

SEMI AUX018-0710

FOUP/LOAD PORT INTEROPERABILITY REPORT

Foreword

Publication of this document as auxiliary information independent of any standards was authorized by a 2/3-majority vote of the Japan Physical Interface & Carriers Committee on April 8, 2010. This action was also approved by the global Physical Interface & Carriers Coordinating Subcommittee by electronic ballot on April 26, 2010; and by the global Audits & Reviews Subcommittee on May 21, 2010.

The information in this document has been furnished by the 300 mm Carrier Task Force comprised of participants from the equipment, carrier, and loadport suppliers, and IC makers from Europe, Japan, North America and Taiwan. This study group developed the report under the SEMI Standards Physical Interfaces & Carriers Committee, working cooperatively between regions.

In the course of evaluation of 300 mm FOUP and loadport implementations, numerous problems have been found. These problems included some noncompliance to the SEMI Standards for physical interfaces, but some problems were system oriented, and, thus, required study of the integration of FOUPs and loadports for solutions. As the problems were internationally recognized, device makers decided to define their requirements to ensure interoperability between FOUPs and loadports in a User System Requirements Document (USRD) for FOUP-to-Loadport Interoperability developed by J300E and International SEMATECH and announced at SEMICON Japan 1999.

International FOUP/Load Port Interoperability Study Group was established to identify the source of interoperability problems, publish the analysis results of the problem, create action plans, and suggest standards activities needed to enhance the maturity of the standards. The results of the study are intended to provide additional implementation guidance to suppliers to ensure interoperability within compliance to all relevant SEMI Standards. A report from the Study Group was presented at an International Workshop on FOUP-Loadport Interoperability July 13, 2000. The present document is an updated version of the report presented in July.

Subsequently, minor revisions to the material have occurred since its initial publication in December of 2000, reflecting changes and advances in the industry. The material within this auxiliary document reflects these changes, with no substantive additions being made.

In February of 2010, this document was re-examined by the global Physical Interfaces & Carriers Maintenance Task Force and revised accordingly. These revisions include the addition of information on FOUP door drop prevention.

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SEMI

FOUP-Load Port Interoperability Implementation Recommendations

Revision 1.06

April 8, 2010

Global PIC Maintenance Task Force
PI&C Committee

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- Volume 1 Interoperability Implementation
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- Revision History

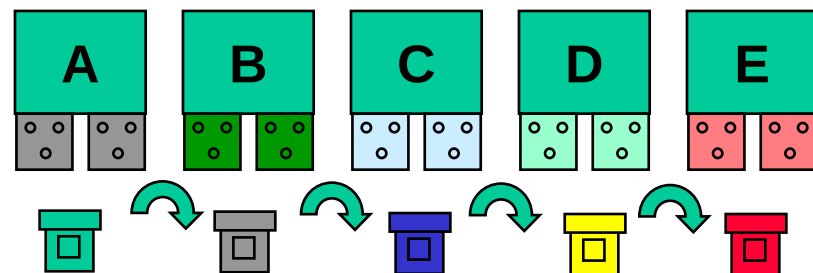
Overview

- ◆ The FOUP has been thought to be utilized as the standard carrier for the 300mm fab, and tremendous amount of effort was invested to bring about 300mm standardized carrier.
- ◆ Numerous problems have been found in the course of evaluation of mini-environment systems (i.e., FOUPs and Load Ports).
- ◆ These problems include some simple non-compliance to the standards, but some are system oriented, and, thus, require “share of responsibilities” between FOUPs and Load Ports for solution.
- ◆ As the problems were internationally recognized, device makers decided to show their requirements to ensure interoperability between FOUPs and Load Ports.
- ◆ The first FOUP/Load Port Interoperability International Workshop was held at SEMICON Southwest 1999.
- ◆ This activity was followed by publication of a User System Requirements Document (USRD) for FOUP-to-Load Port Interoperability developed by J300E and International SEMATECH and announced at SEMICON Japan 1999.
- ◆ In the response to USRD International SEMI FOUP/Load Port Interoperability Study Group (hereafter FLI SG) was formed.
- ◆ FLI SG objective is to publish the analysis results of the problem, create action plans, encourage TF formation to the problem, and enhance the maturity of the standards.

Background

- The required “interoperability of FOUP/Load Port” is NOT only the capability to be able to open FOUPs from multiple manufactures.
- The interoperability requirements include following view points:
 - ♦ any Load Ports from multiple suppliers can open any FOUPs from multiple suppliers as shown in the figure on right hand side of this foil.
 - ♦ repeatability: the FOUP Door position can increasingly deviate from the most preferred center position as processing goes on and may result in interoperability loss since the FOUP Door position depends on the previous closing operation.
- This is a real challenge in an effort to implement 300mm mini-environments in an automated production line, which we can not predict from results in the early methods like “single Load Port vs. single FOUP many open/close cycle test.”

- In order to encourage standard compliance and data feedback for FOUP/LP improvement, FLI SG decided to publish an interoperability recommendation report consisting of two volumes:
 - ♦ Measurement Methods for FOUP and Load Port
 - ♦ Interoperability Implementation Report



N FOUPs vs. M Load Ports situation

Background (continued)

• Interoperability Implementation Report

- ♦ The FOUP Load Port Interoperability SG decided to divide the requirements into 3 categories so that reasonable solution can be obtained:

- FOUP
- Load Port
- System

• Measurement Methods

- ♦ The FOUP Load Port Interoperability SG decided to divide the requirements into 2 categories:

- FOUP
- LP

Objective

•Objective of “FOUP-Load Port Interoperability Implementation Recommendations”

- ◆Alert suppliers and/or add minimum additional requirements to ensure interoperability while assuring compliance to all relevant SEMI Standards.
- ◆Give complementary explanation of standards and/or concrete explanation of proper operation of FOUPs and Load Ports
- ◆Identify the potential areas of concern and may provide several possible design recommendations.
- ◆Propose corresponding TF activities.
 - c.f. Purpose of standards are to define the minimum requirements to enable interoperability
- ◆Each item in “FOUP-Load Port Interoperability Implementation Recommendations” should have an outcome which may suggest changes to existing standards or inclusions in SEMI Guide, etc.

Reflection Philosophy to Standards

- How to reflect the report recommendations to SEMI documents:

- ◆Put in corresponding standards (E47.1 or E62) as application notes for the best appeal as long as the issue is closely related to one of each documents.
- ◆Include high level items such as system view for interoperability in a SEMI Guide.
 - It is proposed to publish all the detailed recommendations in a separate SEMI Guide like the I300I Mini-Environment Best Practices Document while the necessary changes in SEMI Standards are added to the SEMI Standard body.

