

Sample Questions:

a) Is the minienvironment designed to maintain differential pressure during all static and operational equipment conditions?

b) Have these capabilities been tested? In what conditions?

c) What were the results?

Comments: ____

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6.4.22 For process/metrology equipment that is equipped with exhaust, the integrated minienvironment must comprehend the effects of the exhausted air. Minienvironment and exhaust functions must be balanced so that the exhaust function must not degrade minienvironment performance and the minienvironment function must not degrade exhaust system performance. (GL 2.7.8)

Sample Questions:

a) What compounds are present in the exhausted air of this tool?

b) How does the minienvironment design comprehend the effects of the exhausted air?

c) Have these capabilities been tested? In what conditions?

d) What were the results?

Comments: ____

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6.4.23 The integrated minienvironment must be designed to dissipate electrostatic charges both internal and external to the equipment. This may include the use of dissipative materials, conductive materials and/or dissipative methods. (GL 2.7.11)

Sample Questions:

a) What materials are used to dissipate electrostatic charges both internal and external to the equipment?

b) How does the minienvironment design dissipate electrostatic charges both internal and external to the equipment?

c) Have these capabilities been tested? In what conditions?

d) What were the results?

Comments: ____

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6.4.24 The integrated minienvironment design must comprehend heat generated from minienvironment components, equipment processes, and equipment operation. (GL 2.7.12)

Sample Questions:

a) How does the minienvironment compensate for heat generated from the equipment process, operation, or other subsystems within the system?

b) What materials are used?

c) Have these capabilities been tested? In what conditions?

d) What were the results?

Comments: ____

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6.4.25 The integrated minienvironment must be designed to allow for equipment installation in both a ballroom and bay/chase factory configurations. The integrated minienvironment must be designed for ease of maintenance in both ballroom and bay/chase configurations to include removable panels and access to internal components. (GL 2.7.18)

Sample Questions:

a) Describe the differences between the installation of this tool in a bay/chase configuration vs. that of a ballroom layout.

b) How is routine maintenance expected to be different in one configuration compared to the other?

c) What are the expected time differences relating to routine maintenance in a bay/chase configuration vs. that of a ballroom?

d) Do any maintenance records exist on current 300 mm designs?

Comments: ____

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6.4.26 The operational status of the integrated minienvironment should be monitored and indicators of appropriate status conditions should be provided for equipment operators. This includes but is not limited to differential pressure indicators. SECS/GEM messages used for reporting equipment status to factory CIM systems should comprehend minienvironment status (see CIM Guidelines, Section 4). (GL 2.7.20)

Sample Questions:

a) Describe the means by which the minienvironment is monitored for operational status.
b) What minienvironment status conditions are provided for equipment operators?
c) Are the status conditions present on the equipment limited to differential pressure indicators?
d) How do the SECS/GEM messages used for reporting equipment status to factory CIM systems comprehend minienvironment status?
e) Have these capabilities been tested?
f) What were the results?

Comments: ____

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6.4.27 To reduce non-product wafers used for process monitoring use product wafer test sites. Inline metrology equipment should analyze product wafer test sites and communicate the results to the host system through the single communication link using standard communication protocols as expressed in the CIM guidelines 4.1.1 and 4.1.2. (GL 1.1.7.2)

Sample Questions: (Note: These questions apply to inline metrology tool manufacturers or process equipment manufacturers with embedded metrology. A critical point to note is that some IC manufacturers have wafer test sites designed into their respective processes)

a) What product wafer test sites (e.g., between die, special die, edge exclusion, etc) have been defined for your tool?
b) Describe the process that provides product wafer test site data to the host system?
c) Have these capabilities been verified?
d) What were the results?

Comments: ____

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6.4.28 To reduce non-product monitor wafers used for equipment health and maintenance monitoring, semiconductor process equipment should be designed so that all equipment parameters are available to the end user for real-time equipment monitoring. A second communication link must not be required for this function. (GL 1.1.7.3)

Sample Questions:

a) Are these equipment data and parameters available to the host via the communication interface?

b) What is the maximum # of parameters that can be requested and delivered per second?

c) Describe the method that allows the existing communication link to be used for this purpose?

d) What set point and/or alarm capabilities are available for these data and parameters through the host communication interface (to support equipment self-diagnosis)?

e) Have these capabilities been verified?

f) What were the results?

Comments: ____

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6.4.29 All monitoring data should be communicated to the host system through the single communication link using standard communication protocols as expressed in the CIM Guidelines 4.1.1 and 4.1.2. Internally to the equipment the communication from sensors to the equipment controller should comply with one of the SEMI E54 sensor bus communication standards. (GL 1.1.7.4)

Sample Questions:

a) Is all monitoring data provided through the single communication link?

b) Describe the process that communicates equipment parameters to the host system via a single communication link.

c) Are internal sensors connected to the controller via a sensor bus?

d) If a sensor bus interface is provided, can the end user add on additional sensors (possibly with supplier support)?

e) Have you evaluated the need for buses specifically designed for add on sensors?

f) Do you have algorithms for analysis of the data from the add-on sensors to modify equipment behavior?

g) Can new algorithms be added as new sensors are added?

h) Is the equipment compliant to SEMI E54?

i) How was compliance to SEMI E54 demonstrated?

j) What were the test results?

Comments: ____

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7 PRODUCTIVITY ASSESSMENT

The primary driving factors for implementation of 300 mm capacity are cost and productivity, as detailed in the I300I Factory Guidelines. This section contains the specific areas of key interest and quantifies the factors that are highest leverage in determining the timing and performance to those needs.

7.1 Productivity Instrumentation/Tools/Prerequisites

None.

7.2 Productivity Physical Testing Results

None.

7.3 Productivity Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below should serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

Complete the assessment information table below.

I300I Productivity Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Supplier	
Model	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

7.3.1 Relative 300 mm process/metrology equipment capital cost per wafers processed per hour must be < 1.3X. This means that the capital cost per 300 mm wafers processed per hour by each equipment must be less than 1.3X the same ratio for the like 200 mm equipment. (GL 1.1.1)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm capital cost for this equipment?		N/A
What is the process throughput of this 300 mm equipment?		N/A
Calculate the 300 mm cost per wafers processed per hour.		N/A
What was the capital cost of the like 200 mm equipment?		N/A
What was the process throughput of the like 200 mm equipment?		N/A
Calculate the 200 mm cost per wafers processed per hour		N/A
Is the 300 mm capital cost per wafers processed per hour < 1.3 X the 200 mm cost (per wafers processed per hour)?		<1.3 X

Comments: ____

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7.3.2 300 mm process/metrology equipment availability must be greater than 90% for process equipment and greater than 95% for metrology equipment, based on SEMI E10 calculations for availability. (GL 1.1.2)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current availability performance for this equipment?		N/A
Is the availability > 90% for process equipment?		Yes
Is the availability > 95% for metrology equipment?		Yes

Comments: ____

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7.3.3 300 mm process/metrology equipment installation and qualification costs must be less than 6% of 300 mm equipment capital cost. (GL 1.1.3)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What are the current equipment installation and qualification costs?		N/A
What are the details of these costs?		N/A
Is the cost < 6% of the capital cost?		< 6 %

Comments: ____

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7.3.4 Relative process/metrology equipment installation and qualification duration must be < 0.7X. This means that 300 mm equipment installation and qualification duration must be less than 70% of like 200 mm equipment. (GL 1.1.4)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current equipment installation and qualification duration?		N/A
What was the installation and qualification duration for the like 200 mm equipment?		N/A
Is the 300 mm equipment duration < 0.7X the 200 mm duration?		< 0.7 X

Comments: ____

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7.3.5 Relative process/metrology equipment maintenance and spares costs per wafers processed per hour must be < 1.0X. This means that 300 mm equipment maintenance and spares costs per wafers processed per hour must be less than the same ratio for like 200 mm equipment. (GL 1.1.5)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment maintenance and spares cost for this equipment?		N/A
Use the 300 mm throughput from Section 7.2.1 to calculate the 300 mm cost per wafers processed per hour		N/A
What was the equipment maintenance and spares cost for the like 200 mm equipment?		N/A
Use the 200 mm throughput from Section 7.2.1 to calculate the 200 mm cost per wafers processed per hour.		N/A
Is the 300 mm equipment maintenance and spares cost per wafers processed per hour < 1.0 X the 200 mm cost (per wafers processed per hour)?		< 1.0 X

Comments: ____

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7.3.6 300 mm process/metrology equipment consumables (production materials and facility utilities) usage per wafers processed per hour must be less than the same ratio for like 200 mm equipment. (GL 1.1.6)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment consumables usage?		N/A
Use the 300 mm throughput from Section 7.2.1 to calculate the 300 mm consumables per wafers processed per hour.		N/A
What was the equipment consumables usage for the like 200 mm equipment?		N/A
Use the 200 mm throughput from Section 7.2.1 to calculate the 200 mm consumables per wafers processed per hour.		N/A
Is the 300 mm equipment consumables and usage per wafers processed per hour < 1.0 X the 200 mm (per wafers processed per hour)?		< 1.0 X

Comments: ____

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7.3.7 Relative process/metrology equipment monitor wafer usage per wafers processed per hour must be < 0.25X. This means than 300 mm equipment monitor wafer usage per wafers processed per hour must be less than 0.25X the same ratio for like 200 mm equipment. (GL 1.1.7)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment monitor usage?		N/A
Use the 300 mm throughput from Section 7.2.1 to calculate the 300 mm monitor usage per wafers processed per hour.		N/A
What was the equipment monitor usage for the like 200 mm equipment?		N/A
Use the 200 mm throughput from Section 7.2.1 to calculate the 200 mm monitor usage per wafers processed per hour.		N/A
Is the 300 mm equipment monitor usage per wafers processed per hour < 0.25X the 200 mm usage (per wafers processed per hour)?		< 0.25 X

Comments: ____

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7.3.8 300 mm process/metrology equipment software reliability must be better than current 200 mm equipment. (GL 1.1.8)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment software reliability?		N/A
What was the equipment software reliability for the current 200 mm equipment?		N/A
Is the 300 mm software reliability better than the 200 mm performance?		> 200 mm

Comments: ____

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7.3.9 300 mm process/metrology equipment footprint minimization is important. Overall equipment design must minimize footprint to support minimizing fab area growth in 300 mm fabs during installation, operation, and maintenance. (GL 2.12.2)

Sample Questions:

a) What methods were used to minimize the equipment footprint of this equipment during the design phase.

Comments: ______________________________

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7.3.10 First priority for equipment suppliers is to reduce/control the width (i.e., bay length) dimension to maximize the number of equipment that can be placed along the bay wall. (GL 2.12.3)

Sample Questions:

a) What methods were used to reduce and control the equipment width dimension?

Comments: ______________________________

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7.3.11 Relative 300 mm process/metrology equipment utilities consumption (power, water, exhaust and house gases) per wafers processed per hour must be ≤ 1.0X. This means that 300 mm equipment utility consumption per wafers processed per hour must be less than or equal to the same ratio for like 200 mm equipment. (GL 1.3.2.1)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment utility consumption?		N/A
Use the 300 mm throughput from Section 7.2.1 to calculate the 300 mm equipment utility consumption per wafers processed per hour.		N/A
What was the equipment utility consumption for the like 200 mm equipment?		N/A
Use the 200 mm throughput from Section 7.2.1 to calculate the 200 mm equipment utility consumption per wafers processed per hour.		N/A
Is the 300 mm equipment utilities consumption per wafers processed per hour < 1.0X the 200 mm usage (per wafers processed per hour)?		< 1.0 X

Comments: ____

7.3.12 Relative 300 mm process/metrology equipment scrubbed exhaust per wafers processed per hour must be ≤ 0.8X. This means that 300 mm equipment scrubbed exhaust per wafers processed per hour (as measured at the outlet of the equipment) must be less than or equal to 0.8X the same ratio for like 200 mm equipment. (GL 1.3.2.2)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm equipment scrubbed exhaust usage?		N/A
Use the 300 mm throughput from Section 7.2.1 to calculate the 300 mm scrubbed exhaust per wafers processed per hour.		N/A
What was the equipment scrubbed exhaust for the like 200 mm equipment?		N/A
Use the 200 mm throughput from Section 7.2.1 to calculate the 200 mm scrubbed exhaust per wafers processed per hour.		N/A
Is the 300 mm equipment scrubbed exhaust per wafers processed per hour < 0.25X the 200 mm usage (per wafers processed per hour)?		< 0.25 X

Comments: ____

7.3.13 Side-by-side (i.e., zero clearance) installation is preferred for 300 mm equipment, consistent with equipment design for maintainability. (GL 2.12.4)

Sample Questions:

a) Does this equipment allow for side-by-side installation?

b) What is the minimum side clearance for permanent installation?

Comments: ____

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7.3.14 Side access for maintenance must be minimized since it negatively impacts equipment packing density. Designs support overlapping maintenance space for adjacent equipment. (GL 2.12.6)

Sample Questions:

a) Does this equipment design minimize side access and maintenance space?

b) What method was used to minimize the access?

c) What impact did this have on the equipment design?

d) How much space as saved (in m^2)

Comments: ____

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8 ENVIRONMENTAL, SAFETY & HEALTH (ESH) ASSESSMENT

This section includes the specific requirements of the I300I Factory Guidelines for ESH, focusing primarily on certification of safety compliance and a significant effort to control the environmental impact of semiconductor manufacturing equipment.

8.1 ESH Instrumentation/Tools/Prerequisites

None.

8.2 ESH Physical Testing

8.2.1 ESH Standards Compliance – 300 mm process/metrology equipment must meet the standards certification requirements of SEMI S2, SEMI S8, and CE Mark. Additionally, increased focus on emissions levels require constantly improving performance (GL 1.2.1, GL 1.2.2)

1) Determine if the equipment has completed a third-party survey for SEMI S2 compliance.
2) Determine if the equipment has been determined to be fully SEMI S2-compliant.
3) Determine if the equipment has completed a third-party survey for SEMI S8 compliance.
4) Determine if the equipment has been determined to be fully SEMI S8-compliant.
5) Determine if the equipment has completed a survey for CE Mark compliance.
6) Determine if the equipment has been certified as CE Mark-compliant.
7) Procure a copy of S2, S8, and if possible CE Mark results
   - Pass Criteria:
     - i) A third party has surveyed the equipment for SEMI S2-compliance.
     - ii) A third party has certified the equipment as SEMI S8-compliant.
     - iii) The equipment has been certified as CE Mark-compliant.
   - Fail Criteria:
     - i) IF: The equipment has not been surveyed for SEMI S2-compliance by a third party.
     - ii) OR: The equipment is not certified as SEMI S8-compliant by a third party.
     - iii) OR: The equipment is not certified as CE Mark-compliant.

