ORACLE

DIMM Card and Socket Handling and Debug Requirements

Document Number and Revision: 7059302 Rev 07

Overview

This document is intended to provide users with requirements for DIMM handling and debug. The intention is to provide guidance and methodologies that are practical and provide benefit in product quality and manufacturing predictability. These best practices can also be applied to other edge finger types of assemblies such as PCI cards and connectors.

Audience

External and internal manufacturing facilities and associated members of staff responsible for assembly, debug, and failure analysis. Plant managers should also pay attention to environmental requirements.

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Introduction

The purpose behind writing a DIMM insertion guideline comes from the historical data that shows how functional test environments often have high fallout or retest rates that require DIMM re-seating to repair the system. A snapshot of a system test operation shows that fallout rates fixed by DIMM re-seats can vary significantly. Re-seat rates impact board and system test yields which have a big impact on the need for extra test capital, test infrastructure, and shipment predictability.

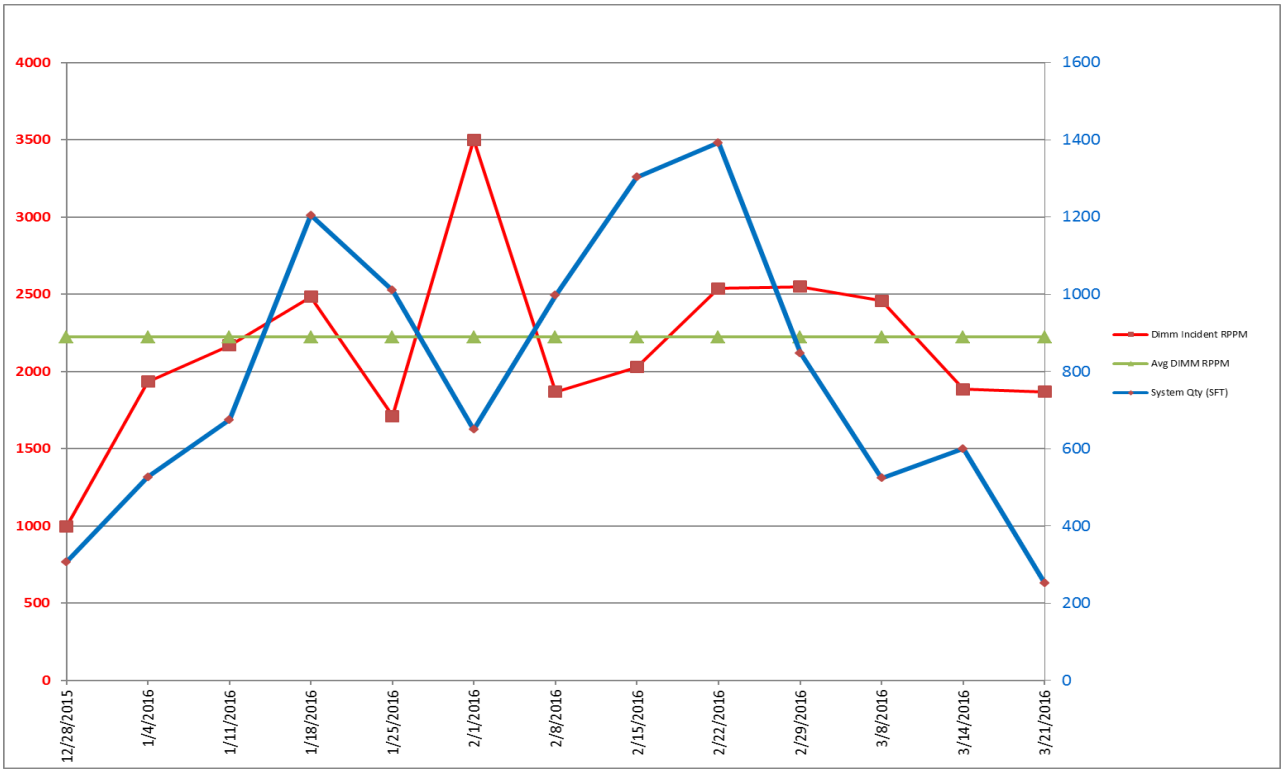


Figure 1 - Chart of DIMM Re-seat Repairs per Million and System Volume over 13 weeks

It is for this reason this document exists; to assist manufacturing and service operations address the fallout. Most of the text and pictures in this document refer to DIMM interconnect issues, but many of the guidelines can also apply to other edge-card interfaces.

1. Background and Approach

It is important to understand that there is no one root cause for problems resulting in DIMM and other card re-seats. The failure analysis matrix below shows possible reasons. Note that there may be more, but to illustrate the point, we have chosen some common failure modes. Also note that as bus speeds increase and contact size decreases, the susceptibility to contamination may become more severe. This document is intended to serve as a guideline to

ensure that one is able to meet the needs of a given product through the board and system level test process.