- General Comment

- ◆In case difference of philosophy on standard exists, suggestions from regional SGs may be listed.

USRD

• User System Requirements Document for FOUP-to-Load Port Interoperability

- (1) E62-y33 Variation for FOUP & Load Port
- (2) FOUP and Load Port Door/Frame Size Relation
- (3) Repeatability of FOUP Door Position
- (4) Gap between FOUP and Load Port Frames
- (5) Accuracy of Wafer Location

Study Requirement

Latch Key Operation

History of Report Development 1

- Oct./99 Kick off at SEMICON/Southwest '99
- Dec./99 FTF meeting for review of first draft at SEMICON/Japan
- March/00 FTF meeting for review of draft R0.08 NA at winter meeting in La Jolla
- 4/18-19/00 VC for review of draft R0.12
- 5/15-16/00 VC for review of draft R0.13
- 5/16/00 With comments from North America/Europe/Korea/Taiwan FOUP-Load Port Interoperability SG meeting
- 5/17/00 With Japan FOUP-Load Port Interoperability SG comments
- 5/17/00 With comments from International SEMATECH
- 6/1/00 With comments from North America/Europe/Korea/Taiwan FOUP-Load Port Interoperability in SG meeting at SEMICON Kansai
- 6/8/00 With comments from North America/Europe/Korea/Taiwan FOUP-Load Port Interoperability in SG meeting at SEMI Japan

History of Report Development 2

- 6/22/00 With comments from North America/Europe/Korea/Taiwan FOUP-Load Port Interoperability in video SG meeting
- 7/12/00 Present this report at International Workshop on FOUP-Load Port Interoperability
- 7/13/00 Proposal of Auxiliary Document publication at NA PIC committee at SEMICON West
- 12/8/00 Pass Auxiliary Document publication at JP PIC committee at SEMICON JAPAN
- 2/21/01 Doc. 3352 AUX006-0201 : User Interface Configurations for 300 mm Equipment Load Ports
- 7/13/01 Approval to revision of Auxiliary Document at NA PIC committee.
- 12/5/01 Approval to revision of Auxiliary Document at JA PIC committee at SEMICON JAPAN.
- 4/10/03 Proposal to revision of Auxiliary Document at JA PIC committee.

History of Report Development 3

- 10/15/03 Proposal to revision of Auxiliary Document at NA PIC committee.
- 11/15/04 Proposal to revision of Auxiliary Document at NA PIC committee.
- 04/08/10 Proposal to revision of Auxiliary Document at JA PIC committee.

Acronyms

- AMH Automatic Material Handling
- AMHS Automatic Material Handling System
- BDP Bilateral Datum Plane
- CMM Coordinate Measurement Machine
- FDP Facial Datum Plane
- FIMS Front-opening Interface Mechanical Standard
- FOUP Front Opening Unified Pod
- HDP Horizontal Datum Plane
- KC-Pin Kinematic Coupling Pin
- KC-Plate Kinematic Coupling Plate
- LP Load Port
- SG Study Group
- TF Task Force
- Those words defined in SEMI Standards are expressed in capital letters for the initials.

450mm FOUP-Load port

- This report is a material to assist the realization of 300mm FOUP-Load port (300mm system) interoperability.
- 450mm FOUP-Load port (450mm system) uses front-opening method, rotary latch method, and kinematic coupling FOUP positioning method etc. like 300mm system, so the philosophy of interoperability described in this report can be reflected onto 450mm system.
- It is recommended to apply this report effectively to 450mm system.
- Note :
 - ◆ Note that this report is for 300mm FOUP-Load port, and names, marks and dimensions, etc in are different from those for 450mm FOUP-Load port.
 - Example: The name of Registration Pins for 300mm system is changed to Door Pins for 450mm system.

Volume 1

Interoperability Implementation

Report Development Process

- **Step 1: Create a report draft for all issues under discussion by FLI-SG**
 - ♦ **To: Provide status on the discussions regarding the items in the latest report draft.**
 - ♦ **How: FLI-SG to post the report draft on web-site**

- **Step 2: Suggest creation of / delegation to TFs for possible standard amendments**
 - ♦ **Types of standard amendments:**
 - Change standards to remove contradiction
 - Add some definition to standards
 - Narrow the definition in standards
 - Add application note

- **Step 3: Remaining items in the report draft after Step 2 may be balloted per SEMI regulation to become a SEMI Guide**

Position of Document

- This report has been developed by international collaboration at following TF/WG.
 - ◆ E47.1 TF
 - ◆ E62TF
 - ◆ International FOUP-Load Port Interoperability Study Group
 - ◆ International 300mm Carrier TF
 - ◆ Global PIC Maintenance TF
- TF to work on:
 - ◆ Convert suggestion of additional application notes in the report into ballots for appropriate inclusion in SEMI Standards.
 - ◆ Convert suggestion of additional requirements in the report into ballots for appropriate inclusion in SEMI Standards.
 - ◆ There are some suggestions in the report such as “gap model” and “FIMS Door Return Accuracy Requirement” which are left to TF to work on corresponding concrete numerical values.

Format Description for Implementation Report

•Template of an individual issue foil

♦Related USRD:

- List related USRDs. (ex. 3. Repeatability of FOUP Door position)

♦Requirement:

- List SEMI level requirements

♦Related Standards:

- List related SEMI Standards and parameters

♦Impact to Standards:

- List impacts such as delete, modify, add, application notes.

♦Application Note:

- Application Notes to apply this recommendation

♦Background:

- List problems and rationales of this recommendation.

♦Approach:

- List approaches/concepts to solve the problem and put the reason why above approach is chosen.

Note:

- Miscellaneous notes

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•Registration Pins Functionality

- ◆System: Registration Pins Operation
- ◆System: Recovery from Utility loss
- ◆Load Port: Load Port Must Provide Registration Pins per SEMI E62
- ◆FOUP: FOUP Should Have Appropriate Size Registration Pin Holes

•FOUP Door Return and Centering

- ◆Load Port: FIMS Door Return Accuracy Requirement
- ◆FOUP: FOUP Strength around Latch Key Holes
- ◆FOUP: FOUP should have Door Centering Capability

•FOUP Door Miss-Catch

- ◆Load Port: FOUP Door to FIMS Door Miss-Catch Prevention by LP
- ◆FOUP: Recommend to improve the accuracy between surface positions of FOUP Frame and FOUP Door
- ◆FOUP: FOUP to Have Enough Door Latch Allowance

•Gap between FOUP and Load Port Frames

- ◆FOUP: FOUP Frame to Load Port Frame Gap/Contact
- ◆FOUP: Inert Gas Application