8.2.2 Minienvironment ES&H Compliance – As an integrated part of the equipment, the integrated minienvironment must comply with all ES&H guidelines for equipment (see Section 1.2 – Environmental, Safety, and Health; in addition, see SEMI S11 [GL 2.7.19])

1) Determine if the minienvironment complies with all ES&H guidelines for equipment (see Environmental, Safety, and Health section 1.2)
2) Determine if the minienvironment been assessed for SEMI S11 compliance.
3) Determine if the minienvironment complies with SEMI S11.
4) Procure a copy of S11 results.

- Pass Criteria:
  - i) A third party has surveyed the minienvironment for SEMI S11 compliance.
  - ii) A third party has certified the equipment as SEMI S11 compliant.
- Fail Criteria:
  - i) IF: The equipment has not been surveyed for SEMI S11 compliance by a third party.
  - ii) OR: The equipment is not certified as SEMI S11 compliant by a third party.

8.3 ESH Physical Testing Results

Complete the assessment information table below.

I300I ESH Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Load Port Supplier	
Load Port Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

8.3.1 ESH Standards Compliance: 300 mm process/metrology equipment must meet the standards certification requirements of SEMI S2, SEMI S8, and CE Mark. Additionally, increased focus on emissions levels require constantly improving performance. (GL 1.2.1, GL 1.2.2)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Has the equipment completed a third party survey for SEMI S2 compliance?		N/A	
Has the equipment been determined to be fully SEMI S2 compliant?		Yes	
Has the equipment completed a third party survey for SEMI S8 compliance?		N/A	
Has the equipment been determined to be fully SEMI S8 compliant?		Yes	
Has the equipment completed a survey for CE Mark compliance?		N/A	
Has the equipment been certified as CE Mark compliant?		Yes	
Has I300I received a copy of S2, S8, and if possible CE Mark results?		N/A	
		Overall Compliance	

Comments: ____

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8.3.2 Minienvironment ES&H Compliance: As an integrated part of the equipment, the integrated minienvironment must comply with all ES&H guidelines for equipment (see Environmental, Safety, and Health, GL section 1.2) and in addition SEMI S11. (GL 2.7.19)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Does the minienvironment comply with all ES&H guidelines for equipment (see Environmental, Safety, and Health, GL section 1.2)?		Yes	
Has the minienvironment been assessed for SEMI S11 compliance?		N/A	
Does the minienvironment comply with SEMI S11?		Yes	
		Overall Compliance	

Comments: ____

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8.4 ESH Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below should serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

8.4.1 All national and local safety code requirements for installation, operation, and maintenance of 300 mm process/metrology equipment must be met. (GL 1.2.1.1)

Sample Questions:

a) What method is used to meet national and local code requirements for this equipment?

b) Are these requirements treated as "customs and specials" for each equipment order?

c) What method is used to minimize the amount of variation driven by differing requirements?

d) How are the configuration changes by equipment order tracked?

Comments: ____

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8.4.2 300 mm process/metrology equipment noise level emissions must be less than or equal to like 200 mm equipment and must comply with the SEMI S2 (Safety) guidelines. (GL 1.2.3)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current noise emission level of this 300 mm equipment?		N/A
What was the like 200 mm equipment noise emission level baseline?		N/A
Is the noise emission level for 300 mm equipment equal to or less than the 200 mm level?		≤ 1 X
Does this level for 300 mm comply with SEMI S2 requirements?		Yes

Comments: ____

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8.4.3 Relative 300 mm process/metrology equipment emissions of hazardous air pollutants (HAPS) per wafers processed per hour must be ≤ 0.5X. This means that 300 mm equipment HAPS emissions per wafers processed per hour must be less than or equal to 0.5X the same ratio for like 200 mm equipment. (GL 1.2.4)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current HAPS emission level for this 300 mm equipment (per wafers processed per hour)?		N/A
What was the like 200 mm equipment HAPS emission baseline (per wafers processed per hour?		N/A
What method was used to measure these levels?		N/A
Is the relative HAPS emission level for 300 mm equipment ≤ 0.5X the 200 mm baseline level?		≤ 0.5 X

Comments: ____

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8.4.4 Relative 300 mm process/metrology perfluorocarbon (PFC) emissions per wafers processed per hour must be ≤ 0.5X. This means that 300 mm equipment PFCs emissions per wafers processed per hour must be less than or equal to 0.5X the same ratio for like 200 mm equipment. (GL 1.2.5)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current PFC emission level for this 300 mm equipment (per wafers processed per hour)?		N/A
What was the like 200 mm equipment PFC emission baseline (per wafers processed per hour)?		N/A
What method was used to measure these levels?		N/A
Is the relative PFC emission level for 300 mm equipment ≤ 0.5X the 200 mm relative baseline level?		< 0.5 X

Comments: ____

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8.4.5 Relative 300 mm process/metrology volatile organic compound (VOC) emissions per wafers processed per hour must be ≤ 0.5X. This means that 300 mm equipment VOC emissions per wafers processed per hour must be less than or equal to 0.5X the same ratio for like 200 mm equipment. (GL 1.2.6)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current relative VOC emission level for this 300 mm equipment (per wafers processed per hour)?		N/A
What was the like 200 mm equipment relative VOC emission baseline (per wafers processed per hour)?		N/A
What method was used to measure these levels?		N/A
Is the relative VOC emission level for 300 mm equipment ≤ 0.5X the 200 mm relative baseline level?		< 0.5 X

Comments: ____

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8.4.6 SEMATECH Application Guide for SEMI S2 and S8 may be used for instructions and information in interpreting these standards. (GL 1.2.1.2)

Sample Questions:

a) Describe how the SEMATECH Application Guide for SEMI S2 and S8 was referenced as an aid for S2 and S8 interpretation?

b) What were the results?

Comments: ____

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9 FACILITIES INTERFACES ASSESSMENT

This section contains a compilation of all of the I300I Factory Guideline items that directly and specifically pertain to cleanroom compatibility and the requirements for installation, qualification and long-term support of equipment in a high volume-manufacturing environment.

9.1 Facilities Interfaces Instrumentation/Tools/Prerequisites

None.

9.2 Facilities Interfaces Physical Testing

None.

9.3 Facilities Interfaces Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below should serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

Complete the assessment information table below.

I300I Facilities Interfaces Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Load Port Supplier	
Load Port Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

9.3.1 300 mm process/metrology equipment should be designed to operate in Class 5 and Class 6 cleanrooms (as defined in ISO 14644-1) without adverse impact to equipment availability and maintainability performance. Equipment designs that include integrated minienvironments should measure performance using the ISO classifications and clearly meet the needs of the process technology. (GL 1.3.3)

Sample Questions:

a) What design considerations or decisions were made specifically to ensure that the equipment could operate in Class 5 and 6 cleanrooms without adverse availability and maintainability impacts?

b) Were any support equipment decisions made to move "dirty" machine functions out of the cleanroom?

c) What material selection or maintenance method changes were made to avoid contamination or longer downtime due to cleanliness requirements?

d) Is there any testing or characterization data evaluating or quantifying equipment cleanroom compatibility? What method was used?

e) What were the results?

f) If this equipment includes an integrated minienvironment, does it meet the appropriate ISO rating classification?

g) Does the minienvironment meet the needs of the process technology? In what way?

h) Has the rating and process compatibility been tested? Using what method?

i) What were the results?

Comments: ____

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9.3.2 300 mm process/metrology equipment should be designed to operate in a cleanroom with a designed controlled temperature between 21 C and 24 C and a designed controlled relative humidity between 35% and 55%. (GL 1.3.3.1)

Sample Questions:

a) Is the equipment designed to operate in defined temperature and humidity environment?

b) Has the equipment design been optimized for heat load contribution? What method or approach was used?

c) Has the equipment design been optimized for relative humidity contribution? What method or approach was used?

d) Has testing or characterization for temperature and humidity performance and contribution been conducted? Using what method?

e) What were the results?

Comments: ____

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9.3.3 Relative 300 mm process/metrology equipment height, floor loading, and move-in size should conform to SEMI E72. (GL 1.3.1.2)

Sample Questions:

a) Does the tool meet the requirements of SEMI E72 for equipment height, floor loading, and move-in size?

b) Do the equipment drawings visibly show the dimensions?

c) What method was used to verify this conformance?

d) What were the results?

Comments: ____

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9.3.4 Relative 300 mm process/metrology equipment footprint per wafers processed per hour must be < 1.0 X. This means that 300 mm equipment footprint per wafers processed per hour must be less than the same ratio for like 200 mm equipment. Compliance on this guideline will be measured on a per-wafers-processed-per-hour basis (Note: Equipment footprint is defined as cost footprint by SEMI E72). (GL 1.3.1)

Data Collection:

Assessment Detail	Results	Pass/Fail Criteria
What is the current 300 mm footprint for this equipment (see Figure 18)?		N/A
What is the process throughput of this 300 mm equipment (in wafers per hour)?		N/A
Calculate the 300 mm footprint per wafers processed per hour.		N/A
What was the footprint of the equivalent 200 mm equipment?		N/A
What was the process throughput of the 200 mm equipment (in wafers per hour) ?		N/A
Calculate the 200 mm footprint per wafers processed per hour.		N/A
Is the 300 mm footprint per wafers processed per hour < 1.0 X the 200 mm footprint per wafers processed per hour?		< 1.0 X

Comments: ____

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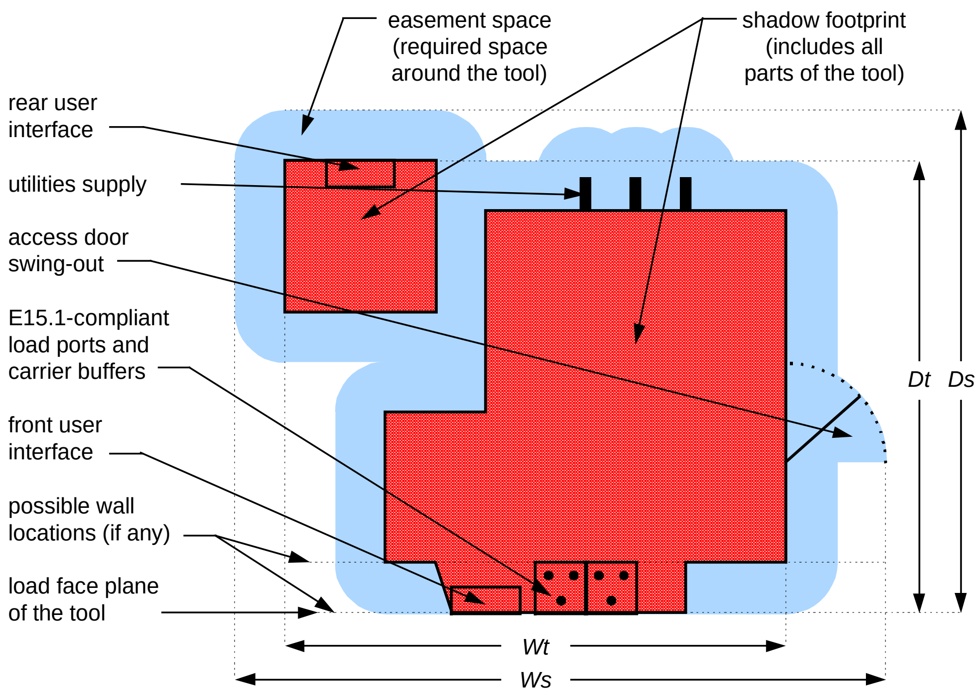

Figure 18 Equipment Footprint

9.3.5 Similarly, associated support equipment footprint located in the sub-fab should not exceed the equipment footprint in the fab cleanroom per SEMI E72. (GL 1.3.1.1)

Sample Questions:

a) Does this tool include support equipment?
b) If so, does it meet the sub-fab footprint requirements of SEMI E72?
c) What method was used to verify this conformance?
d) Does the tool meet the requirements of SEMI E72 for equipment height, floor loading, and move-in size?

Comments: ____

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9.3.6 300 mm process/metrology equipment should be designed, configured, and documented to support the factory accommodation process defined in SEMI E70, including the facilities connection layout meeting the guidance of SEMI E76 and the documentation of facilities interface specifications meeting the requirements of SEMI E6. (GL 1.3.6)

Sample Questions:

a) Does this equipment have all of the elements to meet the SEMI E70 factory accommodation process?
b) Do the facilities layout and connections meet the SEMI E76 requirements?
c) Does the documentation meet the SEMI E6 requirements?
d) Has the accommodation process been used to install this type of equipment before?
e) What were the results and learning’s from that installation?

Comments: ____

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9.3.7 Where possible, 300 mm process/metrology equipment should be designed to operate using typical semiconductor facility utilities (water services, gas services, chemical drain, bulk chemical distribution, exhaust, and electrical services) as defined in SEMI E51. (GL 1.3.2)

Sample Questions:

a) Describe how the SEMI E51 was used to design your equipment such that it could operate with typical facilities utilities.

b) How was SEMI E51 used during system development of facilities interfaces?

c) What were the results?

Comments: ____

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10 COMMUNICATION INTERFACES ASSESSMENTS

This section evaluates the availability of the equipment communication functions defined in the I300I Factory Guidelines. It focuses on the key connectivity, protocol, and messaging structure required for CIM and factory integration.

10.1 Instrumentation/Tools/Prerequisites

None.

10.2 Equipment Communication Interfaces Physical Testing

10.2.1 Communications Interface – 300 mm process/metrology equipment is required to have a single communication link, or point of connection to a host. This link must support local network connectivity for HSMS and comply with the SECS-II/GEM standard protocols (GL 2.13.1, GL 2.13.2, and GL 4.1.1, GL 4.1.2)

1) Determine, by examination, where the SECS-II communication port is located and that one and only one port exists.
2) The port must be configured for HSMS TCP/IP communications, NOT RS-232 SECS-I.
3) Review the equipment communications manual for a list of SECS-II streams and functions supported by the equipment.
4) Verify basic GEM design using the following steps:
    a) Review the physical equipment interface (e.g., operator interface, configuration interface, etc.) for SECS/GEM configuration screens.
    b) Review the equipment communications interface manual for a list of GEM capabilities supported by the equipment control system.
    c) Review the equipment communications interface manual or other document for SECS-II messages for scenarios describing the equipment’s operational situations, along with the corresponding resulting activity.
    d) Review the equipment communications interface manual for the detailed GEM message scenarios (e.g., establish communication, remote commands, etc.) and the corresponding equipment responses.
5) Verify basic HSMS design using the following steps:
    a) Review the physical equipment interface (i.e., operator interface, configuration interface, etc.) for HSMS configuration screens.
    b) Determine, by examination and documentation for equipment, the communication port’s configuration. It should be a standard TCP/IP connection (e.g., Ethernet IEEE 802.3, thin coax 10-BASE-2)(RFC 793 - Transmission Control Protocol).
    c) Verify that the HSMS configuration screens contain selections for setting the equipment to operate in either Active or Passive mode.
    d) Verify that the HSMS configuration screens contain selections for setting the equipment and host IP addresses.
    e) Document the designed communication speed (MBits/second).