Table 1: DIMM Connector Troubleshooting Matrix

Possible Failure Analysis	Possible Root Cause(s)	Possible Mitigation(s)
DIMM not seated properly	DIMM not inserted perpendicularly which causes DIMM connector contacts to misalign on DIMM contacts and not make contact.	Use manual or semi-automated tooling to ensure that DIMMs are inserted properly into a socket. Ensure latches are fully engaged. Operator Training
Environmental debris (dirt/oils/dust) found in contact areas and/or sockets.	Factory air filters do not filter exterior air sufficiently. Oil from manufacturing equipment or dust is blowing onto system from a different operation, etc.	Employ improved filtering capability to ensure meeting Oracle particulate recommendations. Ensure good factory protocols (periodic cleaning of floors and all surfaces) in place.
Oxidation found on DIMM connector or extender pads due to wear-out of gold and exposure of underlying Ni or Cu.	Insertion cycles on DIMM or extender TCAP exceeds product specification limit for gold wear-out. Connector plating may be thin or require better quality control.	Collect data to establish life time of DIMM or extenders to be proactive on replacement. Periodic TCAP cleaning process. Work with socket vendors on contact plating issues.
Debris (plastic bits) found in the DIMM socket contact areas and/or DIMM gold pads.	Molding process at the DIMM socket vendor leaves plastic flashing behind. Tolerances for socket housing are out of spec.	Employ vacuuming or air-blow process. Contact supplier to ask for corrective action and drive necessary improvements at the connector vendor.
Human-origin debris (hair/skin/fibers/dust) found in the DIMM socket contact areas.	Operators doing assembly are not adequately covered. Factory environment not sufficiently clean.	Employ practices that require proper use of hair nets or hair tied back below chin length and smocks. Use a vacuuming or air-blow process on sockets prior to DIMM insertion.
Flux residues found in DIMM socket contact areas.	Wave process or tooling transferring flux to DIMM contact areas.	Ensure wave process is in control and not over-spraying. Ensure pallet cleaning frequency is adequate.

Sticky debris, oils, and films found on the DIMM contact areas.	Test capital DIMMs do not have adequate criteria established for cleanliness. Production DIMMs not handled properly by operators.	Institute a process which regularly cleans contact areas of test capital DIMMs. Have operators wear gloves when handling DIMMs.
Possible Failure Analysis	**Possible Root Cause(s)**	**Possible Mitigation(s)**
Debris and films (solder splash, flux) found on the DIMM contact areas.	DIMM vendor rework process is out of control.	Contact DIMM vendor to improve process controls and inspections.
Intermittent electrical connection between DIMM and DIMM socket contact.	Plastic or molding process allows too much movement in DIMM connector pin field. Socket normal force issues. Electrical issues.	Hard to find issue that should drive a detailed failure and data analysis. Work with the connector vendor should be performed as well.

It is therefore clear and possible that some, all, or none of these issues may present themselves on a given day. As such, failure rates will fluctuate.

NOTE: These fluctuations will make it very difficult to have a zero RPM/DPM level across builds. Failures can be minimized but 0 defects should not be expected.

The next sections of this document will address aspects of the design, the process or method, the environment, the people or man, the equipment or machine, and the components or material that contribute to DIMM and edge-card re-seat rates.

2. Design Factors

The design of a PCBA or system can contribute to DIMM failures. A system's firmware or connector design can have an influence on the fallout rates observed at functional test. Intermittent failures due to design issues can result in re-seats which are not necessary. This document will not address the design issues; instead it will address the issues from a manufacturing perspective.

3. Process – Method

The goal of a DIMM handling process is to ensure DIMMs are handled, installed and removed using practices that ensure that the DIMMs and DIMM connectors are not damaged or contaminated. DIMMs must always be protected against ESD, mechanical damage, and contamination.

Note that contamination is defined as any foreign material or substance that may interfere with the intended operation of the DIMM.DIMM Handling Guidelines

3.1 DIMM Handling Guidelines

3.1.1 DIMM Packaging/Storage

All DIMMs are to be stored in their proper size DIMM trays that are ESD compliant and particulate free. Please see pictures below, Figures 2 and 3.