•Latch Key Operation

- ◆System: Latch Key and Latch Key Hole Alignment and Lead-in
- ◆Load Port: Latch Key and Latch Key Hole Alignment and Lead-in
- ◆FOUP: Latch Key and Latch Key Hole Alignment and Lead-in
- ◆FOUP: Role of Latch Key Hole chamfer
- ◆FOUP: Holding of Latch Key Hole Rotation Angle During Closed
- ◆FOUP: FOUP should Pull-in Latch Key Hole Angle into Origin from Nearly-Closed Position
- ◆Load Port: Increase Lead-in Capability of Latch Key
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- ◆FOUP: Clearance between FOUP Frame and FOUP Door
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•Force

- ◆FOUP: FOUP to reduce Latch Key Hole Torque
- ◆FOUP: FOUP should accept Latch Key under E62 Force Specs
- ◆Load Port: Minimum Docking Force Definition
- ◆Load Port: Minimum Door Closing Force Definition
- ◆Load Port: Dock Holding Force should be larger than Door Open/Close Force
- ◆FOUP: KC Creeping prevention by f33, f34

•Wafer Center

- ◆FOUP: Wafer center should not be retained in front of FDP
- ◆Robot: Wafer center should be set down in front of FDP
- ◆Robot: Side and Vertical FOUP Clearances Must Be Maintained Upon Wafer Insertion

•Datum Planes

- ◆Load Port: Clarify of BOLTS-Plane versus Equipment Boundary

•Kinematic Coupling Functionality

- ◆Load Port: Interference Between Load Port Features and Kinematic Coupling Lead-in Grooves at the time of FOUP Delivery

•FOUP door drop prevention

- ◆Load Port: Confirmation of proper FOUP door close
- ◆FOUP: Avoidance of intermediate state of door open/close

Registration Pins Functionality

USRD: 3. Repeatability of FOUP Door Position

System: Registration Pins Operation

E62: Added to Application Note

• Related USRD:

- ♦ 3. Repeatability of FOUP Door Position

• Requirements:

- ♦ Do not use Registration Pins for FOUP Door lead-in to the Load Port Door.
- ♦ Registration Pins should be used to limit maximum displacement of the FOUP Door while on the Load Port Door.

• Related Standards:

- ♦ E62: d31, x31, z31, r30

• Impact to Standards:

- ♦ Neither the FOUP nor FOUP Door positions should change as a result of engaging or disengaging Registration Pins. Rewording is recommended for the Registration Pin description in SEMI Standards, as is having an Application Note describe this issue.
- ♦ When the Load Port experiences utility loss (such as EMO, vacuum loss, electrical failure, etc.), Registration Pins may be used to maintain the FOUP Door's position, and to ensure the FOUP Door not to fall off.

• Background:

- ♦ Kinematic Coupling and Clamp mechanism primarily restrict six degrees of freedom of the FOUP. Door alignment by Registration Pins causes over-constraint of the FOUP to the Load Port, and this should be avoided.
- ♦ High friction caused by over-constraint may cause particle generation.

• Approach

- ♦ The Load Port does not align the FOUP Door to the Load Port Door but keeps its position as it was.
- ♦ Method will be an implementation issue. Vacuum holding or Latch Key grip with friction may be examples.

• Note:

- ♦ This recommendation is only related to usage of Registration Pins for the purpose of lead-in (guiding the FOUP Door onto the Load Port Door), which may very probably cause an over-constraint. Once the FOUP Door is registered on the Load Port Door, Registration Pins may be used to maintain the position of the FOUP Door once removed from the FOUP.

System: Recovery from Utility Loss Should be Done Without FOUP Frame to FOUP Door Interference

•Related USRD:

- ♦2. FOUP and FIMS Door/Frame Size Relation
- ♦3. Repeatability of FOUP Door Position

•Requirement:

- ♦The FOUP Door should be returned safely to the FOUP (with no bumping, no scraping, etc.) during recovery from any utility loss that might occur while the FOUP Door is open.

•Related Standards:

- ♦E62 Registration Pins shape

•Impact to Standards:

- ♦None.
- ♦See Note.

•Application Note:

- ♦The clearance between the Registration Pins and the Registration Pin Holes should be less than the clearance between the outer edge of the FOUP Door and the inner edge of the FOUP Door Frame. Balancing these tolerances is a FOUP design issue related to the E62 Seal Zone specification. Registration Pin Holes locations should be designed with consideration to above tolerances.

•Background:

- ♦Utility loss (such as EMO or electrical failure) may result in a loss of the FOUP Door position while on the Load Port Door.
- ♦In this situation, the FOUP Door may not be able to be closed automatically if the FOUP Door position changes.
- ♦For cleanliness reasons, the FOUP Door support during utility loss should be considered to avoid human interruption.

•Approach:

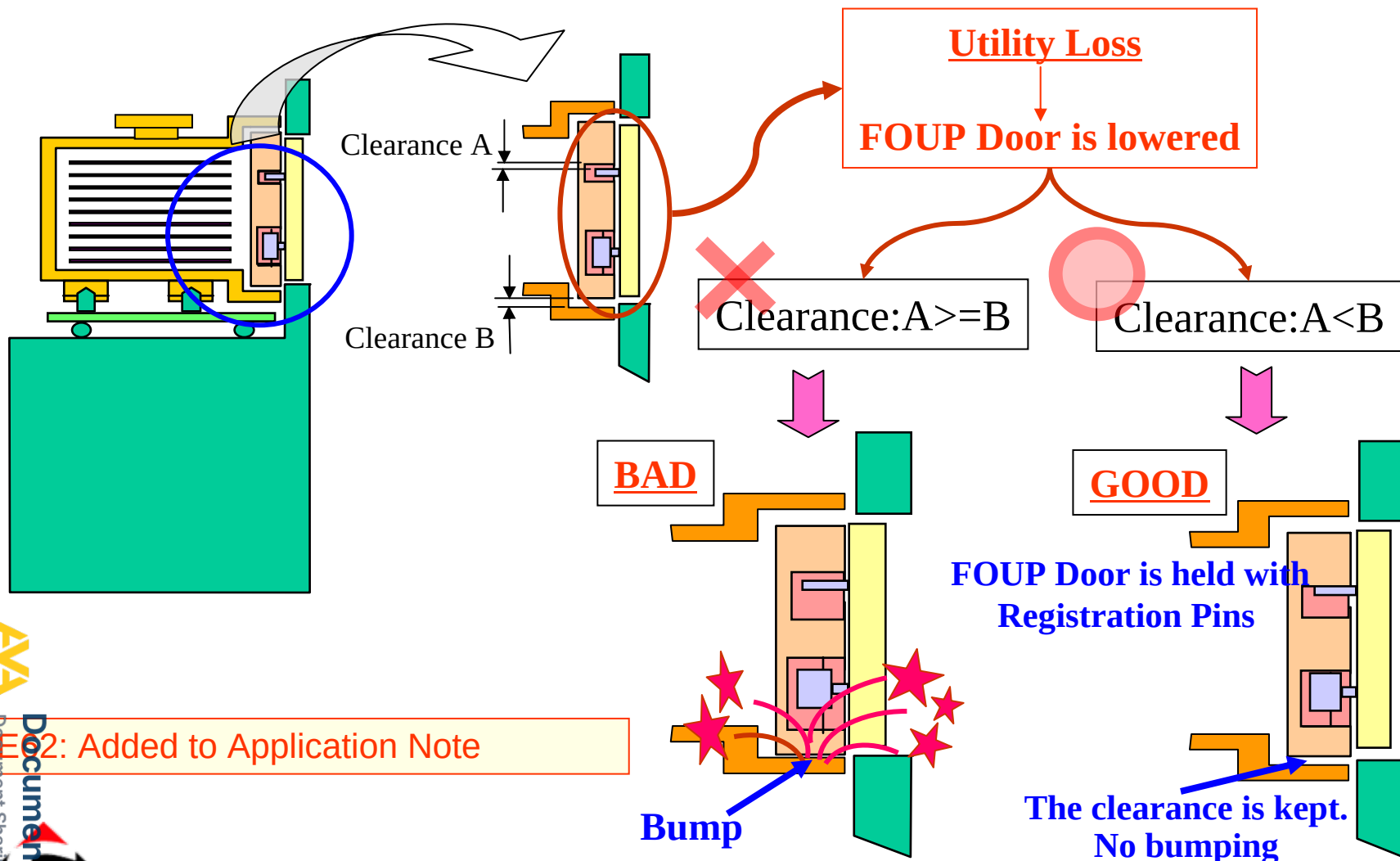
- ♦the Load Port to have Registration Pins per E62.
- ♦the FOUP to have appropriate size of Registration Pin Holes to prevent excessive FOUP Door displacement when utilities are lost.

•Note:

- ♦JA SG thinks this should be included in Application note of E47.1 whereas NA SG thinks this should be in SEMI guide.

E62: Added to Application Note

The clearance between Registration Pins and Holes should be less than the clearance between FOUP Door and Frame.



Load Port: Load Port Must Provide Registration Pins per SEMI E62

•Related USRD:

- ♦3. Repeatability of FOUP Door Position

•Requirement:

- ♦the Load Port must provide Registration Pins compliant with SEMI E62: (d31 etc.)

•Related Standards:

- ♦E62: d31, x31, z31, r30

•Impact to Standards:

- ♦None.
- ♦Compliance required with E62.

•Application Note:

- ♦Registration Pins may be used to enable non-interference error recovery from lost position due to utility loss.

•Background:

- ♦Due to several Load Ports in production having non-compliant Registration Pins to avoid over-constraint, these recommendations were developed to serve as an implementation guide for using SEMI Standard equipment.

- ♦Registration Pins are not appropriate for FOUP Door positioning to the Load Port Door.

- ♦Registration Pins should be used to limit the maximum displacement of the FOUP Door while it is engaged onto the Load Port Door.

•Approach:

- ♦Non-interference error recovery from position loss due to power loss should be considered.

•Note:

- ♦Common non-compliances and reinforcement messages may be collected as a section in some SEMI Guide Document or the like.
- ♦Registration Pins may be used as reference points to measure the Load Port Door position and features.

E62: Added to Application Note

FOUP: FOUP Should Have Appropriate Size Registration Pin Holes

• Related USRD:

- ◆ 3. Repeatability of FOUP Door Position

• Requirements:

- ◆ The FOUP should have Registration Pin Holes of an appropriate size to avoid over-constraint caused by the positioning error resulting from possible FOUP tolerances (not defined in SEMI Standards) and Registration Pin tolerances (defined in E62.)
- ◆ The relation between Registration Pin Holes size and the FOUP Frame to FOUP Door gap should be considered to enable non-interference error recovery from lost position of the FOUP Door due to utility loss.

• Related Standards:

- ◆ E62: d31, x31, z31, r30

• Impact to Standards:

- ◆ None.

• Application Note:

- ◆ The clearance between the Registration Pins and the Registration Pin Holes should be less than the clearance between the outer edge of the FOUP Door and the inner edge of the FOUP Door Frame. Balancing these tolerances is a FOUP design issue related to the E62 Seal Zone specification.

- ◆ The diameter of the Registration Pin Holes should be designed to accommodate the Registration Pin tolerance defined in E62 (x31, z31, d31) and the Registration Pin Hole location tolerance in a FOUP.

• Background:

- ◆ Registration Pins are not appropriate for FOUP Door positioning to the Load Port Door.
- ◆ Registration Pins should be used to limit the maximum displacement of the FOUP Door while it is engaged onto the Load Port Door.

• Approach:

- ◆ Non-interference error recovery from position loss due to power loss should be considered.

• Note:

- ◆ It is proposed to add a note to the SEMI Guide to alert FOUP suppliers of design considerations when determining the size of the hole for Registration Pins while adding an Application note to SEMI E47.1.

E62: Added to Application Note

FOUP Door Return and Centering

USRD: 3. Repeatability of FOUP Door Position

Load Port: FIMS Door Return Accuracy Requirement

E62:Added 5.10 FIMS
Door return repeatability

•Related USRD:

- ◆3. When closing the FOUP, the Load Port must return the FOUP Door to the same location from which it was taken.

•Requirement:

- ◆The Load Port should return the Load Port Door to the position where the Load Port Door was within an accuracy that should be determined in the relevant TF.

•Related Standards:

- ◆E62

•Impact to Standards:

- ◆No contradiction.
- ◆Better to add Load Port Door return accuracy in E62.
- ◆E62 Rev. TF should work out the followings:
 - Need to revise E62 (Figure 1, for example) to clarify how the Load Port Door repeatability is to be included in dimensions.
 - Specify requirement only for X and Z directions in this Standard ammendment.
 - There needs to be clarification of the FOUP Door to the Load Port Door repeatability.

•Application Note:

- ◆Example of FOUP Door holding
 - Vacuum holding
 - Clamping by Latch Key with friction.