- Pass Criteria:
  - i) There is a single TCP/IP communications port.
  - ii) A listing of SECS-II streams and functions supported is available.
  - iii) The physical interface includes SECS/GEM configuration screens.
  - iv) The documentation lists GEM capabilities supported and detailed SECS-II and GEM message scenarios.
  - v) The physical interface includes HSMS configuration screen.
  - vi) The HSMS configuration screens allow selections for Active/Passive mode and for setting equipment/host IP addresses.
- Fail Criteria:
  - i) IF: There is more than one communication link.
  - ii) OR: The communication link is not TCP/IP based.
  - iii) OR: There is no documented listing of SECS-II streams and functions.
  - iv) OR: The physical interface does not include SECS/GEM configuration screens.
  - v) OR: There is no documentation listing GEM capabilities supported and/or detailing SECS-II and GEM message scenarios.
  - vi) OR: The physical interface does not include HSMS configuration screen.
  - vii) OR: The HSMS configuration screens do not allow selection for Active or Passive mode, or the setting of equipment/host IP addresses.

10.3 Equipment Communication Interfaces Physical Testing Results

Complete the assessment information table below.

I300I Equipment Communication Interfaces Guideline Compliance Assessment Information

Company	
Address	
Phone number	
Equipment Type	
Equipment Model #	
Equipment Serial #	
Configuration	
Load Port Supplier	
Load Port Model	
3rd party Buffer Supplier (if used)	
Buffer Model # (if supplied by 3rd party)	
Date	
Location	
Assessment Team Leader	
Assessor	
Assessor	
Assessor	
Supplier Team Leader	
Supplier member 1	
Supplier member 2	
Supplier member 3	

10.3.1 Communications Interface: 300 mm process/metrology equipment is required to have a single communication link or point of connection to a host. This link must support local network connectivity for HSMS and comply with the SECS-II/GEM standard protocols. (GL 4.1, GL 2.13.1, GL 2.13.2)

Assessment Detail	Results	Pass/Fail Criteria	Compliance
Is there one, and only one, SECS-II communication port?		Yes	
Is the port configured for HSMS TCP/IP communications?		Yes	
Does the communication manual include definitions of the SECS-II streams and functions?		Yes	
Does the physical equipment have a GEM configuration screens?		Yes	
Do the communication manuals include detailed GEM function and message scenarios?		Yes	
Does the equipment have designed in GEM function?		Yes	
Does the physical equipment have an HSMS configuration screens?		Yes	
Do the HSMS configuration screens contain selections for setting the equipment to operate in either Active or Passive mode?		Yes	
Do the HSMS configuration screens contain selections for setting the equipment and host IP addresses?		Yes	
Record the HSMS communication speed (MBits/second).		N/A	
		Overall Compliance	

Comments: ____

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10.4 Equipment Communication Interfaces Intelligent Inquiry

Some aspects of guideline implementation and compliance will be investigated through interactive discussion with the support of documentation and other materials. Each of the guideline items represents an expectation or requirement for 300 mm equipment. Sample questions found below should serve as the basis to begin these discussions. The questions should also help to clarify the intent and expectation of the guideline and the acceptable proof of compliance.

10.4.1 300 mm process/metrology equipment designs must include software interlocks between OHT and PGV operation modes to prevent simultaneous access of the same load port. The equipment should comprehend the access mode and allow exclusive use by that mode for that lot/load port, rejecting requests other than the authorized mode. (GL 4.3.3)

Sample Questions:

a) Does the equipment include software interlocks to prevent simultaneous access to the load port by OHT and PGV?

b) What approach was used?

c) Has the function been tested?

d) What were the results?

Comments: ____

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10.4.2 300 mm production equipment must be capable of communicating via parallel I/O with all AMHS transport equipment. (GL 4.2.2)

Sample Questions:

a) Is the equipment designed to communicate to a variety of AMHS components? What method or approach was used for this capability?

b) Does the communication capability meet all current standardized protocols, state models, and interfaces for AMHS?

c) What testing or characterization of this capability has been conducted?

d) What were the results?

Comments: ____

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10.4.3 300 mm process/metrology equipment must be capable of tracking and managing exception lots by the assigned CIM system lot or carrier identification. (GL 3.1.6.1)

Sample Questions:

a) Does this equipment treat exception lot ID's assigned by the CIM system, the same as any other production lot?

b) Is the slot-to-slot, same carrier integrity maintained for exception lots/wafers?

c) Is the slot-to-slot integrity maintained if less that the full exception lot is processed at one time or if wafers are distributed between multiple runs?

d) Has this capability been tested? Using what method and to what extent?

e) What were the results?

Comments: ____

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10.4.4 300 mm process/metrology equipment must be capable of tracking and managing exception wafers by the assigned CIM system wafer identification. (GL 3.1.6.2)

Sample Questions:

a) Does this equipment treat exception wafer ID's assigned by the CIM system, the same as any other production wafers?

b) Has this capability been tested? Using what method and to what extent?

c) What were the results?

Comments: ____

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10.4.5 300 mm process/metrology equipment should be designed to act as part of the CIM system in physically and logically tracking exception lots and wafers in the same manner as production materials. (GL 3.1.6)

Sample Questions:

a) Does the equipment accurately and adequately communicate the logical tracking of exception lots and wafers to the CIM system?

b) Does the equipment physically track exception lots and wafers the same way as production materials?

c) Has this capability been tested or characterized? In what manner and to what extent?

d) What were the results?

Comments: ____

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10.4.6 The equipment control system is responsible for the management of all FOUP and material tracking within the equipment, at the load ports, within the buffer or in process, including the storage of empty FOUPs while the associated wafers are being processed. (GL 4.4.2)

Sample Questions:

a) Does the control system track every FOUP regardless of process status?

b) How does the system distinguish between queued, empty, and completed lots?

c) Do empty FOUPs pose a special tracking and control challenge?

Comments: ____

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10.4.7 300 mm process/metrology equipment must be capable of communicating utilization and reliability data, such as that collected in Section 6.4.17, to the host systems using standard messages and state models. (GL 4.1.3)

Sample Questions:

a) How does this equipment communicate the reliability and utilization data to the host system?

b) What state models and messages are being used for this data transfer?

c) Has this capability been tested while connected to a host?

d) What were the results?

Comments: ____

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10.4.8 300 mm process/metrology equipment must be capable of fault-free processing of date and date-related data in the 20th and 21st centuries. So the design must preclude any issues related to the year 2000 concerns. (GL 4.1.6)

Sample Questions:

a) Is this equipment designed for fault-free date transitions?

b) What method was used?

c) Has this capability been tested?

d) What were the results?

Comments: ____

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10.4.9 Reliable Data Collection – Data collected by production equipment must be time-stamped at the time of collection and not at the time of transmission. (GL 4.1.4)

Sample Questions:

a) What is the smallest interval for time stamping data?
b) Describe the effect of data collection and transfer to the host on equipment performance.
c) How was this verified?
d) Has this scenario been tested?
e) What were the results?

Comments: ____

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10.4.10 Variable Parameter Support – Production equipment must support variable parameters sent by the host or set from the operator interface. (GL 4.1.5)

Sample Questions:

a) What are the variable process parameters?
b) What parameters are varied to control the process?
c) What experimentation has been performed on the identified variables?
d) What were the results?

Comments: ____

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10.4.11 Production equipment and AMHS equipment must allow both continuous and simultaneous hand-off (see glossary for further definition) of up to two carriers at load ports and allow recovery from time-outs and hand-off errors. (GL 4.2.3)

Sample Questions:

a) How did you upgrade from E23 to E23.1
b) Is your parallel I/O device designed as one per port or one per two ports?
c) How many parallel I/O devices are designed into the equipment?
d) How many exclusion zones does your tool have to support multiple methods of automated delivery? (AGV, rail, OHT)
e) What testing has been performed?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.12 Any PGV must be able to dock mechanically at any standard compliant load port through a standard PGV docking interface. (GL 4.2.4)

Sample Questions: (Note: These questions are for PGV suppliers only)

a) What equipment have you used to test your PGV?
b) What PGVs has the equipment maker used to test their docking flange?
c) What testing has been performed?
d) What were the results of any testing that has been performed?

Comments: ____

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10.4.13 IC manufacturers will use either read-only or read/write carrier ID technologies based on operational requirements. The carrier must be located at a different position on the load port during an ID operation depending on the technology used. When read-only carrier ID is specified, Fixed Buffer Equipment must support the capability to read the carrier ID at the load/unload position on the E15.1 load port. When read/write carrier ID is specified, Fixed Buffer Equipment must support the capability to read/write the carrier ID at the FIMS position on the E15.1 load port. While data is being written to an ID tag, the carrier must be physically locked relative to the read/write device. (GL 4.2.8)

Sample Questions:

a) How many exclusion zones for ID reader or reader/writer devices do you have?
b) If you have one, how can you support both read only and read/write requirements?
c) What read and read/write devices have been tested on your equipment?
d) What types of carriers were used for these tests?
e) What were the results?

Comments: ____

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10.4.14 To reduce factory and equipment cost of ownership, production equipment suppliers are encouraged to implement innovative ways to minimize the number of load ports kept as spares in 300 mm factories. (GL 4.2.9)

Sample Questions:

a) What methods are used to ensure backward compatibility for load ports?
b) What load ports have been tested for backward compatibility?
c) What was the biggest difficulty for backward compatibility?
d) What were the results of any testing that has been performed?

Comments: ____

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10.4.15 Production equipment must accept only one Access Mode (RGV/AGV/OHT or PGV/Operator) at a time, and allow the Access Mode to change at any time except during carrier hand-off. The mode shall be applied by equipment, and not by individual load ports and the Production equipment must reject all requests other than requests within the accepted mode. Equipment that has physically separated load port groups must allow different access modes for the different load port groups. (GL 4.3.1)

Sample Questions:

a) Describe or show the Access Mode state model for the port group?
b) How do you prevent Access Mode state change (auto to manual and vice versa)?
c) How do you define Port Groups?
d) How many Port Groups can be defined on your team?
e) Can a Port Group consist of only one load port?
f) How did you define physical separation?
g) What happened when you tried to illegally change access mode?
h) What were the results of any testing that has been performed?

Comments: ____

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10.4.16 Switching between Manual Access Mode and Automatic Access Mode must be smooth and manual carrier hand-off must be safe. Production equipment must have the capability of handshaking during manual carrier hand-off in a manner similar to automated hand-off. In the manual handshaking procedure, the equipment must provide a simple input method of manual hand-off completion. (GL 4.3.2)

Sample Questions:

a) How does the operator change the Access mode to manual when at a host interface?
b) How does the operator change the Access mode when at the equipment interface?
c) How does the operator change the Access mode when at the load port?
d) How does the operator indicate that a manual load transfer is complete?
e) How does the operator indicate that a manual unload transfer is complete?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.17 Effective manufacturing in 300 mm factories requires the use of AMHS material delivery to production equipment even when the production equipment is operated by the operator. Therefore, production equipment must support automated and manual material handling interactions independent of wafer processing and measurement operations. (GL 4.3.4)

Sample Questions:

a) How does the equipment indicate that Automated material handling is permitted?
b) Does this vary when in the GEM online local, online remote mode, or the GEM offline?
c) Is automated delivery allowed when in the GEM offline mode? (Yes or no, but important!)
d) How would an automated delivery be prevented when in the GEM offline mode?
e) How do you manage independence of processing and material handling functions?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.18 The order of processing for a carrier or batch in the equipment buffer is independent of the order of its delivery. Production equipment must be able to set and change the order of processing as directed by the host and the operator interface. Equipment must always maintain the association between a carrier or batch and it's processing instructions. This capability is especially important for supporting QTAT (quick turnaround time) for a hot lot by putting it at the top of the order. (GL 4.3.5)

Sample Questions:

a) How will the equipment support defining a processing order for carriers?
b) How will the equipment support changing a defined order?
c) When will a change in processing order not be supported?
d) Can a carrier be prevented from processing after the FOUP is opened?
e) What testing has been performed?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.19 To achieve consistent carrier handling within internal buffer equipment, standard carrier handling commands (sent from the host to the equipment) must be supported by the equipment. When the equipment's carrier handling is controlled by the host: Carrier movement must be controlled by using these commands, and carrier movement between the internal buffer and the load port must remain under host control until further specified by the host or from operator interface. (GL 4.3.6)

Sample Questions:

a) When did you implement the carrier management standard?
b) What state models from the carrier management standards are completely installed?
c) What testing has been performed?
d) What were the results of any testing that has been performed?

Comments: ____

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10.4.20 Internal Buffer Capacity Notification: Internal Buffer Equipment must report the available buffer capacity to the host whenever the available capacity changes and when requested by the Host. (GL 4.3.7)

Sample Questions:

a) How does the equipment notify the host of internal buffer capacity changes?
b) Will the equipment accept requests from the host to change the capacity of a logical partition?
c) What SECS II message is used?
d) If the equipment can accept changes to the logical partition capacity, when would it be prohibited?
e) What testing has been performed?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.21 FOUP Open and Close Notification: Production equipment that supports FOUP must control FOUP opening and closing and have the capability to send corresponding event notification to the host through standard event messages. This does not apply to equipment that supports open cassette carrier interfaces only. (GL 4.3.8)

Sample Questions:

a) How does the tool notify the host of FOUP open and close?
b) What is the SECS II message used?
c) Does the equipment control FOUP open and close?
d) How would it reject a request from the host to open the FOUP?
e) What testing has been performed?
f) What were the results of any testing that has been performed?

Comments: ____

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10.4.22 Carrier Slot Verification: Prior to processing wafers, production equipment must have the capability to detect which slots within a carrier have wafers. This information is used to verify the carrier/slot map. (GL 4.4.3)

Sample Questions:

a) How does the tool verify which slots have wafers?
b) What are the error conditions that the equipment can detect?
c) What is the throughput detraction if any due to the wafer to slot detection?
d) Does the equipment support carrier slot verification?
e) What is the method for carrier slot verification?
f) What testing has been performed?
g) What were the results of any testing that has been performed?

Comments: ____

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10.4.23 Host Control of Wafer Process Order: Single wafer production equipment must be able to process some or all of the wafers in a carrier as specified by both the host and the operator interface. Single wafer process equipment must be able to process wafers based on an order specified by both the host and the operator interface. (GL 4.4.4)

Sample Questions:

a) What method does the equipment use to support host control of wafer process order?

b) Does it use E40 (process management?) or a combination of E40 and control job management?

c) How many different recipes can be defined for a carrier?

d) What testing has been performed?

e) What were the results of any testing that has been performed?