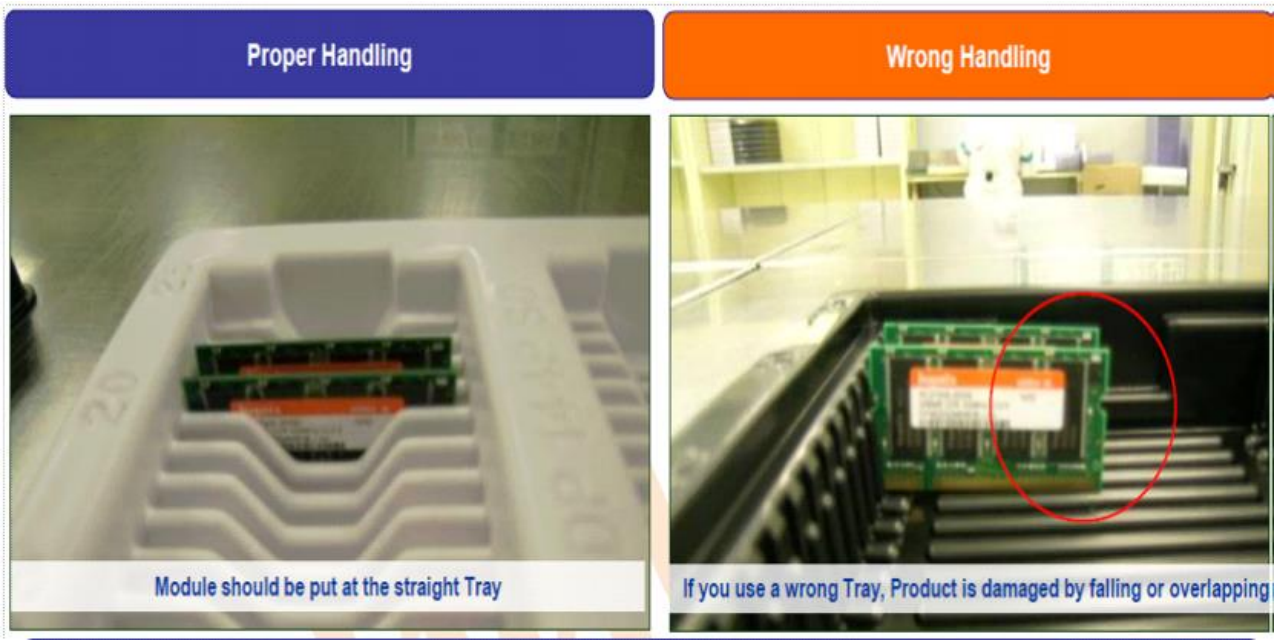


Figure 2 - Correct and Incorrect DIMM Tray Size

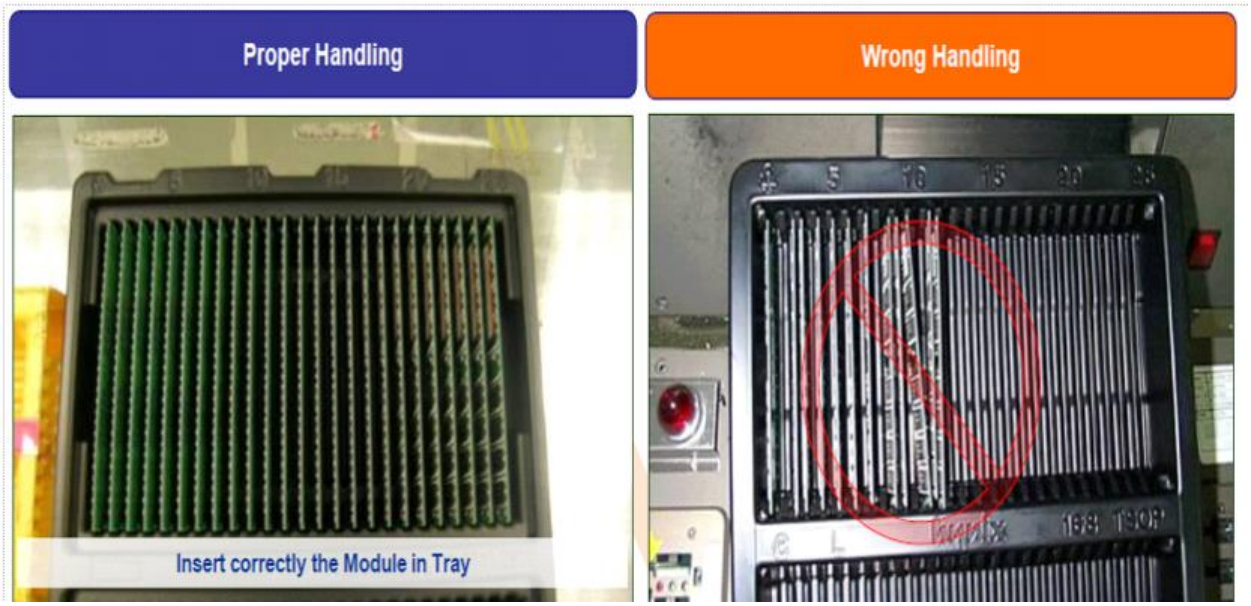


Figure 3 – Proper Storage use of DIMM inside the DIMM Tray

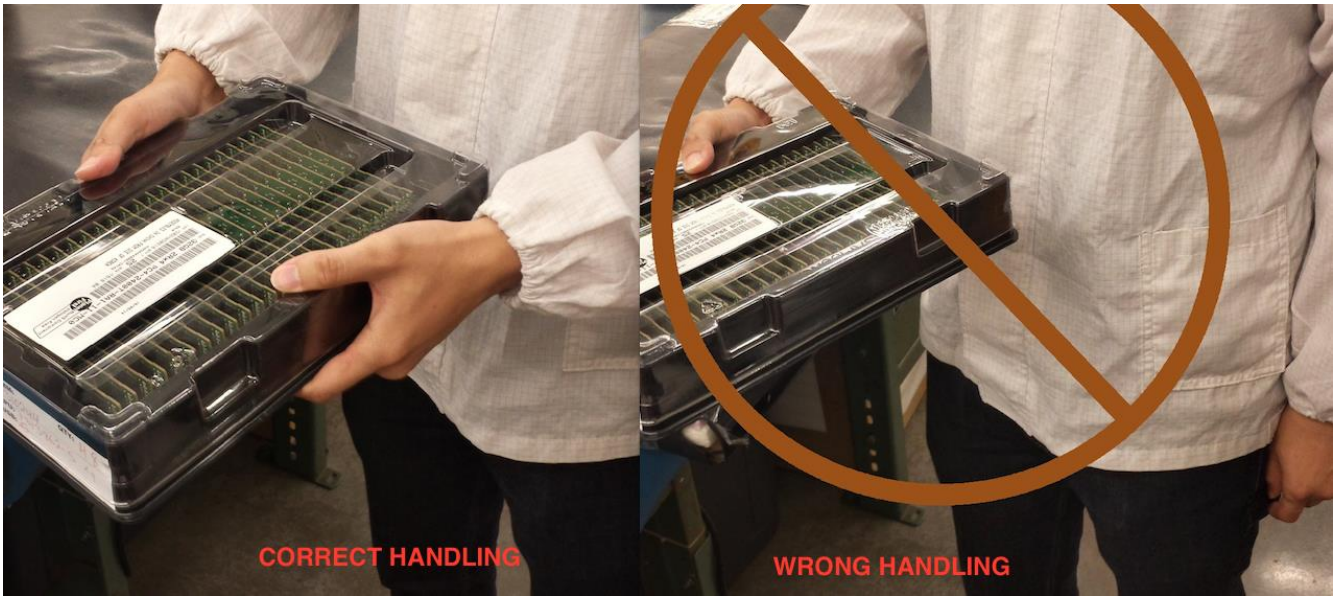


Figure 4 – Proper Way of Carrying DIMM Tray

Note: When storing the DIMMs, they must be in the original vendor packaging until they are kitted for production use. Stacking of the DIMM vendor's original shipping box, where it contains known good or fresh DIMMs from a supplier must be no more than 4 boxes high at any time.

3.1.2 DIMM Handling

1. DIMMs are always to be protected against ESD damage. Wear a fully functionalwrist strap or equivalent method, such as foot straps, that ensures DIMMs are protected from ESD at all times.
2. Wear low lint or lint-free ESD gloves when handling DIMMs.
3. DIMMs are handled on the (short) side edges using two hands whenever possible. See Figure 5 or by an Alternative Method on Section 3.1.2.1. Handling of the DIMMs on the (short) side edges using two hands must always be the default.
4. If handling by the side edges with two hands is not possible, pick up the DIMM by the center top center of the DIMM PCB carefully **avoiding** touching the components on the PCB and **avoid touching** the gold edge contact fingers. See Figures 5 and 6. This alternative method should be used as a last resort rather than a default or for convenience.

- **Anti-ESD straps should be used.**
- **The strap should be linked to your body.**

- **Modules should be pickup up from packing trays only one-by-one.**

Figure 5- Default method for DIMM handling

3.1.2.1 DIMM Handling Alternative:

Alternative method of handling, applicable to barcode scanning or DIMM bagging process or DIMM label removal, when handling by side edges is impractical. Any deviation has to be approved by Oracle.