•Background:

- ◆To avoid the FOUP Frame from contacting the FOUP Door during FOUP Door closing, at least the FOUP Frame to FOUP Door clearance (dynamic) or the FOUP Door return accuracy by the Load Port must be defined.
- ◆Displacement should be as small as possible to avoid particle generation due to the FOUP Door sliding in the FOUP Frame.
- ◆The FOUP is expected to keep its Door centered to prevent the FOUP Door from creeping due to accumulation of Door return position errors.
- ◆The current +/-0.1mm FIMS Door per E62 (x30, x31, z30, z31) is to be further examined from the view point of tolerance and repeatability. The question here is if E62 intends to include the Load Port Door return repeatability tolerance.

•Approach:

- ◆Define the Load Port Door return accuracy of the Load Port.

FOUP: FOUP Strength around Latch Key Holes

E62:Added 5.11 Latch Key Retention force

•Related USRD:

- ♦3. Repeatability of FOUP Door Position

•Requirement:

- ♦Regardless of the FOUP Door holding mechanism (vacuum chuck, Latch Key clamping, etc.), the FOUP Door strength around the Latch Key Holes should be designed to have an appropriate value.

•Related Standards:

- ♦E62:f35 , E47.1

•Impact to Standards:

- ♦No contradiction to current Standards
- ♦E47.1 TF worked on this issue to add strength definition compatible with the pulling force for clamping by Latch Keys.
 - $F_{pull} \leq 20N$ for each key (40N in total)

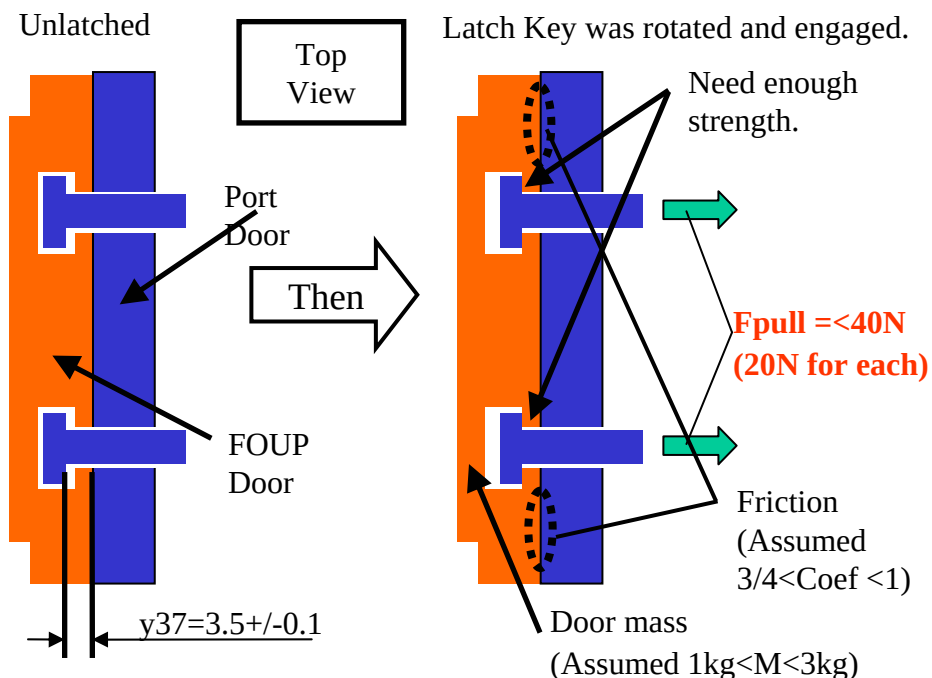
•Application Note:

•Background:

- ♦The Load Port should return the FOUP Door to the position where the FOUP Door was.

•Approach:

•Note:



FOUP: FOUP should have Door Centering Capability

• Related USRD:

- ◆ 2. FOUP and Load Port Door/Frame Size Relation
- ◆ 3. Repeatability of FOUP Door Position

• Requirement

- ◆ The FOUP should have a capability to roughly center the FOUP Door in the FOUP Frame during the FOUP Door close sequence (during either return of the FOUP Door and/or during latching of the FOUP Door).
- ◆ This centering capability should keep the clearance between the FOUP Frame and the FOUP Door larger than sum of the FOUP (self) tolerance and the E62 Registration Pin tolerance along with the FOUP Door's circumference.

• Related Standards:

- ◆ E62-z33, z34, x33, x34

• Impact to Standards:

- ◆ None (See Note).

• Application Note:

- ◆ The intention of this recommendation is not to imply an accurate centering toward an ideal center but to keep the FOUP Frame to FOUP Door clearance appropriate for Latch Key insertion into the FOUP Door.

Candidate examples may include centering by latch motion and centering by slope between the FOUP Frame and the FOUP Door.

• Background:

- ◆ There is an over-constrain issue between the “FOUP Door Return to the same position” function of the Load Port and the “FOUP Door centering” function of the FOUP. This expected to be solved within the mechanical compliance of both the FOUP and the Load Port.
- ◆ Even though the Load Port Door tries to return the FOUP Door to the position where it was, accumulation of system error can occur, and, the FOUP Door may creep to hit the FOUP Frame.

• Approach:

- ◆ The Load Port has a function to return the FOUP Door where it was and cannot have a centering function at the same time.
- ◆ The FOUP is expected to keep the FOUP Door centered to prevent Door creeping due to an accumulation of Door return errors.

• Note:

- ◆ It is recommended that the FOUP Door centering function be highlighted as an Application Note in E47.1.
- ◆ It is believed that most FOUPs already have this.

E47.1: Added application note

FOUP Door Miss-Catch

1: E62-y33 Variation for FOUP & Load Port

Load Port: Gap control between FOUP and Load Port Frames

•Related USRD:

- ♦1: E62-y33 Variation for FOUP & Load Port

•Requirements:

- ♦The gap between the FOUP Frame and the Load Port Frame when a FOUP is docked and opened should be controlled less than the minimum value deduced from relevant tolerances.

- The gap can be zero in the case of "Soft Contact."

- ♦The range of this gap should be discussed in joint TF of E47.1 and E62.

•Related Standards:

- ♦E62-y33:Frame
- ♦E47.1-y33 (y52) :Frame

•Impact to Standards:

- ♦TF to propose an application note that clarifies the relation between y52 (frame) in E47.1 and y33 (frame) in E62.

- ♦TF to create a consistent gap model in which relevant dimensions and operation are shown. See the figure in the following page

- E47.1 TF to propose of an application note regarding y52 (Frame) in E47.1.

•Application Note:

- ♦The current standard individually gives y33 (FOUP Frame) and y33 (Load Port Frame) tolerances of +/-0.5mm and +/-0.5mm, respectively. Since these tolerances are independent to each other, the Load Port has to advance the FOUP so as to have the nominal FOUP Frame location at 1mm before the nominal Load Port Frame location in order to avoid a collision between Frames.