Comments: ____

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10.4.24 Additional Wafer Control after Processing or Measurement: In addition to the minimum slot and carrier integrity capability, specific single wafer production equipment must be able to output wafers to a specific slot in a specific carrier different than the one from which it was taken. (GL 4.4.6)

Sample Questions:

a) What method does the equipment use to support additional wafer control after processing or measurement?

b) Does it use control job management?

c) How does the equipment support sorting of wafers?

d) How many destinations are possible for a wafer?

e) How many sorts are possible?

f) What testing has been performed?

g) What were the results of any testing that has been performed?

Comments: ____

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10.4.25 Multi-Module Wafer Tracking Events: Multi-module single wafer processing equipment must track the movement of each wafer through the modules and report this information to the host. The equipment must be capable of associating data collected at a module with the wafer being processed at that module. (GL 4.4.7)

Sample Questions:

a) What SECS II messages are used to report wafer movement through the equipment?

b) Describe any tests that have been performed which showed evidence that the equipment was capable of associating wafers with multiple equipment modules during processing.

c) What testing has been performed?

d) What were the results of any testing that has been performed?

Comments: ____

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10.4.26 Recipe and Variable Parameter Change between Wafers: 300-mm manufacturing requires wafer level process control and management for higher production efficiency, development speed and fine process control. To realize this requirement with cost effectiveness, single wafer production equipment must support the capability to set different recipes and/or variable parameters associated with subsets of wafers within a carrier in a standard way. Standardizing concept, state models and communication interfaces are necessary to fulfill this goal. (GL 4.5.1)

Sample Questions:

a) Will this equipment support both recipe changes or variable parameter changes between wafers? Or both?

b) How many different recipes can be used to process one carrier?

c) What state models were developed during the design process that supported variable parameter change capabilities?

d) What testing has been performed?

e) What were the results of any testing that has been performed?

Comments: ____

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10.4.27 Process Parameter Change between Wafers: Single wafer process equipment may optionally need to support runtime variable parameter modification by host. When implemented, it must be done in a standard way. (GL 4.5.2)

Sample Questions:

a) Will this equipment support both recipe changes or variable parameter changes between wafers? Or both?
b) How many different recipes can be used to process one carrier?
c) What state models were developed during the design process that supported variable parameter change capabilities?
d) What testing has been performed?
e) What were the results of any testing that has been performed?

Comments: ____

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10.4.28 AMHS Framework: Semiconductor factories that have AMHS require an integrated software system to realize automated material movement. This AMHS integration system must be interoperable with AMHS equipment controllers and factory host systems from different suppliers. In order to achieve this goal, the AMHS integration system must conform to standard communication protocols, state models, and interfaces. This includes coordination and integration of AMHS equipment as well as integration with factory host systems. (GL 4.6.2)

Sample Questions:

a) What software standards does this MCS or integrator comply with.
b) What transport equipment has this software been integrated with?
c) What factory software has this MCS software been integrated with?
d) What testing has been performed?
e) What were the results of any testing that has been performed?

Comments: ____

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11 GUIDELINE COMPLIANCE TESTING RESULTS SUMMARY (Example Only: A report will contain all items)

FIMA Section	Description	Compliance (Yes or No)	Comments/Issues (If No, provide details)
4.1	**Load Ports**		
4.1.3.1	FOUP Compatibility		
4.1.3.2	Minimum Load Port Requirement		
4.1.3.3	Permitted Auxiliary Load Ports		
4.1.3.4	Load Port Features		
4.1.3.5	E15.1 Compliance		
4.1.3.6	FIMS Compliance		
4.2	**Interface for Material Delivery**		
4.2.3.1	OHT Exclusion Zone		
4.2.3.2	Cart Docking Interface		
4.2.3.3	Photocoupled Interface		
4.2.3.4	AMHS/Equipment Installation Alignment		
5.	**Buffering**		
5.3.1	Requirement for Buffering		
5.3.2	Buffer FIMS Compliance		
5.3.3	Buffer Kinematic Couplings Compliance		
5.3.4	Simple, Reliable Buffers		
6.	**Tool Capability Requirements**		
6.2.1	Slot and Carrier Integrity and Alignment		
6.3.2	User Interfaces		
6.3.3	Minienvironments		
7.	**Productivity**		N/A
8.	**Environment, Safety, and Health**		
8.3.1	ESH Standards Compliance		
8.3.2	Minienvironment ES&H Compliance		
9.	**Facilities Interfaces**		N/A
10.	**Equipment Communications Interface**		
10.3.1	Communications Interface		
	Overall Compliance:		

APPENDIX A
Reference Documents

The following standards have been endorsed by I300I member companies and are a subset of 1998 Equipment Performance Metrics.

A.1 SEMI Standards

Note: The most recently published versions of these standards apply. No version with a date earlier than that noted below should be used. If a newer version of any document listed is available, reference the newly published version.

A.1.1 SEMI Silicon Wafer Standards

– **SEMI M1.15-0699** – Standard for 300 mm Polished Monocrystalline Silicon Wafers (Notched)...................................... *[cited in I300I Factory Guideline (FGL) Sections 8.1, 8.2]*

– **SEMI M31-0999** – Provisional Mechanical Specification for Front-Opening Shipping Box Used to Transport and Ship 300 mm Wafers.......................... *[cited in I300I FGL Section 8.3]*

– **SEMI T7-0997** – Specification for Back Surface Marking of Double-Side Polished Wafers with a Two-Dimensional Matrix Code Symbol .... *[cited in I300I FGL Section 8.2]*

A.1.2 SEMI Equipment and Automation Hardware Standards

– **SEMI E1.9-0699** – Provisional Mechanical Specification for Cassettes Used to Transport and Store 300 mm Wafers ....*[cited in I300I FGL Sections 2.1, 2.2, 4.2, 4.4, 7.1, 7.2, 7.14]*

– **SEMI E10-0699** – Standard for Definition and Measurement of Equipment Reliability, Availability, and Maintainability (RAM)....................... *[cited in I300I FGL Sections 1.1, 4.1]*

– **SEMI E15.1-0200** – Provisional Specification for 300 mm Tool Load Port ....*[cited in* ..... *I300I FGL Sections 2.4, 2.5, 2.6, 2.9, 2.10, 2.14, 3.1, 4.2, 5.3, 5.4, 5.5, 7.4, 7.5, 7.9, 7.10]*

– **SEMI E19.3-0697** – Port Standard for Mechanical Interface of Wafer Cassette Transfer, 150 mm (6 inch) Port .... *[cited in I300I FGL Section 6.1]*

– **SEMI E47.1-0200** – Provisional Mechanical Specification for Boxes and Pods Used to Transport and Store 300 mm Wafers...*[cited in I300I FGL Sections 2.3, 3.1, 4.2, 5.4, 5.5, 7.3]*

– **SEMI E57-0299** – Provisional Mechanical Specification for Kinematic Couplings Used to Align and Support 300 mm Wafer Carrier .... *[cited in I300I FGL Sections 2.2, 4.2]*

– **SEMI E62-0999** – Provisional Specification for 300 mm Front-Opening Interface Mechanical Standard (FIMS).................... *[cited in I300I FGL Sections 2.3, 2.4, 3.1, 7.3, 7.4]*

– **SEMI E63-0200** – Provisional Mechanical Specification for 300 mm Box Opener/ Loader to Tool Standard (BOLTS-M) Interface .... *[cited in I300I FGL Sections 2.4, 2.10, 7.4]*

– **SEMI E64-0698** – Provisional Specification for 300 mm Cart to SEMI E15.1 Docking Interface Port.. *[cited in I300I FGL Sections 2.9, 2.14, 7.9, 7.14]*

– **SEMI E83-0699** – Provisional Specification for 300 mm PGV Mechanical Docking Flange .... *[cited in I300I FGL Section 5.3]*

A.1.3 SEMI Information and Control Software Standards

- **SEMI E5-0200 –** SEMI Equipment Communications Standard 2 Message Content (SECS-II)...........................*[cited in I300I FGL Sections 2.13, 4.1, 4.3, 4.4, 4.5, 4.6, 4.7, 7.13]*
- **SEMI E23-96 –** Specification for Cassette Transfer Parallel I/O Interface) ....*[cited in I300I FGL Sections 4.6, 7.13]*
- **SEMI E30-0200 –** Generic Model for Communications and Control of SEMI Equipment (GEM) .... *[cited in I300I FGL Sections 2.13, 4.1, 4.3, 4.4, 4.6, 4.7, 7.13]*
- **SEMI E37-0298 –** High-Speed SECS Message Services (HSMS) Generic Services) ....*[cited in I300I FGL Sections 2.13, 4.1, 4.3, 4.4, 4.6, 4.7, 7.13]*
- **SEMI E37.1-96 –** High-Speed SECS Message Services Single-Session Mode (HSMS-SS) ....*[cited in I300I FGL Sections 4.1, 4.4, 4.6, 4.7]*
- **SEMI E40-0200 –** Standard for Processing Management ....*[cited in I300I FGL Sections 4.5, 4.7]*
- **SEMI E42-0299 –** Recipe Management Standard: Concepts, Behavior, and Message Services ....*[cited in I300I FGL Sections 4.1, 4.3]*
- **SEMI E54-0997**- Sensor/Actuator Network Standard .... *[cited in I300I FGL Section 1.1]*
- **SEMI E58-0697 –** Automated Reliability, Availability, and Maintainability Standard (ARAMS): Concepts, Behavior, and Services .... *[cited in I300I FGL Sections 1.1, 4.1]*
- **SEMI E58.1-0697 –** SECS-II Protocol for Automated Reliability, Availability, and Maintainability Standard (ARAMS): Concepts, Behavior, and Services .... *[cited in I300I FGL Section 4.1]*
- **SEMI E81-0699 –** Provisional Specification for CIM Framework Domain Architecture .... *[cited in I300I FGL Section 4.7]*
- **SEMI E82-0999 –** Intrabay AMHS SEM Specification (IBSEM).. ....*[cited in I300I FGL Sections 4.6, 4.7]*
- **SEMI E84-0200 –** Specification for Enhanced Carrier Handoff Parallel I/O Interface ....*[cited in I300I FGL Sections 2.13, 4.2, 4.3, 4.6, 7.13]*
- **SEMI E87-0200 –** Provisional Specification for Carrier Transfer Standard (CTS) ....*[cited in I300I FGL Sections 4.3, 4.4, 4.7]*
- **SEMI E88-0999 –** Specification for AMHS Storage SEM (Stocker SEM) ....*[cited in I300I FGL Sections 4.6, 4.7]*
- **SEMI E90-0200 –** Specification for Substrate Tracking... ....*[cited in I300I FGL Sections 4.4, 4.7]*
- **SEMI E93-0999 –** Provisional Specification for CIM Framework Advanced Process Control Component .... *[cited in I300I FGL Section 4.7]*
- **SEMI E94-0200 –** Provisional Standard for Control Job Management.................................... ....*[cited in I300I FGL Sections 4.3, 4.4, 4.5, 4.7]*
- **SEMI E96-0200 –** Proposed Guide for CIM Framework Technical Architecture .... *[cited in I300I FGL Section 4.7]*

– **SEMI E97-0200 –** Provisional Specification for CIM Framework Global Declarations and Abstract Interfaces.. *[cited in I300I FGL Section 4.7]*

A.1.4 SEMI Facilities Interface and Safety Standards

– **SEMI S2-93A –** Safety Guidelines for Semiconductor Manufacturing Equipment..................

– .... *[cited in I300I FGL Sections 1.2, 4.3, 5.2]*

– **SEMI S8-0999 –** Safety Guidelines for Ergonomics/Human Factors Engineering of Semiconductor Manufacturing Equipment .. *[cited in I300I FGL Sections 1.2, 2.14, 5.2, 7.14]*

– **SEMI S11-1296 –** Environment, Safety and Health Guidelines for Semiconductor Manufacturing Equipment Minienvironments....................... *[cited in I300I FGL Section 2.7]*

– **SEMI E6-1296 –** Facilities Interface Specifications Guideline and Format............................. .... *[cited in I300I FGL Section 1.3]*

– **SEMI E49.3-0298 –** Guide for Ultrahigh Purity Deionized Water and Chemical Distribution Systems in Semiconductor Manufacturing Equipment.......... *[cited in I300I FGL Section 1.3]*

– **SEMI E49.5-0298 –** Guide for Ultrahigh Purity Solvent Distribution Systems in Semiconductor Manufacturing Equipment .... *[cited in I300I FGL Section 1.3]*

– **SEMI E49.9-0298 –** Guide for Ultrahigh Purity Gas Distribution Systems in Semiconductor Manufacturing Equipment... *[cited in I300I FGL Section 1.3]*

– **SEMI E51-0298 –** Guide for Typical Facilities Services and Termination Matrix .... *[cited in I300I FGL Section 1.3]*

– **SEMI E70-0698 –** Guide for Tool Accommodation Process *[cited in I300I FGL Section 1.3]*

– **SEMI E72-0699 –** Provisional Specification and Guide for 300 mm Equipment Footprint, Height, and Weight.. *[cited in I300I FGL Section 1.3]*

– **SEMI E73-0299 –** Specification for Vacuum Pump Interfaces – Dry Pump .... *[cited in I300I FGL Section 1.3]*

– **SEMI E74-0299 –** Specification for Vacuum Pump Interfaces – Turbomolecular Pump.......... .... *[cited in I300I FGL Section 1.3]*

– **SEMI E76-0299 –**Guide for 300 mm Process Tool Points of Connection to Facility Services. .... *[cited in I300I FGL Section 1.3]*

– **SEMI F49-0999 –** Specification for Semiconductor Processing Equipment Voltage SAG Immunity .... *[cited in I300I FGL Section 1.3]*

A.2 ISO Standards

Note: The most recently published version of this standard applies.

– **ISO 14644-1 –** Cleanrooms and Associated Controlled Environments – Part 1: Classification of Airborne Particulates.. *[cited in I300I FGL Sections 1.3, 2.7, 6.2]*

A.3 SEMI Draft Documents

Note: The following standardization activities are endorsed in principle as being required for 300 mm equipment. The referenced draft documents may be in different stages of development. Copies of the most recent draft documents known as ballots are available from SEMI to standards participants. Active participation in document development and ballot review is recommended.