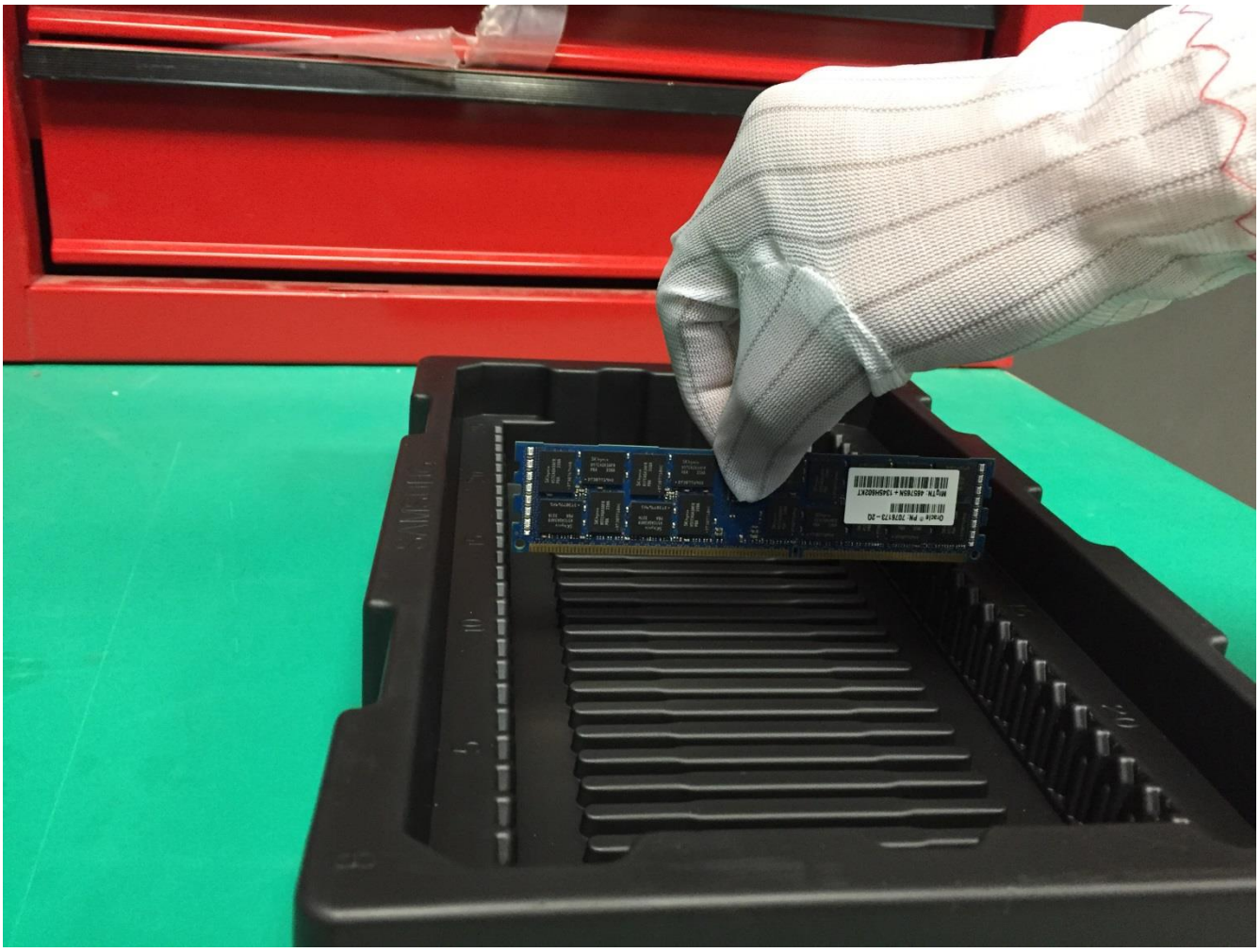


Figure 6 - Alternative DIMM Handling

Note: Only touch the PCB and avoid touching the components.

1. DIMMs are never held, stacked, or stored touching another DIMM. See Figures 7 and 8.

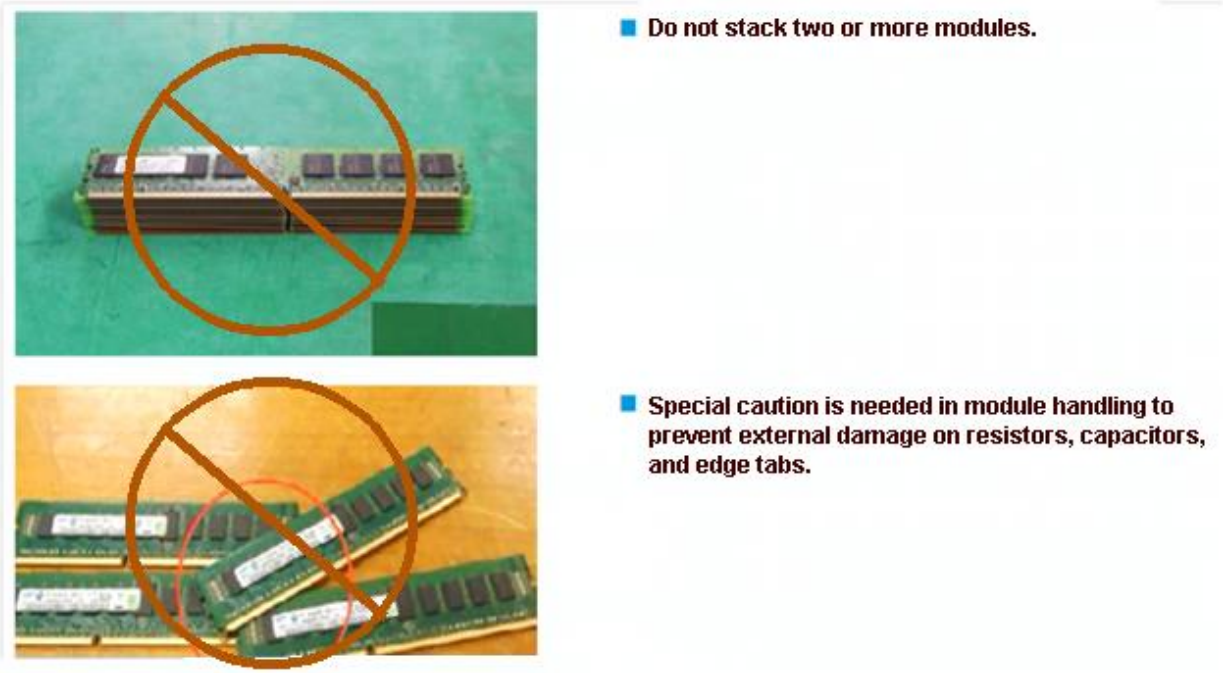


Figure 7 – Stacking Examples of DIMMs while laying on the table (Not Allowed)