- ♦It can be that the actual FOUP Frame plane is 0.5mm before the the nominal location and, at the same time, that the actual Load Port Frame plane is 0.5mm further into equipment from the nominal location. This situation will give a 2mm wide gap, and which is thought to be too large.

•Background:

- ♦The system is required to be designed to leave a gap between the FOUP Frame and the Load Port Frame to avoid a collision between the two when the FOUP is docked (soft contact is OK).

- ♦The reasons are to prevent:

- 1. wafer center location displacement from docked FDP.
- 2. particle generation from rubbing between the FOUP Frame and the Load Port Frame.

Load Port: Gap control between FOUP and Load Port Frames(continued)

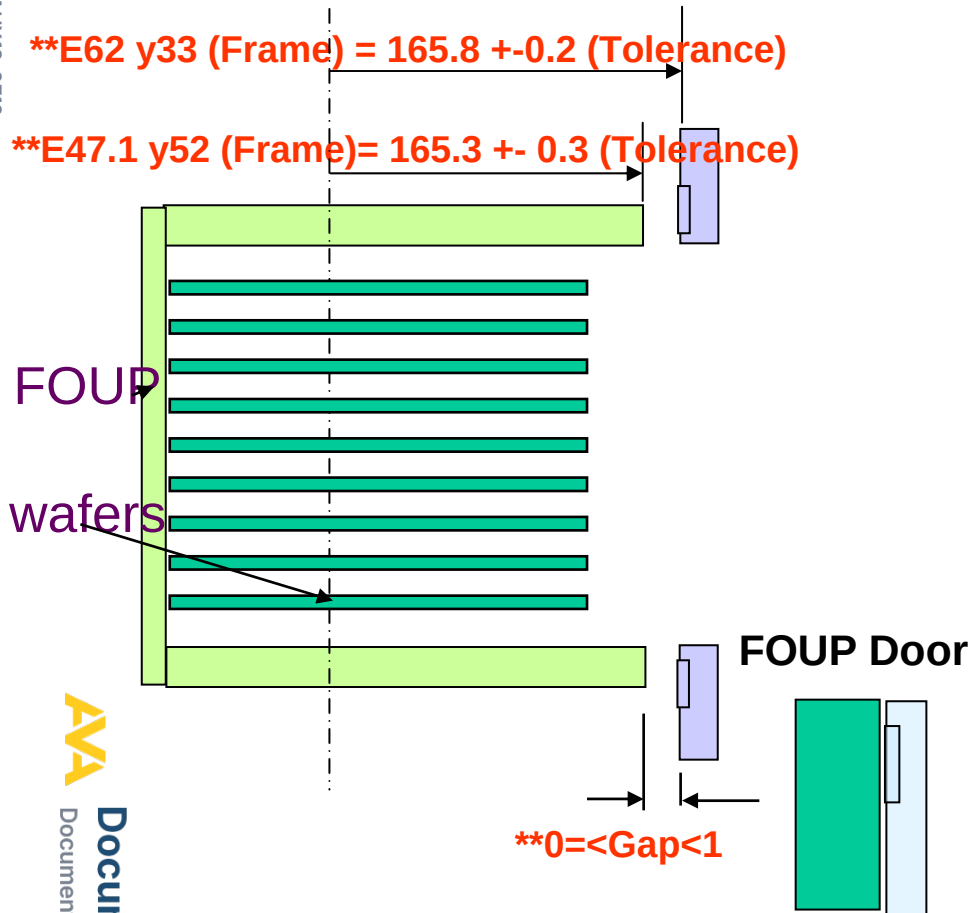
E47.1:y52 was changed 166mm Max. to 165.5+/- 0.5mm
E62:y33 was deleted

• Approach:

- ◆ Since the variation of y33 (Load Port Frame) and y52 are found to be within +/- 0.2mm in most of the currently available LPs and FOUPs, it is profitable to require the tolerance of y33 (FOUP Frame) to be much smaller in value to assure interoperability.
- ◆ If we are to design the system with the nominal gap width to be 0.5 +/-0.5mm, the tolerances in y33 of the current standard should be halved in value.

• Note:

- ◆ The system is required to be designed to leave a gap between the FOUP Frame and the Load Port Frame to avoid a collision between the two when the FOUP is docked (soft contact is OK).
- ◆ The reasons are to prevent:
 - 1. wafer center location displacement from docked FDP.
 - 2. particle generation from rubbing between the FOUP Frame and the Load Port Frame.
- ◆ The dimensions may be defined in a joint TF to resolve this systematic problem.



*These dimensions are to be defined in TFs.

Load Port: FOUP Door to Load Port Door Miss-Catch Prevention by LP

E62:y33 ,y34 were deleted.

•Related USRD:

- ♦1: E62-y33 Variation for FOUP & Load Port

•Requirement:

- ♦The Load Port should have a function to absorb variation in the FOUP Door surface position (facing the Load Port Door) due to the tolerance of the FOUP and the Load Port in order to prevent a miss-catch of the FOUP Door by the Load Port Door.

•Related Standards:

- ♦E62-y33
- ♦E47.1-y33 (y52)

•Impact to Standards:

- ♦Remove y33 in E47.1.
- ♦Propose an application note that clarifies the relation between y52 in E47.1 and y33 in E62.
- ♦Create a consistent gap model in which relevant dimensions and operations such as door catching can be analyzed and explained.

AWA

Documents
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In addition, JP-SG proposes

- y33 in E62 has to be redefined as “compliance range” for rather than “tolerance” as is currently defined.
- Generate a proposal of an application note regarding y52 in E47.1.

♦In addition, NA SG proposes;

- Generate a proposal for clearly defining the FOUP dimension range currently referenced from y33.
- Also include an Application Note about FIMS cushioning ability from USRD.

•Application Note:

- ♦An angular variation compliance function may be needed.

•Background:

- ♦Due to the following factors, the FOUP Door and the Load Port Door may cause a miss-catch;
 - Tilt of the FOUP Door
 - Distribution of y52 along the FOUP Door surface
 - Tilt of the Load Port Door
 - Docking stroke repeatability

•Approach:

- ♦The Load Port must absorb this mismatch because the FOUP has a bigger restriction on its tolerance improvement.
- ♦Relative errors such as system alignment error in E62 should also be absorbed by the Load Port side which is more flexible to design.