– **SEMI Draft Document 2824A –** CIM Framework Material Movement Group... *[cited in I300I FGL Section 4.7]*

APPENDIX B
Cross Reference Factory Guidance (GL #) to FIMA Section

GL #	Title/Description	FIMA Section	Description
1	**Factory Productivity Guidelines**		
1.1	**Equipment Productivity and Performance**		
1.1.1	Relative Capital Cost	7.3.1	Inquiry regarding relative capital cost vs. 200 mm equipment
1.1.2	Availability	7.3.2	Inquiry regarding availability of production equipment (process and metrology)
1.1.2.1	Embedded Support of E10, E58, OEE & IEE	6.4.17	Inquiry regarding designed-in capacity to collect and analyze productivity performance
1.1.3	Installation and Qualification Cost	7.3.3	Inquiry regarding relative equipment installation and qualification costs to capital costs
1.1.4	Relative Installation and Qualification Duration	7.3.4	Inquiry regarding relative equipment installation and qualification duration compared to 200 mm equipment
1.1.5	Relative Maintenance and Spares Cost	7.3.5	Inquiry regarding relative equipment maintenance and spares cost compared to 200 mm equipment
1.1.6	Relative Consumable Cost	7.3.6	Inquiry regarding relative utilities (power, compressed air, exhaust) consumption compared to 200 mm equipment
1.1.7	Relative Monitor Wafer Usage	7.3.7	Inquiry regarding relative monitor wafer usage compared to 200 mm equipment
1.1.7.1	NPW Reduction - Advanced Process Control Support	6.4.12	Inquiry regarding support for advanced process control and in situ sensors
1.1.7.2	NPW Reduction – Use Inline Metrology to Analyze Wafer Test Sites & Communicate Data to Host	6.4.27	Inquiry related to the description of message structures and any associated data variables that may be present in streams and functions that provide test site results to the host system
1.1.7.3	NPW Reduction – Equipment Parameters Available to User Through Single Communication Link	6.4.28	Inquiry about process set points that are provided to the user console as well as alarmed set points for real time monitoring
1.1.7.4	NPW Reduction - Comm/Sensor Bus Compliance with one of the SEMI E54 Sensor Bus Communication Standards.	6.4.29	Inquiry regarding monitoring data communicated to the host system, E54 compliance, and the process that communicates equipment parameters to the host system via a single communication link
1.1.8	Relative Software Reliability	7.3.8	Inquiry regarding relative reliability compared to 200 mm equipment
1.1.9	3 Mm Edge Exclusion	6.4.1	Inquiry regarding edge exclusion
1.1.10	Wafer Notch Alignment	6.2.1	Equipment requirement to return wafers to same carrier, same slot
1.2	**Environmental, Safety, and Health**		
1.2.1	Comply 100% with S2 and S8	8.2.1	3rd party assessment of S2, S8, and CE Mark
1.2.1.1	All National and Local Codes Met	8.4.1	Inquiry regarding compliance to all national and local codes
1.2.1.2	SEMATECH Application Guide for SEMIS2 & S8	8.4.6	Usage of SEMI standards S2 and S8 during system development of facilities interfaces

GL #	Title/Description	FIMA Section	Description
1.2.2	Comply 100% to EU Directives	8.2.1	3rd party assessment of S2, S8, and CE Mark
1.2.3	Relative Noise Emissions Level	8.4.2	Inquiry regarding noise emissions assessment and compliance to S2
1.2.4	Relative HAPS Emissions	8.4.3	Inquiry regarding HAPS assessment
1.2.5	Relative PFC Emissions	8.4.4	Inquiry regarding PFCs assessment
1.2.6	Relative VOC Emissions	8.4.5	Inquiry regarding VOCs assessment
1.3	**Facilities Cost and Utilities Consumption**		
1.3.1	Relative Footprint Calculated per SEMI E72	9.3.4	Inquiry regarding relative footprint/productivity requirements
1.3.1.1	Support Equipment Footprint per SEMI E72	9.3.5	Inquiry regarding support equipment footprint requirements
1.3.1.2	Equipment height, floor loading, and move-in size per SEMI E72	9.3.3	Inquiry regarding equipment design to ceiling and OHT height restrictions
1.3.2	Facility Utilities per SEMI E51	9.3.7	Use of SEMI E51 during development of the facilities interfaces
1.3.2.1	Relative Utilities Consumption	7.3.11	Inquiry regarding relative utilities (power, water and process chemicals) consumption compared to 200 mm equipment
1.3.2.2	Relative Scrubbed Exhaust Requirement	7.3.12	Inquiry regarding relative scrubbed exhaust requirements compared to 200 mm equipment
1.3.2.3	Electrical Voltage Drop-Out Immunity	6.4.2	Inquiry regarding voltage drop-out immunity
1.3.2.4	Pressure Drop Immunity (Liquid and Gas)	6.4.3	Inquiry regarding pressure drop immunity
1.3.3	Cleanroom Class Compatibility	9.3.1	Inquiry regarding equipment compatibility with cleanrooms Class 5-6
1.3.3.1	Temperature and Humidity Compatibility	9.3.2	Inquiry regarding equipment compatibility with cleanroom temperature and humidity ranges
1.3.4	Relative Vibration Isolation	6.4.4	Inquiry regarding vibration isolation
1.3.5	Static Charge Dissipation	6.4.5	Inquiry regarding dissipation of ESC
1.3.6	Factory Accommodation Process	9.3.6	Inquiry regarding conformance to accommodation process of SEMI E70 and connection layout of SEMI PR2 and E6
1.3.6.1	Gas Delivery/Systems Requirements	6.4.8	Inquiry regarding configuration of internal gas delivery system, Inquiry regarding gas delivery system designed to SEMI E49.9
1.3.6.2	Liquid Systems Purity Requirements	6.4.9	Inquiry regarding configuration of internal chemical delivery system, Inquiry regarding liquid purity conformance to SEMI E49.5
1.3.6.3	Vacuum Pump Interface Standardization	6.4.10	Inquiry regarding standard interface for equipment support vacuum pumps, Inquiry regarding standardized interfaces for vacuum pump connections
1.4	**Wafer Traceability and Tracking**		
1.4.1	Slot-To-Slot Integrity	6.2.1	Equipment requirement to return wafers to same carrier, same slot

GL #	Title/Description	FIMA Section	Description
2.	**Elaboration of The Original I300I 14 Guidelines**		
2.1	**Carrier Capacity**		
2.1.1	13 Wafer Supports Early Implementation	4.1.2.1	300 mm FOUP compatibility with equipment base design
2.1.2	25 Wafer Supports Mass Production	4.1.2.1	300 mm FOUP compatibility with equipment base design
2.1.3	Cost Effective Conversion Requirement	4.1.4.1	Inquiry regarding cost-effectiveness
2.2	**Carrier Configuration for Wafer Handling**		
2.2.1	Horizontal Transfer/Storage Orientation	N/A	
2.2.2	Transport Carrier 10 mm Pitch	4.1.2.4	SEMI E15.1 load port functionality
2.2.3	Process Carrier Exception	6.4.7	Inquiry regarding internal wafer carrier characteristics
2.2.4	Kinematic Coupling Requirement	4.1.2.4 5.2.3	SEMI E15.1 load port functionality Buffer kinematic couplings compliance
2.3	**Carrier Type**		
2.3.1	FOUP Support Requirement	4.1.2.1	300 mm FOUP compatibility with equipment base design
2.3.2	Automatic Pod Opener Requirement	4.1.2.6	FIMS engagement -- FOUP door open/close
2.3.3	Interoperability Requirement	4.1.4.3	Inquiry regarding interoperability of load ports
2.3.4	Robotic Handling Flange for Pods	4.1.4.4	Inquiry regarding robotic handling flange
2.3.5	Human Handles Size and Space	4.1.2.5	SEMI E15.1 dimensions
2.3.6	Internal Carrier Responsibility	6.4.6	Inquiry regarding internal wafer carrier
2.4	**Load Port**		
2.4.1-3	Load Port	4.1.2.4	Load Port Features
2.4.1	SEMI E15.1 Compliance	4.1.2.5	SEMI E15.1 dimensions
2.4.1.1	Buffer Port Exception (Height)	4.1.2.3, 4.1.2.5	Permitted auxiliary load ports, SEMI E15.1 dimensions
2.4.2	Supports Pods and Open Cassette	N/A	
2.4.3	25 Wafer Base Design Requirement	4.1.2.1	300 mm FOUP compatibility with equipment base design
2.5	**Support for Overhead Transport**		
2.5.1	Floor Based and OHT System Compatible	4.2.2.1, 4.2.2.2	Equipment compatible with delivery systems
2.5.1.1	Both Delivery Systems Used Concurrently	4.2.2.1 4.2.4.1	Equipment compatible with delivery systems, Inquiry regarding concurrent but not simultaneous access to load ports
2.5.2	Vertical OHT Easement	4.2.2.1	Equipment compatible with delivery systems
2.5.3	Load Port E15.1 Overhead Clearance	4.2.2.1	Equipment compatible with delivery systems
2.5.4	Supplemental Buffer Load Ports	4.2.4.2	Inquiry regarding load ports on internal buffers

GL #	Title/Description	FIMA Section	Description
2.6	**Continuous Processing Using Buffering**		
2.6.1	Integral Buffer for Continuous Processing	5.4.1	Inquiry regarding design for continuous processing
2.6.1.1	Continuous Process Wafer Flow	5.4.3	Inquiry regarding wafer level continuous processing
2.6.1.2	Continuous Process Recipe Execution	5.4.4	Inquiry regarding recipe loading for continuous processing
2.6.1.3	Buffer Accommodates Non-Production Wafers	5.4.5	Inquiry regarding accommodation of all wafer types
2.6.2	Two E15.1 Load Port Minimum Buffer	4.1.2.2, 5.2.1	Inline/offline 300 mm equipment, Minimum Buffering
2.6.2.1	Each Load Port Meets FIMS Compliance Requirements	4.1.2.6, 5.2.2	FIMS -- FOUP door open/close, Internal equipment buffer
2.6.2.2	Load Lock Requirement	4.1.2.6	FIMS -- FOUP door open/close
2.6.3	Additional Buffering	5.4.2	Inquiry regarding large batch or high throughput equipment
2.6.3.1	Equipment Class Buffer Requirements	5.4.2	Inquiry regarding large batch or high throughput equipment
2.6.4	Inline vs. Offline Load Port Requirement	4.1.2.2	Inline/offline 300 mm equipment
2.6.5	Buffer Design Simple, Reliable and Small	5.2.4	Simple, Reliable Buffers
2.6.6	Buffer Size Basis Considerations	N/A	
2.6.7	Vertical Buffer Robust Recovery Support	5.4.9	Inquiry regarding buffer failure recovery capability
2.7	**Integrated Minienvironment**		
2.7.1	Equipment Must Be Minienvironment Ready	6.2.3	Integrated minienvironment
2.7.2	Beta Equipment Include Minienvironment	6.2.3	Integrated minienvironment ease of airflow adjustment
2.7.2.1	Pod Automatically Engages Front-Opening Interface	4.1.2.6 6.4.20	FIMS -- FOUP door open/close Minienvironment degradation.
2.7.2.2	Automatic Pod Open/Close Integrated	4.1.2.6	FIMS -- FOUP door open/close
2.7.3	Fab Ambient Condition Basis	N/A	
2.7.3.1	Factory Cleanliness Requirements	9.3.1	Inquiry regarding equipment compatibility with cleanrooms Class 5-6
2.7.3.2	Minienvironments Meet Process Needs	6.2.3	Minienvironment compatibility with the process environment
2.7.4	High Speed Recovery Capability	6.4.19	Inquiry to understand if minienvironment is designed for high speed recovery and able to attain processing levels of cleanliness within one minute after a down event
2.7.4.1	Minienvironment Availability Loss Definition	N/A	
2.7.5	Integrated Buffering Requires Minienvironment	N/A	
2.7.6	Filter Challenge Testing Limited to PSL Spheres	6.2.3	Usage of PSL spheres in filter challenge testing only
2.7.7	Minienvironment to Maintain Differential Pressure	6.4.21	The ability of the minienvironment design to maintain differential pressure during all static and operational equipment conditions

GL #	Title/Description	FIMA Section	Description
2.7.8	Effects of Exhausted Air	6.4.22	The exhaust function does not compromise minienvironment performance and the minienvironment function must not degrade exhaust system performance
2.7.9	Eliminate Aspiration to Factory	6.2.3	Smooth and well sealed component joints, connections, and corners
2.7.10	Constructed with Factory Compatible Materials	6.2.3	Usage of low outgassing materials and compounds
2.7.11	Dissipation of Electrostatic Charges Both Internal & External to the Equipment	6.4.23	Usage of dissipative materials, conductive materials and/or dissipative methods in the design of the minienvironment
2.7.12	Designed for Heat Dissipation	6.4.24	Design considerations for heat generated from minienvironment components, equipment processes, and equipment operation
2.7.13	Access Required for Test Probes	6.2.3	Presence of a port that allows for test measurement probes to be placed within the minienvironment
2.7.14	Lighting Required to Support Operation & Service	6.2.3	Compatibility and degradation of lighting required to support equipment operation and service during operation
2.7.15	Incorporation of Electrical Service within Tool	6.2.3	Assessment of fan/filter units and associated electrical services for the minienvironment
2.7.16	Noise and Vibration Must Meet Tool Specifications	6.4.4	Design considerations specifically controlling and isolating vibration
2.7.17	Include Physical Characteristics in Facilities Cost	9.3.7	Assessment of how size, height, and weight of the integrated minienvironment (including fan/filter units) affected the footprint, height, floor loading, and move-in size requirements for equipment
2.7.18	Designed for Ballroom & Bay/Chase Configuration	6.4.25	Assessment of the differences between the installation of a tool in a bay/chase configuration vs. that of a ballroom layout for minienvironment
2.7.19	ES&H Compliance and SEMI S11	8.2.2	Minienvironment compliance with SEMI S11 as well as all ES&H guidelines
2.7.20	Operational Status Indicators	6.4.26	Assessment of the means by which the minienvironment is monitored for operational status
2.7.21	Documentation for Operation and Maintenance	N/A	
2.7.22	Primary Equipment Responsibility as the Integrator	N/A	
2.8	**Slot/Carrier Integrity**		
2.8.1	Wafers Return to Same Slot, Same Carrier	6.2.1	Equipment requirement to return wafers to same carrier, same slot
2.8.2	Hardware & Software Support In Design	6.2.1	Equipment requirement to return wafers to same carrier, same slot
2.9	**Single-Side Load Ports**		
2.9.1	Primary Load Ports All on One Side	4.1.2.2	Inline/offline 300 mm equipment
2.9.2	Optional Exception Load Port	4.1.2.3	Permitted Auxiliary Load Ports
2.9.3	Optional Load Port PGV Compatible	4.1.2.3	Permitted Auxiliary Load Ports