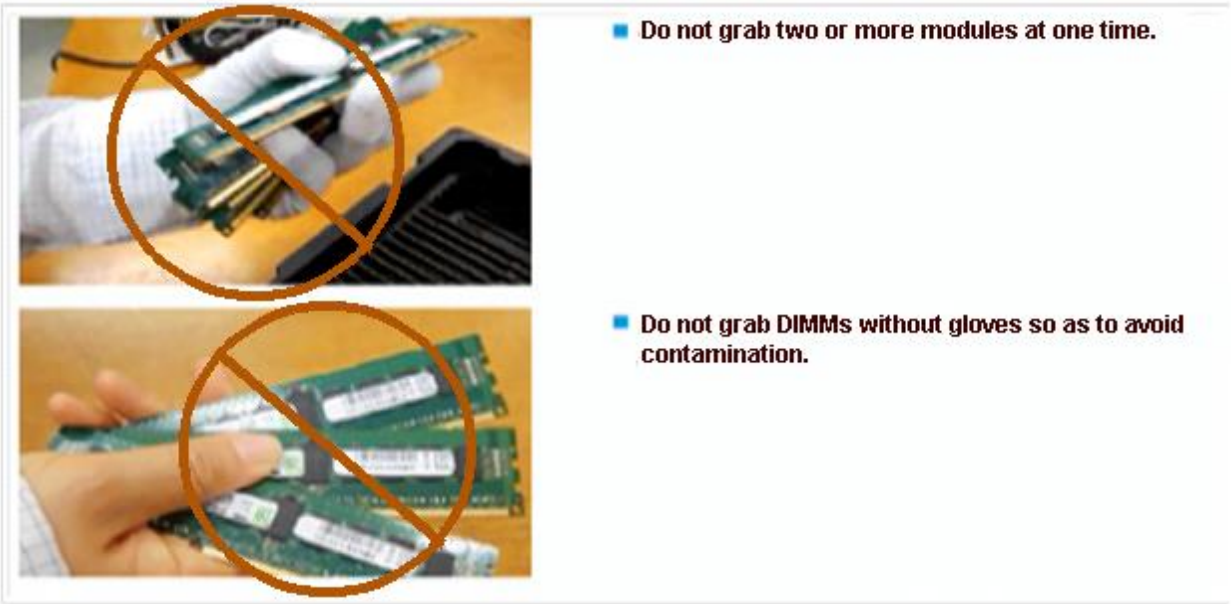


Figure 8 – Stacking Examples of DIMMs while handled by hand (Not Allowed)

2.The contact fingers of the DIMMs are never touched.

3. Dropped, twisted, bent, or otherwise damaged DIMMS are scrapped at the EM or RV.

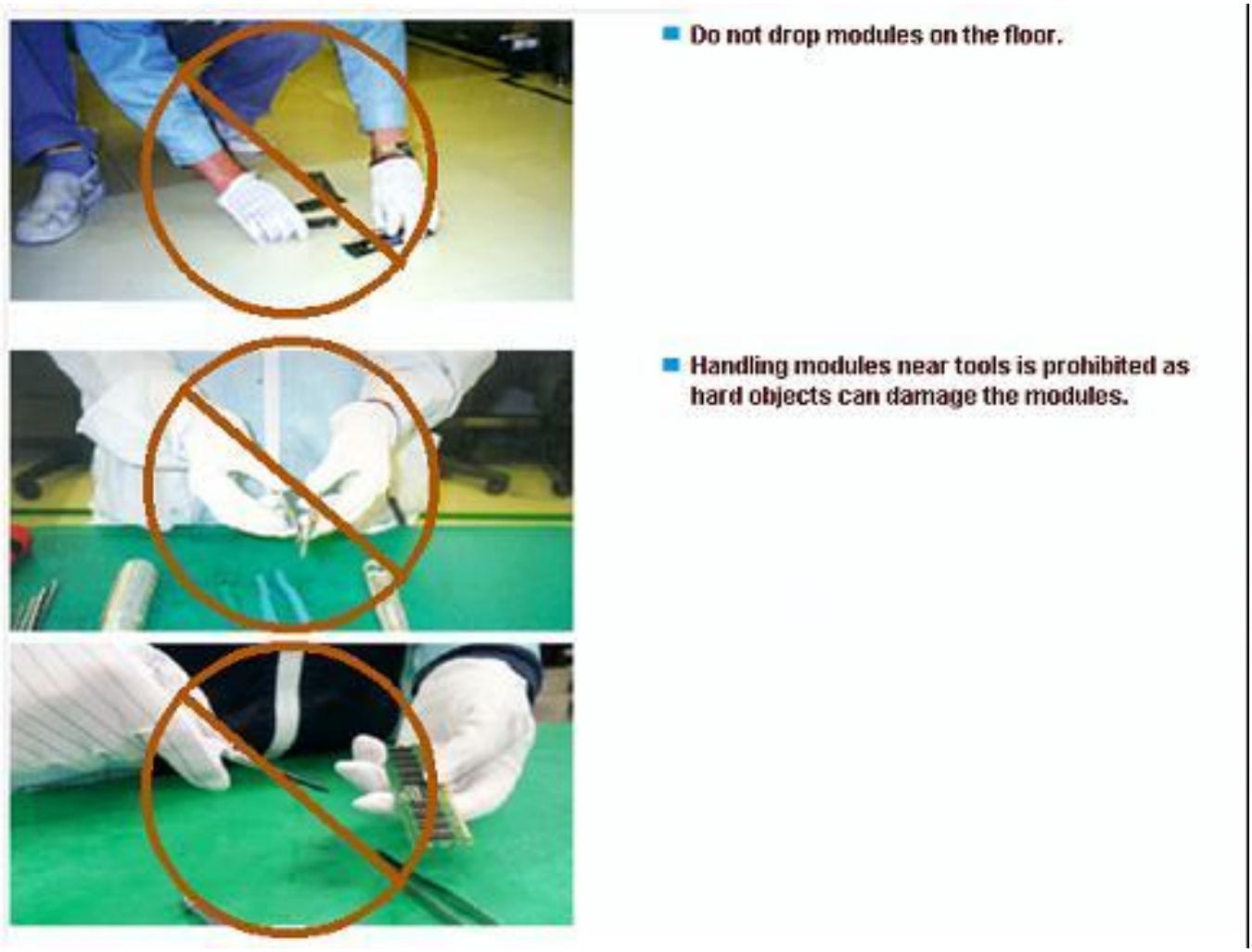


Figure 9 – Handling that causes Mechanical Damage (Not Allowed)