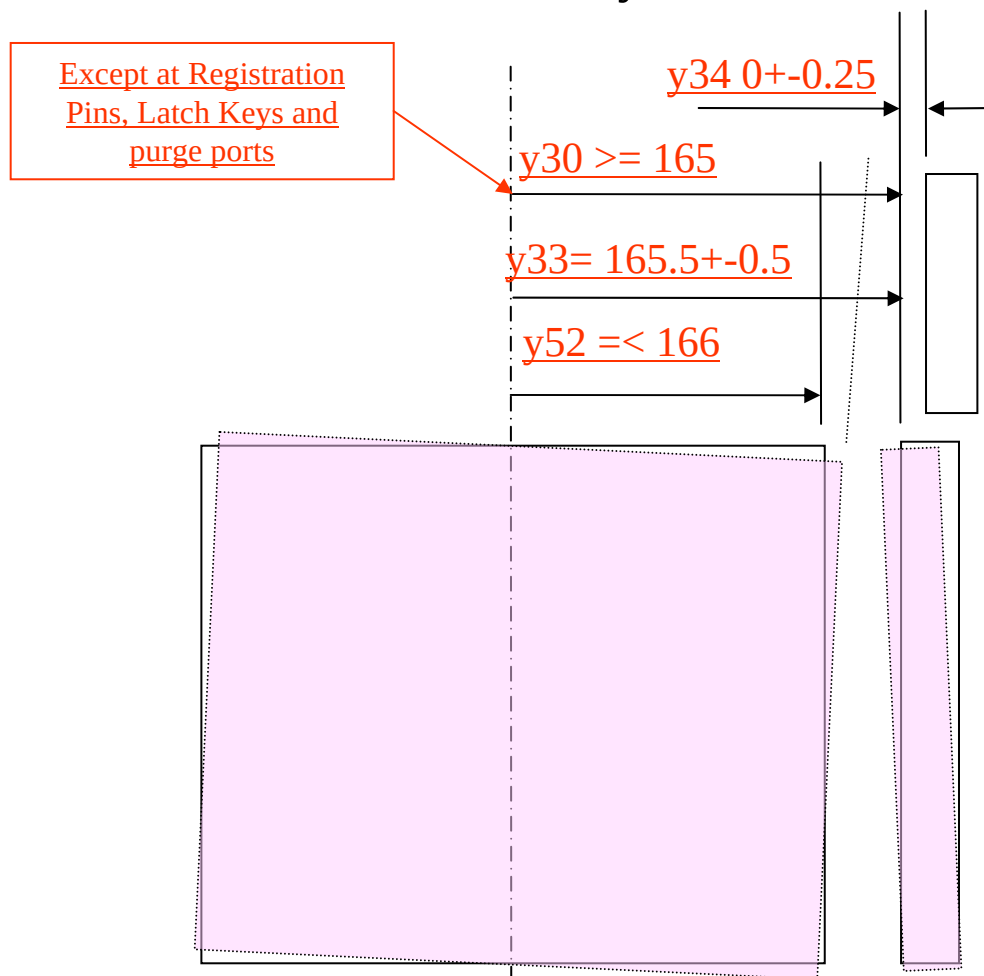
•Note:

- ♦This function may have influence on the FOUP Door holding repeatability of the Load Port. Careful design is required.

Load Port: FOUP Door to Load Port Door Miss-Catch Prevention by LP (continued)

E62:y33 ,y34 were deleted.

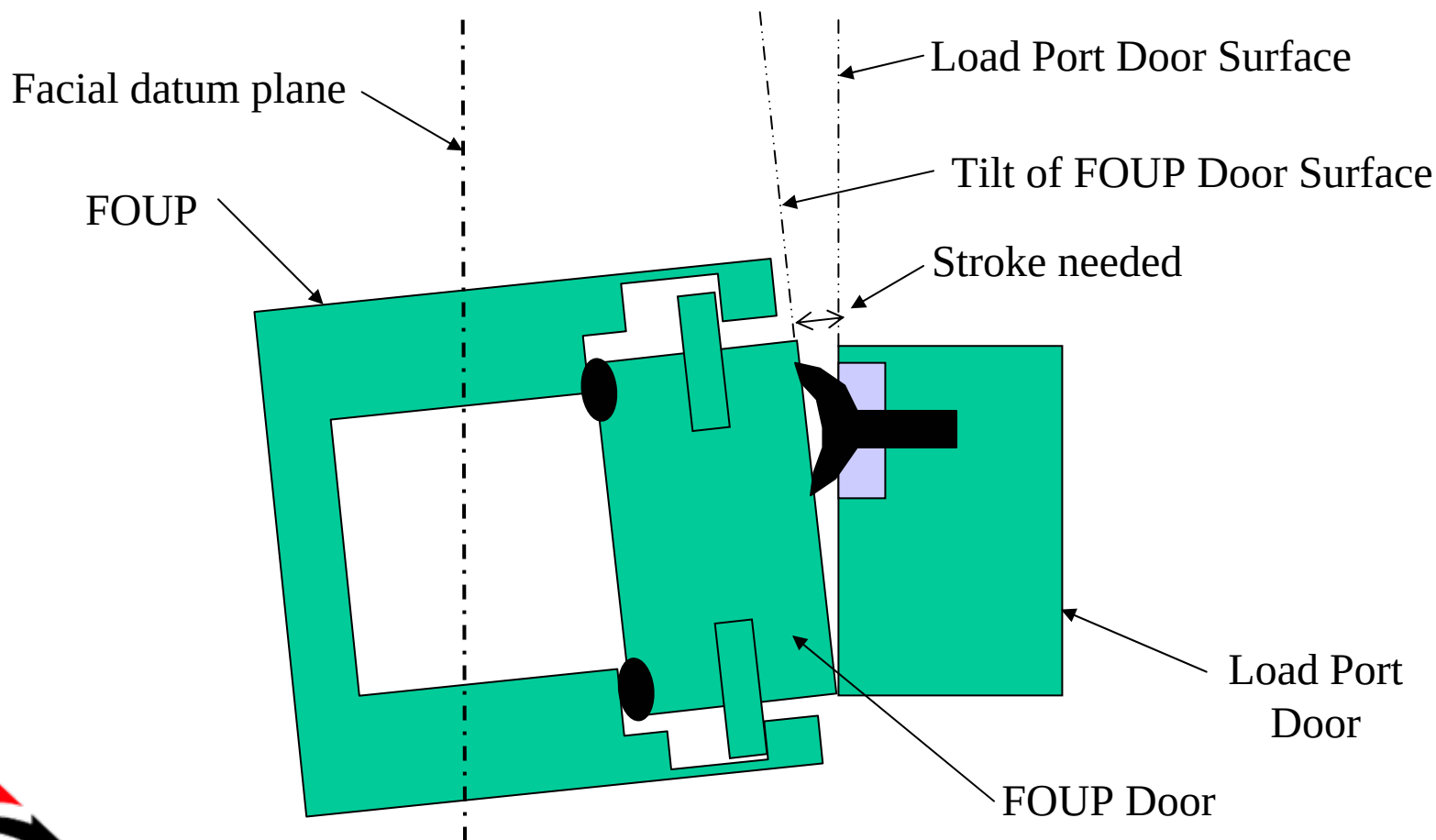
FOUP-Load Port Position Model by current Standards



Load Port: FOUP Door to Load Port Door Miss-Catch Prevention by LP (continued)

E62:y33 ,y34 were deleted.