GL #	Title/Description	FIMA Section	Description
2.10	**Straight-Line Alignment of Load Ports**		
2.10.1	Equipment Front Face Alignment	4.2.2.4	Equipment compatible with delivery systems
2.10.2	SEMI E15.1 “D” & “D1” Requirement	4.1.2.5	SEMI E15.1 dimensions
2.11	**Alternative User Interface Location**		
2.11.1	Primary User Interface Location	6.2.2	Primary and alternate user interface
2.11.2	Alternative User Interface Location/Function	6.2.2	Primary and alternate user interface
2.12	**Dense Packing of Equipment In The Factory**		
2.12.1	Maintenance Access Recommendation	5.2.4	Simple, reliable, and minimum footprint
2.12.2	Footprint Minimization	7.3.9	Inquiry regarding minimized footprint design
2.12.3	Width (Bay Length) Control	7.3.10	Inquiry regarding design to reduce width of equipment for efficient bay layout
2.12.4	Side-By-Side Installation Preferred	7.3.13	Inquiry regarding design for side-by-side installation and maintenance access requirements
2.12.5	Front Access Maintenance Limitation	5.2.4	Simple, reliable, and minimum footprint
2.12.6	Side Maintenance Access Minimized	7.3.14	Inquiry regarding minimizing side maintenance
2.13	**Communication Interfaces**		
2.13.1	Comply with SEMI SECS/GEM Standards	10.2.1	Single point of connection and link to host and SECS-II, GEM, HSMS compliance
2.13.2	HSMS Connectivity Required	10.2.1	Single point of connection and link to host and SECS-II, GEM, HSMS compliance
2.13.3	Parallel I/O Capability Required	4.2.2.3	Photocoupled interace.
2.13.3.1	E23 Synchronizes Load Port and AMHS	4.2.2.3	Photocoupled interface.
2.14	**Cart Docking Interface**		
2.14.1	PGV Docking Interface Required	4.2.2.2	Equipment compatible with delivery systems
2.14.2	PGV Automation Description	4.2.2.2	Equipment compatible with delivery systems
2.14.3	Semi-Automated Docking Allowed	4.2.2.2	Equipment compatible with delivery systems
3.	**Exception Lot Handling Guidelines**		
3.1	**Handling of Exception Lots**		
3.1.1	Exception Wafer Type Handling Requirement	6.4.11	Inquiry regarding type 1-5 exception wafer handling
3.1.2	Exception Lot Buffer Loading Requirement	4.1.4.2	Inquiry regarding loading and unloading of internal buffers and exception lots
3.1.2.1	Buffer Positions Used to Store FOUPs	5.4.7	Inquiry regarding use of buffer locations for exception wafers
3.1.3	Damaged Wafer FOUP Handling Requirement	6.4.13	Inquiry regarding handling of FOUPs with damaged wafers
3.1.5	AMHS Size Consideration	5.4.8	Inquiry regarding the use of buffers for exception lots
3.1.6	CIM Tracking Requirements	10.4.5	Inquiry regarding equipment designed to physically and logically track exception lots just like production lots

GL #	Title/Description	FIMA Section	Description
3.1.6.1	CIM System ID and/or Carrier ID	10.4.3	Inquiry regarding equipment capability to track and manage exception lots by assigned lot and/or carrier IDs
3.1.6.2	CIM System Wafer ID	4.1.2.4 10.4.4	SEMI E15.1 load ports functionality, Inquiry regarding equipment capability to track and manage exception wafers by assigned wafer IDs
3.1.6.3	FOUP ID Reader Requirement	4.1.2.4	SEMI E15.1 load port functionality
3.2	**Handling of FOUPs During Equipment and AMHS Failures**		
3.2.1.1	Operator Selectable Mode for Wafer Return	6.4.14	Inquiry regarding operator selectable modes for manual control during equipment failure
3.2.1.2	Reposition FOUP at Load Port	5.4.10 6.4.15	Inquiry regarding equipment failures and repositioning the FOUP at the load port, Inquiry regarding repositioning FOUPs at the load port pickup point
3.2.1.3	Buffer Local Mode Requirement	5.2.2, 6.4.16	Internal equipment buffer, Inquiry regarding equipment with internal buffers support of maintenance mode
3.2.2	AMHS Failure Expectations	N/A	
4.	**CIM Guidelines**		
4.1	**CIM - Production Equipment Guidelines**		
4.1.1	Single Communication Link	10.2.1	Single point of connection and link to host and SECS-II, GEM, HSMS compliance
4.1.2	Compliance to Communication Standards	10.2.1	Single point of connection and link to host and SECS-II, GEM, HSMS compliance
4.1.3	Utilization and Reliability Management	10.4.7	Inquiry regarding equipment being able to communicate utilization and reliability date to the host
4.1.4	Reliable Data Collection	10.4.9	Reliable data collection.
4.1.5	Variable Parameter Support	10.4.10	Variable parameter support.
4.1.6	Fault Free Date Transitions (Year 2000)	10.4.8	Fault Free processing of year 2000 dates
4.2	**CIM - Load Port Guidelines**		
4.2.1	Bi-directional Load Port	4.1.2.4	SEMI E15.1 load ports functionality
4.2.2	Interface; Equipment to AMHS	4.2.2.3	Photocoupled interace.
4.2.3	Carrier Hand-Off Interface Enhancement	10.4.11	Inquiry about hand-off communication.
4.2.4	PGV Docking Standard	10.4.12	PGV tests performed showing compliance.
4.2.5	Carrier Sensors at E15.1 Load Port	4.1.2.4	SEMI E15.1 load ports functionality
4.2.6	Carrier ID Reader at E15.1 Load Port	4.1.2.4	SEMI E15.1 load ports functionality
4.2.7	Carrier ID Reader for Internal Buffer Equipment	5.2.3	Buffer Kinematic Coupling Compliance
4.2.8	Carrier ID Reader for Fixed Buffer Equipment	10.4.13	ID reader support and test data.
4.2.9	Load Port Backward Compatibility	10.4.14	Design for backward compatibility.

GL #	Title/Description	FIMA Section	Description
4.3	**CIM - Production Equipment Material Handling Guidelines**		
4.3.1	Exclusive Access Mode and Mode Change Timing	10.4.15	Inquiry about the rejection of all access requests except one.
4.3.2	Equivalent Handshaking for Carrier Hand-Off	10.4.16	Access mode switching.
4.3.3	Simultaneous OHT/PGV Interlock	10.4.1	Inquiry regarding software interlock between OHT and PGV access to load ports
4.3.4	Independent Control of Material Handling and Wafer Processing	10.4.17	Continuous processing transparent to operation of material handling (both manual and automatic).
4.3.5	Processing Order Control for Equipment Buffer	10.4.18	Tracking of buffer lots for possible priority change.
4.3.6	Carrier Transfer Control of Internal Buffer Equipment	10.4.19	Host control of carrier movement.
4.3.7	Internal Buffer Capacity Notification	10.4.20	Inquiry regarding buffer capacity changes and SECS-II.
4.3.8	FOUP Open and Close Control	10.4.21	Inquiry about FOUP open/close notification to host.
4.4	**CIM - Production Equipment Material Management Guidelines**		
4.4.1	Slot Number and Load Port Numbering	6.4.18	Inquiry regarding carrier slot and load port numbering
4.4.2	Empty Carrier Management	5.4.6 10.4.6	Inquiry regarding handling of empty carriers, Inquiry regarding equipment responsibility to manage all FOUPs at the equipment
4.4.3	Carrier Slot Verification	10.4.22	Inquiry regarding methods of carrier slot verification.
4.4.4	Host Control of Wafer Process Order	10.4.23	Inquiry about host control and job management.
4.4.5	Wafer Slot and Carrier Integrity	6.2.1	Equipment requirement to return wafers to same carrier, same slot
4.4.6	Additional Wafer Control After Processing or Measurement	10.4.24	Inquiry surrounding the possible FOUP destinations for wafers from single wafer tools.
4.4.7	Multi-Module Wafer Tracking Events	10.4.25	Inquiry about SECS-II messages used to single track wafers through multiple modular tools.
4.5	**CIM - Production Equipment Single Wafer Control Guidelines**		
4.5.1	Recipe and Variable Parameter Change Between Wafers	10.4.26	Inquiry about variable parameter change capabilities within a tool.
4.5.2	Process Parameter Change Between Wafers	10.4.27	Inquiry regarding recipe changes between wafers.
4.6	**CIM - AMHS Equipment Guidelines**		
4.6.1	Interoperable AMHS Equipment	10.4.2	Inquiry regarding communicating with AMHS equipment
4.6.2	AMHS Framework	10.4.28	Inquiry about standards compliance and integration of MCS software.

APPENDIX C
Cross Reference FIMA Section to Factory Guidance (GL #)

FIMA Section	Title/Description	GL #	Description
4.1	**Load Port Assessment**		
4.1.2	**Load Port Physical Testing**		
4.1.2.1	FOUP Compatibility	2.1.1	13 Wafer Supports Early Implementation
		2.1.2	25 Wafer Supports Mass Production
		2.3.1	FOUP Support Requirement
		2.4.3	25 Wafer Base Design Requirement
4.1.2.2	Minimum Load Port Requirements	2.6.2	Two E15.1 Load Port Minimum Buffer
		2.6.4	Inline vs. Offline Load Port Requirement
		2.9.1	Primary Load Ports All on One Side
4.1.2.3	Permitted Auxiliary Load Ports	2.4.1.1	Buffer Port Exception (Height)
		2.9.2	Optional Exception Load Port
		2.9.3	Optional Load Port PGV Compatible
4.1.2.4	Load Port Features	2.2.2	Transport Carrier 10 mm Pitch
		2.2.4	Kinematic Coupling Requirement
		2.4	Compliance With SEMI E15.1 Load Port and SEMI E62 FIMS Interface
		3.1.6.2	CIM System Wafer ID
		3.1.6.3	FOUP ID Reader Requirement
		4.2.1	Bi-directional Load Port
		4.2.5	Carrier Sensors at E15.1 Load Port
		4.2.6	Carrier ID Reader at E15.1 Load Port
4.1.2.5	SEMI E15.1 Compliance	2.3.5	Human Handles Size and Space
		2.4.1	SEMI E15.1 Compliance
		2.4.1.1	Buffer Port Exception (Height)
		2.10.2	SEMI E15.1 “D” & “D1” Requirement
4.1.2.6	FIMS Compliance	2.3.2	Automatic Pod Opener Requirement
		2.6.2.1	Each Load Port Meets FIMS
		2.6.2.2	Load Lock Requirement
		2.7.2.1	Pod Automatically Engages Front-Opening Interface
		2.7.2.2	Automatic Pod Open/Close Integrated
4.1.4	**Load Port Intelligent Inquiry**		
4.1.4.1	Inquiry regarding cost-effectiveness	2.1.3	Cost Effective Conversion Requirement
4.1.4.2	Inquiry regarding internal buffers and exception lots	3.1.2	Exception Lot Buffer Loading Requirement
4.1.4.3	Inquiry regarding interoperability	2.3.3	Interoperability Requirement
4.1.4.4	Inquiry regarding pod handling flange	2.3.4	Robotic Handling Flange for Pods

FIMA Section	Title/Description	GL #	Description
4.2	**Interfaces for Material Delivery**		
4.2.2	**Material Delivery Interfaces Physical Testing**		
4.2.2.1	OHT Exclusion Zone	2.5.1	Floor Based and OHT System Compatible
		2.5.1.1	Both Delivery Systems Used Concurrently
		2.5.2	Vertical OHT Easement
		2.5.3	Load Port E15.1 Overhead Clearance
4.2.2.2	Cart Docking Interface	2.5.1	Floor Based and OHT System Compatible
		2.14.1	PGV Docking Interface Required
		2.14.2	PGV Automation Description
		2.14.3	Semi-Automated Docking Allowed
4.2.2.3	Photocoupled Interface	2.13.3	Parallel I/O Capability Required
		2.13.3.1	Synchronized Intrabay AMHS Vehicle and Load Port Communication
		4.2.2	Interface; Equipment to AMHS
4.2.2.4	AMHS Installation Alignment	2.10.1	Equipment Alignment
4.2.4	**Material Delivery Interfaces Intelligent Inquiry**		
4.2.4.1	Inquiry regarding concurrent but not simultaneous access to load ports	2.5.1.1	Both Delivery Systems Used Concurrently
4.2.4.2	Inquiry regarding load ports on internal buffers	2.5.4	Supplemental Buffer Load Ports
5	**Buffering**		
5.2	**Buffering Physical Testing**		
5.2.1	Requirement for Buffering	2.6.2	Two E15.1 Load Port Minimum Buffer
5.2.2	Buffer FIMS Compliance	2.6.2.1	Each Load Port Meets FIMS
		3.2.1.3	Buffer Local Mode Requirement
5.2.3	Buffer Kinematic Couplings Compliance	2.2.4	Kinematic Coupling Requirement
		4.2.7	Carrier ID Reader for Internal Buffer Requirement
5.2.4	Simple, Reliable Buffers	2.6.5	Buffer Design Simple, Reliable and Small
		2.12.1	Maintenance Access Recommendation
		2.12.5	Front Access Maintenance Limitation
5.4	**Buffering Intelligent Inquiry**		
5.4.1	Inquiry regarding design for continuous processing	2.6.1	Integral Buffer for Continuous Processing
5.4.2	Inquiry regarding large batch or high throughput equipment	2.6.3	Additional Buffering
		2.6.3.1	Equipment Class Buffer Requirements
5.4.3	Inquiry regarding wafer level continuous processing	2.6.1.1	Continuous Process Wafer Flow
5.4.4	Inquiry regarding recipe loading for continuous processing	2.6.1.2	Continuous Process Recipe Execution
5.4.5	Inquiry regarding accommodation of all wafer types	2.6.1.3	Buffer Accommodates Non-Production Wafers
5.4.6	Inquiry regarding handling of empty carriers	4.4.2	Empty Carrier Management