3.1.3 DIMM Installation

1. The operator opens all latches on the DIMM sockets completely.
2. The DIMM socket must be vacuumed using an approved vacuum, following the instructions provided in Appendix B, before DIMM installation.
3. Blowing out the sockets with clean-dry ionized air, rather than vacuuming, is allowable, but not preferred. Observe all ionizer preventative maintenance and conduct all performance evaluation checks as recommended by the equipment supplier and required under ESD guidelines. Follow the manufacturer's

recommendations for your clean dry air or nitrogen supply pressure. Outgoing pressure for dust-blowing purposes is usually @ 30psi. Per OSHA regulations, air-gun nozzles must have relief valves that limit pressure to less than 30psi if the tip is blocked. Air gun nozzle tips must be non-metallic and must never be allowed to contact any surface on the product. Pressurized air must never be aimed at a person for safety reasons.

4. After vacuuming or air-blow, and prior to DIMM insertion, the operator inspects the DIMM edge contacts and the DIMM socket for immovable debris, bent pins, or other irregularities. If any of these are present the board or DIMM is rejected.
5. Insert the DIMMs one at time on the empty DIMM socket using the correct handling procedure; make sure that you insert the DIMM on the correct notch orientation as shown on the left side of the picture below. Failure to do so will damage the DIMM. See Figure 10 below:

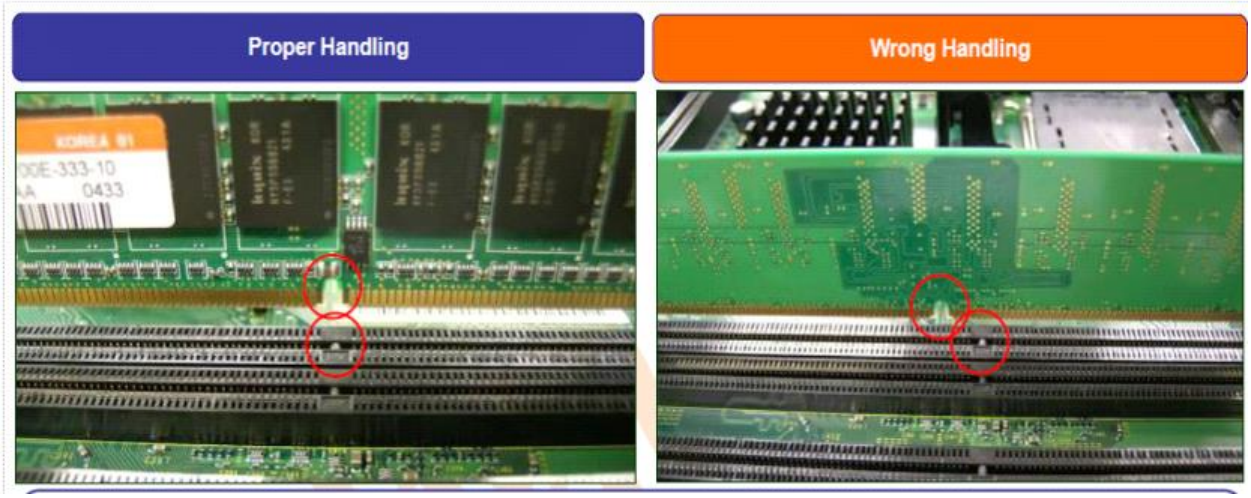


Figure 10 – Proper and Incorrect Notch Orientation during DIMM Installation

6. Do not angle the DIMM when aligning the DIMM at the top of the socket, and ensure that latches and keys fit properly in the appropriate DIMM notches.

7. The DIMMS are installed applying uniform pressure across the top of the DIMM. See Figure 11 below. This illustration shows insertion of a DIMM using operator fingers. However, use of properly qualified tooling, rather than fingers, for DIMM insertion is mandated for system assembly in high volume production.