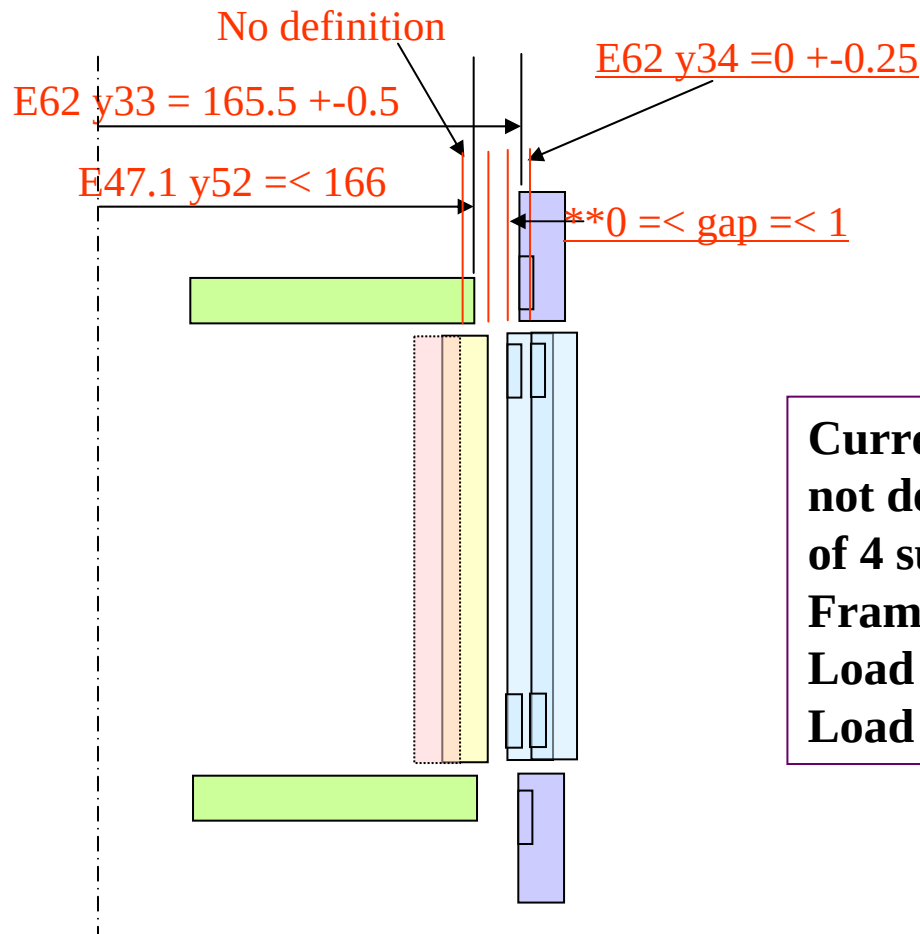
FOUP Door - Load Port Door Miss-Contact Absorption Model



Load Port: FOUP Door to Load Port Door Miss-Catch Prevention by LP (continued)

E62:y33 ,y34 were deleted.

Gap Model by Current Standards



Current Standards do not define relationship of 4 surfaces (FOUP Frame, FOUP Door, Load Port Door, and Load Port Frame)

****These dimensions and names are to be defined in TFs.**

Load Port: FOUP Door to Load Port Door Miss-Catch Prevention by LP (continued)

E62:y33 ,y34 were deleted.

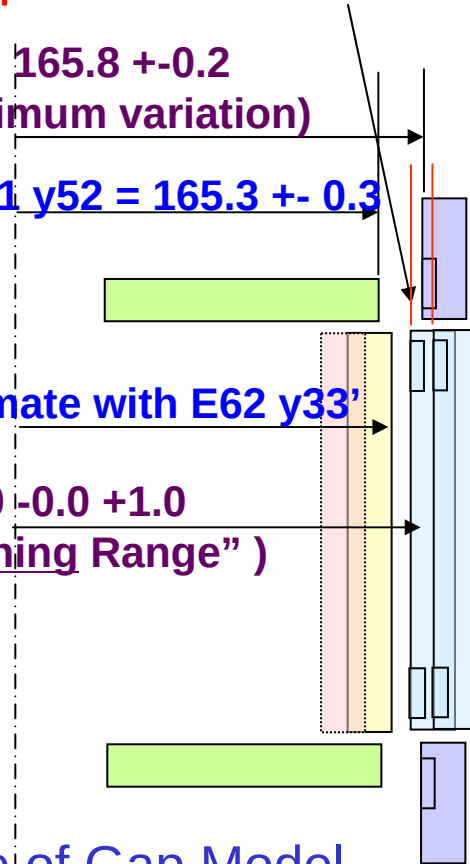
E62 y34 has to be defined with an appropriate tolerance in TF.

E62 y33 = 165.8 +-0.2
(allowed maximum variation)

E47.1 y52 = 165.3 +- 0.3

E47.1 y52 should mate with E62 y33'

E62 y33' = 165.0 -0.0 +1.0
("Minimum Cushioning Range")



Note:

- ◆ Since Frames are not in contact as described in the Frame Gap Model, the Doors have to be in contact to ensure the FOUP Door catch by the Load Port Door (with Latch Keys fully inserted for proper Latch Key Operation).
- ◆ To ensure this Door contact, the system has to be designed to allow overlapping of the Load Port and the FOUP Door planes, but the current Standard allows the overlapping as much as from -1mm to +1mm.
- ◆ This negative value in overlap means no Door contact, and this definitely has to be avoided. This leads to the following requirements:
 - The system has to be designed only to have a positive overlapping value.
 - The system has to be designed to absorb this positive overlapping.
- ◆ To ensure #1 criteria, either side can be defined, but from *One-Sided Definition Policy* we should define the Load Port side y33 (E62 y33') for the Load Port Door to protrude out of Load Port Frame.
- ◆ #2 criteria is to be embedded into E62 y33' as a "Cushioning Range."
- ◆ FOUP suppliers need to design their FOUP Door to mate with E62 y33' or Door Gap Model.

One Example of Gap Model

**These dimensions and names are to be defined in TFs.