FIMA Section	Title/Description	GL #	Description
5.4.7	Inquiry regarding use of buffer locations for exception lots	3.1.2.1	Buffer Positions Used to Store Foups
5.4.8	Inquiry regarding design consideration for internal equipment buffers	3.1.5	AMHS Size Consideration
5.4.9	Inquiry regarding buffer failure recovery capability	2.6.7	Vertical Buffer Robust Recovery Support
5.4.10	Inquiry regarding equipment failures and repositioning the FOUP at the load port	3.2.1.2	Reposition FOUP at Load Port
6	**Equipment Capability Requirements**		
6.2	**Equipment Capability Requirement Physical Testing**		
6.2.1	Slot and Carrier Integrity and Alignment	1.1.10	Wafer Notch Alignment
		1.4.1	Slot-to-Slot Integrity
		2.8.1	Wafers Return to Same Slot, Same Carrier
		2.8.2	Hardware & Software Support In Design
		4.4.5	Slot and Carrier Integrity
6.2.2	User Interface	2.11.1	Primary User Interface Location
		2.11.2	Alternative User Interface Location/Function
6.2.3	Minienvironments	2.7.1	Equipment Must Be Minienvironment Ready
		2.7.2	Beta Equipment Include Minienvironment
		2.7.3.2	Minienvironment Must Be Compatible with Process Needs
		2.7.6	Filter Challenge Testing Limited to PSL Spheres
		2.7.9	Eliminate Aspiration to Factory
		2.7.10	Constructed with Factory Compatible Materials
		2.7.13	Access Required for Test Probes
		2.7.14	Lighting Required to Support Operation & Service
		2.7.15	Incorporation of Electrical Service within Tool
6.4	**Equipment Capability Requirement Intelligent Inquiry**		
6.4.1	Inquiry regarding edge exclusion	1.1.9	3 Mm Edge Exclusion
6.4.2	Inquiry regarding voltage drop-out immunity	1.3.2.3	Electrical Voltage Drop-Out Immunity
6.4.3	Inquiry regarding pressure drop immunity	1.3.2.4	Pressure Drop Immunity (Liquid and Gas)
6.4.4	Inquiry regarding vibration isolation	1.3.4	Relative Vibration Isolation
		2.7.16	Noise and Vibration Must Meet Tool Specifications
6.4.5	Inquiry regarding dissipation of ESC	1.3.5	Static Charge Dissipation
6.4.6	Inquiry regarding internal wafer carrier	2.3.6	Internal Carrier Responsibility
6.4.7	Inquiry regarding internal wafer carrier characteristics	2.2.3	Process Carrier Exception
6.4.8	Inquiry regarding configuration of internal gas delivery system	1.3.6.1	Gas Delivery/Systems Requirements
6.4.9	Inquiry regarding configuration of internal chemical delivery system	1.3.6.2	Liquid Systems Purity Requirements
6.4.10	Inquiry regarding standard interface for equipment support vacuum pumps	1.3.6.3	Vacuum Pump Interface Standardization

FIMA Section	Title/Description	GL #	Description
6.4.11	Inquiry regarding handling of exception wafer types 1-5	3.1.1	Exception Wafer Type Handling Requirement
6.4.12	Inquiry regarding support for advanced process control and in situ sensors	1.1.7.1	Advanced Process Control Support
6.4.13	Inquiry regarding handling of FOUPs with damaged wafers	3.1.3	Damaged Wafer FOUP Handling Requirement
6.4.14	Inquiry regarding operator selectable modes for manual control during equipment failure	3.2.1.1	Operator Selectable Mode for Wafer Return
6.4.15	Inquiry regarding repositioning FOUPs at the load port pickup point	3.2.1.2	Reposition FOUP at Load Port
6.4.16	Inquiry regarding equipment with internal buffers support of maintenance mode	3.2.1.3	Buffer Local Mode Requirement
6.4.17	Inquiry regarding designed in capacity to collect and analyze productivity performance	1.1.2.1	Embedded Support of E10, E58, OEE & IEE
6.4.18	Inquiry regarding carrier slot and load port numbering	4.4.1	Slot Number and Load Port Numbering
6.4.19	Inquiry regarding minienvironment capability for high speed recovery	2.7.4	Minienvironment High Speed Recovery
6.4.20	Assessment of minienvironment degradation	2.7.2.1	Pod Automatically Engages Front-Opening Interface
6.4.21	Minienvironment designs must maintain differential pressure during all static and operational equipment conditions	2.7.7	Minienvironment to Maintain Differential Pressure
6.4.22	The exhaust function does not compromise minienvironment performance and the minienvironment function must not degrade exhaust system performance	2.7.8	Effects of Exhausted Air
6.4.23	Usage of dissipative materials, conductive materials and/or dissipative methods in the design of the minienvironment	2.7.11	Dissipation of Electrostatic Charges Both Internal & External to the Equipment
6.4.24	Design considerations for heat generated from minienvironment components, equipment processes, and equipment operation	2.7.12	Designed for Heat Dissipation
6.4.25	Assessment of the differences between the installation of a tool in a bay/chase configuration vs. that of a ballroom layout for minienvironment	2.7.18	Designed for Ballroom & Bay/Chase Configuration
6.4.26	Assessment of the means by which the minienvironment is monitored for operational status	2.7.20	Operational Status Indicators
6.4.27	Inquiry related to the use of data from product wafer test sites and how results are provided to the host system	1.1.7.2	NPW Reduction – Use Inline Metrology to Analyze Wafer Test Sites & Communicate Data to Host
6.4.28	Inquiry about process data and parameters that are supplied to the host system to support equipment self-diagnosis	1.1.7.3	NPW Reduction – Equipment Parameters Available to User Through Single Communication Link
6.4.29	Inquiry process that communicates equipment parameters to the host system via a single communication link	1.1.7.4	NPW Reduction - Comm/Sensor Bus Compliance with one of the SEMI E54 Sensor Bus Communication Standards

FIMA Section	Title/Description	GL #	Description
7	**Productivity**		
7.3	**Productivity Intelligent Inquiry**		
7.3.1	Data collection regarding relative capital cost vs. 200 mm equipment	1.1.1	Relative Capital Cost
7.3.2	Data collection regarding availability of production equipment (process and metrology)	1.1.2	Availability
7.3.3	Data collection regarding relative equipment installation and qualification costs to capital costs	1.1.3	Installation and Qualification Cost
7.3.4	Data collection regarding relative equipment installation and qualification duration compared to 200 mm equipment	1.1.4	Relative Installation and Qualification Duration
7.3.5	Data collection regarding relative equipment maintenance and spares cost compared to 200 mm equipment	1.1.5	Relative Maintenance and Spares Cost
7.3.6	Data collection regarding relative utilities (power, compressed air, exhaust) consumption compare to 200 mm equipment	1.1.6	Relative Consumable Cost
7.3.7	Data collection regarding relative monitor wafer usage compared to 200 mm equipment	1.1.7	Relative Monitor Wafer Usage
7.3.8	Data collection regarding relative reliability compared to 200 mm equipment	1.1.8	Relative Software Reliability
7.3.9	Inquiry regarding minimized footprint design	2.12.2	Footprint Minimization
7.3.10	Inquiry regarding design to reduce width of equipment for efficient bay layout	2.12.3	Width (Bay Length) Control
7.3.11	Data collection regarding relative utilities (power, water and process chemicals) consumption compared to 200 mm equipment	1.3.2.1	Relative Utilities Consumption
7.3.12	Data collection regarding relative scrubbed exhaust requirements compared to 200 mm equipment	1.3.2.2	Relative Scrubbed Exhaust Requirement
7.3.13	Inquiry regarding design for side-by-side installation and maintenance access requirements	2.12.4	Side-By-Side Installation Preferred
7.3.14	Inquiry regarding minimizing side maintenance	2.12.6	Side Maintenance Access Minimized
8	**Environmental, Safety, and Health**		
8.2	**Environmental, Safety, and Health Physical Testing**		
8.2.1	3rd party assessment of S2, S8, and CE Mark	1.2.1	Comply 100% with S2 and S8
		1.2.2	Comply 100% to European Union (EU) Directives
8.2.2	Minienvironment compliance with SEMI S11 as well as all ES&H guidelines	2.7.19	ES&H Compliance and SEMI S11
8.4	**Environmental, Safety, and Health Intelligent Inquiry**		
8.4.1	Inquiry regarding compliance to all national and local codes	1.2.1.1	All National and Local Codes Met
8.4.2	Data collection regarding noise emissions assessment and compliance to S2	1.2.3	Relative Noise Emissions Level
8.4.3	Data collection regarding HAPS assessment	1.2.4	Relative HAPS Emissions
8.4.4	Data collection regarding PFCs assessment	1.2.5	Relative PFC Emissions

FIMA Section	Title/Description	GL #	Description
8.4.5	Data collection regarding VOCs assessment	1.2.6	Relative VOC Emissions
8.4.6	Usage of SEMI standards S2 and S8 during system development of facilities interfaces	1.2.1.2	SEMATECH Application Guide for SEMI S2 & S8
9	**Facilities Interfaces**		
9.3	**Facilities Interfaces Intelligent Inquiry**		
9.3.1	Inquiry regarding equipment compatibility with cleanrooms Class 5-6	1.3.3	Cleanroom Class Compatibility
		2.7.3.1	Factory Cleanliness Requirements
9.3.2	Inquiry regarding equipment compatibility with cleanroom temperature and humidity ranges	1.3.3.1	Temperature and Humidity Compatibility
9.3.3	Inquiry regarding equipment design to ceiling and OHT height restrictions	1.3.1.2	Equipment Height that Affects Ceiling Height
9.3.4	Inquiry regarding relative footprint/productivity requirements	1.3.1	Relative Footprint
9.3.5	Inquiry regarding support equipment footprint requirements	1.3.1.1	Support Equipment Footprint
9.3.6	Inquiry regarding conformance to accommodation process of SEMI E70 and connection layout of SEMI PR2 and E6	1.3.6	Factory Accommodation Process
9.3.7	Inquiry on how size, height, and weight of the integrated minienvironment (including fan/filter units) affected the footprint, height, floor loading, and move-in size requirements for equipment	2.7.17	Include Physical Characteristics in Facilities Cost
9.3.7	Use of SEMI E51 during development of the facilities interfaces	1.3.2	Facility Utilities per SEMI E51
10.	**Equipment Communication Interfaces**		
10.2	**Equipment Communication Interfaces Physical Testing**		
10.2.1	Communications Interface	2.13.1	Comply with SEMI SECS/GEM Standards
		2.13.2	HSMS Connectivity Required
		4.1.1	Single Communication Link
		4.1.2	Compliance to Communication Standards
10.4	**Equipment Communication Interfaces Intelligent Inquiry**		
10.4.1	Inquiry regarding software interlock between OHT and PGV access to load ports	4.3.3	Simultaneous OHT/PGV Interlock
10.4.2	Inquiry regarding communicating with AMHS equipment	4.6.1	Interoperable AMHS Equipment
10.4.3	Inquiry regarding equipment capability to track and manage exception lots by assigned lot and/or carrier IDs	3.1.6.1	CIM System ID and/or Carrier ID
10.4.4	Inquiry regarding equipment capability to track and manage exception wafers by assigned wafer IDs	3.1.6.2	CIM System Wafer ID
10.4.5	Inquiry regarding equipment designed to physically and logically track exception lots just like production lots	3.1.6	CIM Tracking Requirements

FIMA Section	Title/Description	GL #	Description
10.4.6	Inquiry regarding equipment responsibility to manage all FOUPs at the equipment	4.4.2	Empty Carrier Management
10.4.7	Inquiry regarding equipment being able to communicate utilization and reliability date to the host	4.1.3	Utilization and Reliability Management
10.4.8	Inquiry regarding equipment capability for fault-free date transitions	4.1.6	Fault-Free Date Transitions
10.4.9	Inquiry regarding time stamping of data collection	4.1.4	Reliable Data Collection
10.4.10	Inquiry regarding variable parameters set by the host or operator	4.1.5	Variable Parameter Support
10.4.11	Inquiry regarding allowances for both continuous and simultaneous hand-off of up to two carriers at load ports	4.2.3	Carrier Hand-Off Interface Enhancement
10.4.12	Questions that address mechanical docking at any standard compliant load port through a standard PGV docking interface	4.2.4	PGV Docking Standard
10.4.13	Inquiry about the position of the carrier ID reader dependent upon reader technology	4.2.8	Carrier ID Reader for Fixed Buffer Equipment
10.4.14	Inquiry about the minimization of load port spares in 300 mm factories	4.2.9	Load Port Backward Compatibility
10.4.15	Inquiry as to how a tool allows for only one access mode to be accepted during normal production runs	4.3.1	Exclusive Access Mode and Mode Change Timing
10.4.16	Questions about switching between manual access mode and automatic access mode	4.3.2	Equivalent Handshaking for Carrier Hand-Off
10.4.17	Inquiry that addresses the support of automated and manual material handling interactions independent of wafer processing and measurement operations	4.3.4	Independent Control of Material Handling and Wafer Processing
10.4.18	Inquiry about the ability to set and change the processing order as directed by the host from the operator interface	4.3.5	Processing Order Control for Equipment Buffer
10.4.19	Inquiry regarding the support of standard carrier handling commands by the equipment	4.3.6	Carrier Transfer Control of Internal Buffer Equipment
10.4.20	Inquiry about how the host is notified of capacity changes	4.3.7	Internal Buffer Capacity Notification
10.4.21	Query surrounding notification of FOUP status to the host	4.3.8	FOUP Open and Close Control
10.4.22	Questions regarding how a tool verifies open or occupied slots in a FOUP	4.4.3	Carrier Slot Verification
10.4.23	Inquiry about how equipment supports host control of wafer process orders	4.4.4	Host Control of Wafer Process Order
10.4.24	Inquiry about the methods that equipment uses to support additional wafer control after processing or measurement	4.4.6	Additional Wafer Control After Processing or Measurement
10.4.25	Inquiry regarding the methods that equipment uses to track multi-module single wafer processing	4.4.7	Multi-Module Wafer Tracking Events

FIMA Section	Title/Description	GL #	Description
10.4.26	Questions on how equipment supports both recipe changes or variable parameter changes between wafers	4.5.1	Recipe and Variable Parameter Change Between Wafers
10.4.27	Questions that address how equipment supports runtime variable parameter modification by host	4.5.2	Process Parameter Change Between Wafers
10.4.28	Inquiry regarding the integration of AMHS system with equipment controllers	4.6.2	AMHS Framework

APPENDIX D
Acronyms

The acronyms used in this document are defined below.

Acronym	Definition
AGV	Automatic Guided Vehicle
FIMA	Factory Integration Maturity Assessment
FIMS	Front Opening Interface Mechanical Standard
FOSB	Front Opening Shipping Box
FOUP	Front Opening Unified Pod
HAP	Hazardous Air Pollutant
I/O	Input/Output
OHT	Overhead Hoist Transport
PFC	Perflourocarbon
POU	Point-of-use
PGV	Person Guided Vehicles
RSP	Reticle SMIF Pod
SEMI	Semiconductor Equipment and Materials International
SMIF	Integrated Standard Mechanical Interface
U/I	User Interface
UPW	Ultra Pure Water
VOC	Volatile Organic Compound

APPENDIX E
Glossary

The terms used in this document are defined below.

Term	Definition
Bilateral datum plane	A vertical plane that bisects the wafers and that is perpendicular to both the horizontal and facial datum planes. See Figure 9 and Figure 17, Datum Point Reference.
Buffer	Physical FOUP storage locations on the process or metrology equipment, where the next lot(s) to be processed wait while the current lot(s) are processed.
Chimney exclusion zone	A SEMI defined exclusion zone, or volume, above the load port that ensures the capability of loading from overhead systems.
Exclusion zone	A volume of “air” that no part of the equipment can enter in any way.
Equipment boundary	The outermost part of the equipment defines the equipment boundary. For example, if a button or user interface screen protrudes from the panel of the equipment, the equipment boundary is defined by an invisible plane at the edge of the protrusion and is not physically realized as a surface.
Horizontal datum plane	A horizontal plane from which projects the kinematic coupling pins on which the FOUP sits. On equipment load ports, it is at the load height specified in SEMI E15 and might not be physically realized as a surface.
Kinematic coupling	A registering mechanism commonly employed in 300 mm equipment, consisting of three pins and corresponding mating surfaces that provide an order of magnitude improvement in wafer registration and placement accuracy compared to the traditional H-bar in 200 mm.
Load Port	A defined location on the process and metrology equipment, located at the front of the equipment, where the FOUP is loaded for processing or unloaded from after processing is complete.
Load face plane	The load face plane is defined as the furthest physical vertical boundary plane from the FOUP centroid (marked on fixture) on the front of the equipment.
Minienvironment	In a factory-employing minienvironment, only the wafer processing zone and its closest vicinity is kept very clean, while the other areas are sealed off and allowed to remain at Class 100 or worse.

Term	Definition
Photocoupled interface or I/O	Low level communications handshake between the equipment load ports and intrabay robots. This interface permits the safe exchange and transfer of FOUPs between load ports and intrabay robots.
Uni-Cassette	A term first originated in 200 mm, signifying the capability of the process or metrology equipment to return wafers to the same slot of the same carrier after processing. Such a capability greatly improves cascading ability and improves the effective run rate of the equipment.

APPENDIX F
Minienvironment Parametric Test Methods

F.1 Purpose of the Assessment

This assessment is to determine the performance capabilities of the integrated minienvironment in meeting the I300I requirements stated in Guideline 7 and the guideline elaboration statements.

Since, each IC manufacturer will have different criteria for the minienvironment, this assessment plan will determine the characteristics of the minienvironment and report the characteristics in a standard format. SEMI E44-96 is to be used as the standard report format for data.

F.2 Instrumentation/Tools/Prerequisites

F.2.1 Instrumentation/Tools

1. Airborne Particulate – Met One laser particle counter or equivalent. Sensitivity of 0.1 µm and a counting efficiency of at least 90%.
2. Pressure/Velocity – Shortridge ADM-870, Solomat MPM 4000, or equivalent.
3. Metric tape measure.
4. Set of metric feeler gauges.

F.2.2 Supplies

1. One 25-wafer FOUP.

F.2.3 Prerequisite/Reference Material

1. Plan diagram of equipment (three copies – designating wafer stop/pause locations, doors/access points, filter coverage).
2. ISO 14644-1 Cleanrooms and associated controlled environments.
3. SEMI E14 Measurement of Particle Contamination Contributed to the Product from the Process or Support Tool.
4. SEMI E44-96 Guide for Procurement and Acceptance of Mini-environments.
5. Detailed FIMA Guideline Conformance Procedure (Document 3).

F.3 Setup Procedures

F.3.1 Inspection at Equipment Supplier (non-clean room)

1. Equipment must have an operational loadport, wafer handler, fan/filter unit, exhaust units (if applicable).
2. The equipment should be on a raised floor. Indicate in Table 2 of SEMI E44, the test conditions. (Unknown how much influence a solid floor will have on testing - differential pressure, air flow, etc.)

F.3.2 Inspection in a Clean Room Facility

1. Equipment must have an operational loadport, wafer handler, fan/filter unit, exhaust units.
2. The equipment installed and in operation as per manufacturing use. Indicate in Table 2 of SEMI E44, the test conditions.

F.3.3 Documentation

For either setup, document all wafer stop/pause locations during wafer handling operations such as:

1. Extracted from FOUP #1 through 'N' (at each FIMS)
2. Notch finder
3. Wafer ID reader
4. Placement into internal equipment cassette
5. XY Stage
6. Process Chamber
7. Cool down
8. Internal wafer buffer

Also document each enclosure opening which requires daily opening for operation or maintenance (reference Table 15 of SEMI E44).

F.4 Test Procedures

F.4.1 Visual Inspection

Table F-1 Visual Inspection

Test	Guideline Reference	Definition	Tool	SEMI E44 Table	Result
		Verify equipment can engage a FOUP.	Visual	N/A	**[P] [F]**
		Check FIMS and FOUP interface for gaps. Indicate seal/gasket information in SEMI E44 Table 16. Criteria: Gaps should be < 0.5 mm.	Visual	Table 16	**[P] [F]**
		Verify that the FOUP does not lift off kinematic pins as it engages the FIMS door seal.	Visual	N/A	**[P] [F]**
		Verify FIMS is operational. Indicate automated I/O Information in SEMI E44 Table 17.	Visual	Table 17	**[P] [F]**
		Verify minienvironment coverage for all exposed wafer areas.	Visual	N/A	**[P] [F]**
		Verify that FOUP storage (internal buffer) and internal exposed wafer movement areas do not share the same environment.	Visual	N/A	**[P] [F]**

Test	Guideline Reference	Definition	Tool	SEMI E44 Table	Result
		Check frame and panel surfaces for finish integrity, smoothness, scratches and defects. Record information in SEMI E44 Tables 13 and 14	Visual	Tables 13 and 14	**[P] [F]**
		Verify materials used for wall and frame. Record information in SEMI E44 Tables 13 and 14.	Visual	Tables 13 and 14	**[P] [F]**
		Verify that no bare metal surfaces exist in the minienvironment. All surfaces shall be anodized, stainless or painted using powder coat paint.	Visual	Tables 13 and 14	**[P] [F]**
		Check component joints, connections and corners for strength, integrity, tightness and smoothness. Record information in SEMI E44 Table 16.	Visual	Table 16	**[P] [F]**
		Check operation of seals on doors, hinges, latches and removable panels. Record information in SEMI E44 Table 15	Visual	Table 15	**[P] [F]**
		Verify operation and ease of adjustment of relief Grilles (diffusers) and baffles (dampers) for Adjusting air balance and pressurization. Record information in SEMI E44 Table 15.	Visual	Table 15	**[P] [F]**
		Verify maintenance accessibility, fan-motor and equipment interference. Record information in SEMI E44 Table 15.	Visual	Table 15	**[P] [F]**
		Verify minienvironment dimensions. Record information in SEMI E44 Table 1. Criteria: Dimensions - must be no larger than and included in the equipment footprint. Height - Cannot exceed 3500 mm (Reference SEMI PR1 (Doc 2708))	Visual	Table 1	**[P] [F]**
		Verify enclosure lighting meets requirements for the specific piece of equipment. Record information in SEMI E44 Table 23 as “Others”.	Tape Measure	Table 23	**[P] [F]**
		Verify that electrical services for the Minienvironment fan/filter units are incorporated in the equipment electrical service and are not separate.	Visual	N/A	**[P] [F]**
		Verify filter documentation. Record type and certification in SEMI E44 Table 11. Criteria: Efficiency of filter = 99.99995% at 0.1 µm particle size and the MPPS	Documentation	Table 11	**[P] [F]**

Test	Guideline Reference	Definition	Tool	SEMI E44 Table	Result
		Verify filter media is solvent and acid resistant and low boron, or boron free such as PTFE.	Documentation	N/A	**[P] [F]**
		Verify that filter challenge testing did not use DOP or Mineral Oil	Documentation	N/A	**[P] [F]**
		Verify fan documentation. Record type and certification in SEMI E44 Table 12. Indicate if variable speed control in "Others".	Documentation	Table 12	**[P] [F]**
		Inspect and indicate any self-measurement or Control systems in SEMI E44 Table 19.	Documentation	Table 19	**[P] [F]**
		Indicate the existence of any differential pressure visual indicators on the equipment.	Documentation	Table 19	**[P] [F]**

F.4.2 Air Velocity and Adjustability

1. Using the Shortridge or equivalent, measure the air velocity over the center of the wafer handler, holding the probe at the wafer level for a minimum of 5 seconds. Measure the location 3 times.
2. Set the velocity adjustment to High setting. Record measurements.
3. Set the velocity adjustment to Low setting. Record measurements.
4. Record values for Velocity in Table 10 of SEMI E44.

M/E Air Velocity Range	High Velocity (FPM)	Low Velocity (FPM)
Test #1		
Test #2		
Test #3		
Average (Sum/3)		
Criteria	90 ft/min ±10 %	40 ft/min ±10 %

For tools with exhaust systems, the following additional testing is required.

Complete the following matrix by setting the M/E air velocity and exhaust system accordingly. Record the values for Air Velocity in the table.

Criteria: With the exhaust system at the min and max settings, the measured minienvironment air velocity should be adjustable to the following values.

M/E @ High Velocity Setting	M/E Air Velocity Measurement	Air Velocity Criteria (FPM)
Exhaust @ Maximum Setting		90 ±10 %
Exhaust @ Minimum Setting		90 ±10 %

M/E @ Low Velocity Setting	M/E Air Velocity Measurement	Air Velocity Criteria (FPM)
Exhaust @ Maximum Setting		40 ±10 %
Exhaust @ Minimum Setting		40 ±10 %

F.4.3 Static Pressure

1. Using the Shortridge or equivalent, place a low pressure sensor outside of the equipment minienvironment.
2. Place a high-pressure sensor inside the minienvironment above the center of the wafer handler.
3. Open all air flow dampers.
4. Measure with FOUP opened on FIMS.
5. Repeat measurement with FIMS port closed. (No FOUP)
6. Record values for Velocity in Table 10 of SEMI E44.
7. Verify the pressure readings are the same as displayed on the differential pressure indicator if applicable (see Visual Inspection section).

Criteria: static pressure ≥ 0.005” H_20 above cleanroom ambient

Static Pressure Measurements	M/E Static Pressure Measurement	Static Pressure Criteria (in H_20)
No FOUP engaged		≥ 0.005”
FOUP engaged @ loadport		≥ 0.005”

For tools with exhaust systems, the following additional testing is required.

Complete the following matrix by setting the M/E air pressure and exhaust system accordingly. Record the values for Static Pressure in the table which follows.

Static Pressure Measurements	M/E Static Pressure Measurement	Static Pressure Criteria (in H_20)
Exhaust @ Maximum Setting		≥ 0.005”
Exhaust @ Minimum Setting		≥ 0.005”

F.4.4 Installed Filter Test

1. Using the Met One (or equivalent) measure the airborne particulate of the filter by scanning the entire face of the filter(s) with overlapping strokes.
2. The probe shall be held 1 inch from the face of the filter and traversed at no more than 2.0 inches per second.
3. All filters, grids and gasket areas are to be scanned.
4. Re-check any areas that produce particulate counts.

Criteria: No areas found with repeated, high particulate counts

F.4.5 Airborne Particulate Test

Equipment should be installed in a Class ISO-7 (Class 10K) or simulated ambient environment to provide a sufficient challenge to the minienvironment. Therefore, the ambient environment must be measured to ascertain the challenge conditions.

F.4.6 Recovery Test

1. Obtain baseline data from Air Velocity, Static Pressure and Airborne Particulate Test.
2. Open the minienvironment to the ambient for 5 minutes.
3. Close the minienvironment and record the amount of time required for the minienvironment to return to the baseline data values. Repeat tests.

Criteria: The minienvironment is required to recovery to baseline performance values within one minute (reference Guideline 7.4).

Air Velocity Recovery	[P] [F]
Static Pressure Recovery	[P] [F]
Airborne Particulate Recovery	[P] [F]

F.5 Ambient Air Classification

1. Using the Met One (or equivalent) measure the airborne particulate around the process tool. Establish at least three measurement locations (more may be required based on size of equipment) and sample the challenge air for 1 min. (minimum) in each location. This time is based on a sample rate of 1 ft^3/min. and provides a sample sufficient to detect 20 particles of the targeted size.
2. Record the number of particles for sizes 0.5 µm and 1.0 µm.

Ambient Air Classification	0.5 µm particles/m^3	1.0 µm particles/m^3
Test #1		
Test #2		
Test #3		
Average (Sum/3)		
Criteria (ISO-7)	≥ 352,000	≥ 83,200

F.6 M/E Air Classification

1. Using the Met One (or equivalent) measure the airborne particulate above the center of the wafer handler and other areas where bare wafers reside. Take 3 measurements, each sampling for 8 minutes (minimum). This time is based on a sample rate of 1 ft^3/min. and provides a sample sufficient to detect 20 particles of the targeted size.
2. Record the values for Cleanliness of Equipment at Rest in Table 9 of SEMI E44.

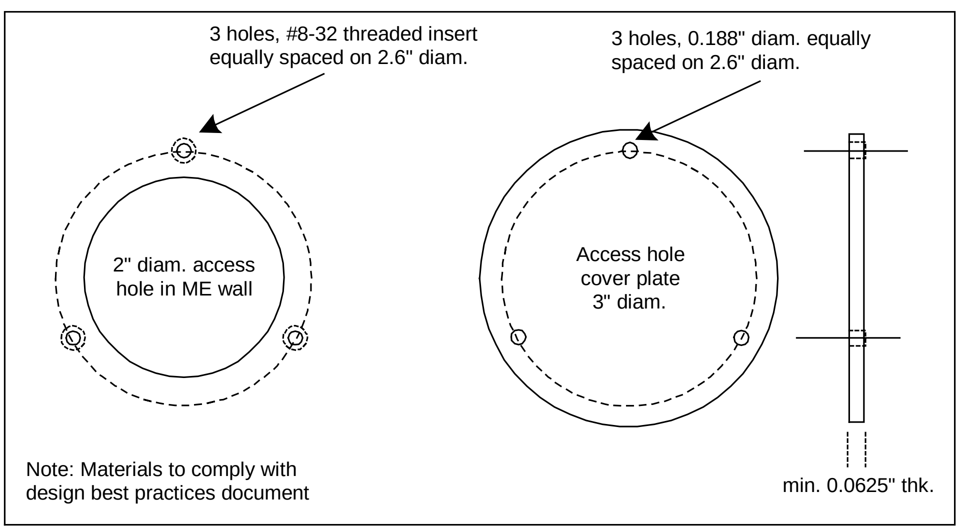
M/E Air Classification	0.1 □m	0.2 □m	Additional bins
Test #1			
Test #2			
Test #3			
Average (Sum/3)			
Criteria (ISO-2) particles/m^3	≤ 100	≤ 24	

F.7 Action Items for Equipment Supplier

1. Supply airflow modeling diagrams. Attach to Table 10 of SEMI E44 for air flow direction.
2. Supply thermal modeling diagrams. Attach to Table 10 of SEMI E44 for temperature data.
3. Supply Noise and Vibration data for Table 23 of SEMI E44.
4. Supply self obtained minienvironment data.
5. Supply Operation manual.
6. Supply Maintenance manual.
7. Supply Spare Parts manual.

F.8 QA/Measurement Access Port

The following is a suggested design for the QA/Measurement Access Port.



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