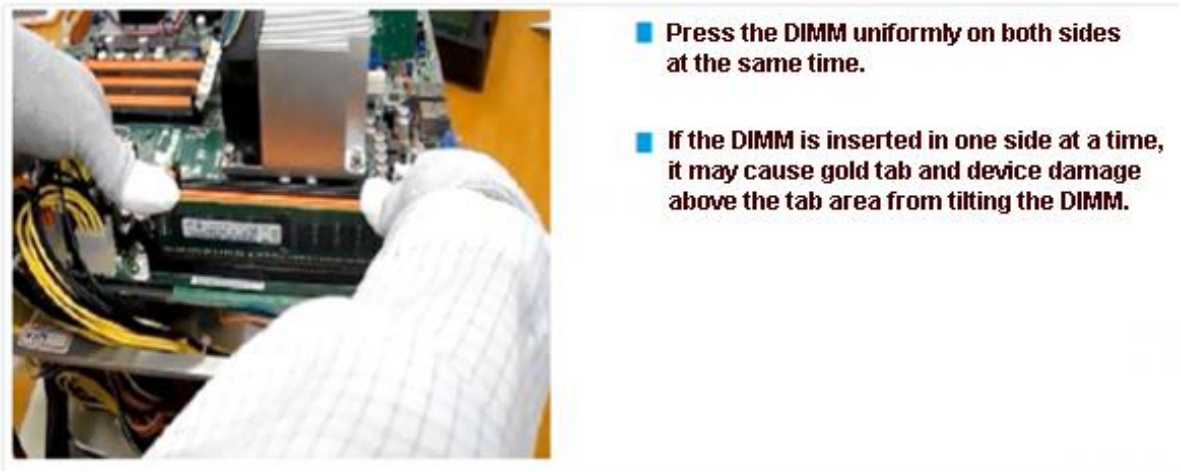


Figure 11 – Proper Manual DIMM Insertion Method

8. Unlatch the DIMM and re-seat if a double insertion is required. Double insertion is optional.
9. A tool with calibrated force (e.g., pneumatic) may be used to install the DIMM with even pressure across the top of the DIMM.
10. A hand held tool, which places uniform pressure across the top of the DIMM, may be used to install the DIMM.
11. Hand-tools or semi-automatic tools for insertion must be calibrated and regulated to the DIMM and approved by Oracle WWOPs Engineering. Use of approved tools is mandated for mass production operations.
12. Insertion tools must be maintained to a regular schedule. The design of such tools must be under revision control. Maintenance records for insertion tools must be available.
13. Upon completion of DIMM insertion, the operator inspects to ensure that the connector latches are locked in place.
14. If connector latches are not locked, additional pressure is applied uniformly across the top of the DIMM until connector latches are locked. Simply flipping up

the latches without applying downward force is not permitted. As always, care must be taken to ensure that too much force is not being used and that the tooling to perform this operation is not out of calibration or damaged.

15. The maximum allowed insertions of DIMMs is 15 times. Any DIMM that has exceeded maximum allowed insertions should be quarantined and dispositioned by Memory SE.

3.1.4 DIMM Removal

1. The operator unlocks both latches simultaneously. See Figure 12 below. To prevent the DIMM from popping out, the operator may touch the top edge of the DIMM with a gloved finger.
2. DIMM removal is performed touching only the edges of the DIMM. Do not touch gold fingers.
3. The DIMM is placed back into an appropriate DIMM carrier or packaging.

- The DIMMs are never "rocked" into place, eg. one side first then the other.
- DIMMs are never installed while touching or handing components on the sides of the DIMM
- DIMMs are never removed/installed with a screwdriver or similar engagement through the holes in the PCB.

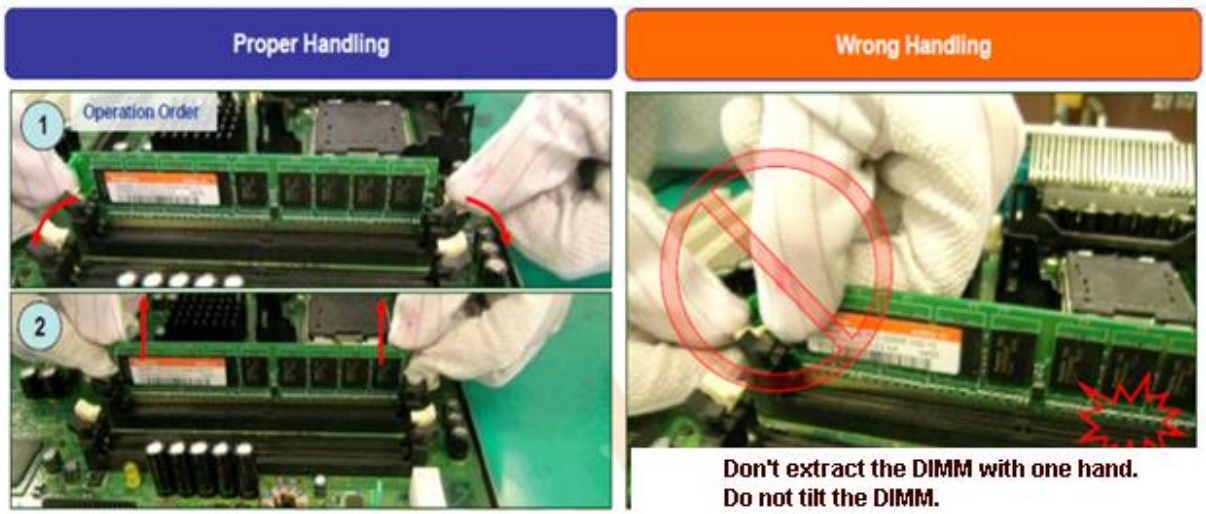


Figure 12 – Correct and Incorrect Method of Un-installing DIMMs

3.1.5 DIMM Labeling- Two Alternative Approaches

Procedure A:

1. For installing an additional label apart from the DIMM Vendor's label, prepare and clean the surface of a rigid table that is ESD compliant. ESD table surface cleaning has to be done at the beginning and end of the work and after production breaks.

2. Place the DIMM lying flat on the side of the DIMM where there is no DIMM vendor's label ensuring that the DIMM edges do not touch the table surface and the edge fingers are towards you. See Figure 13 - 15 below.

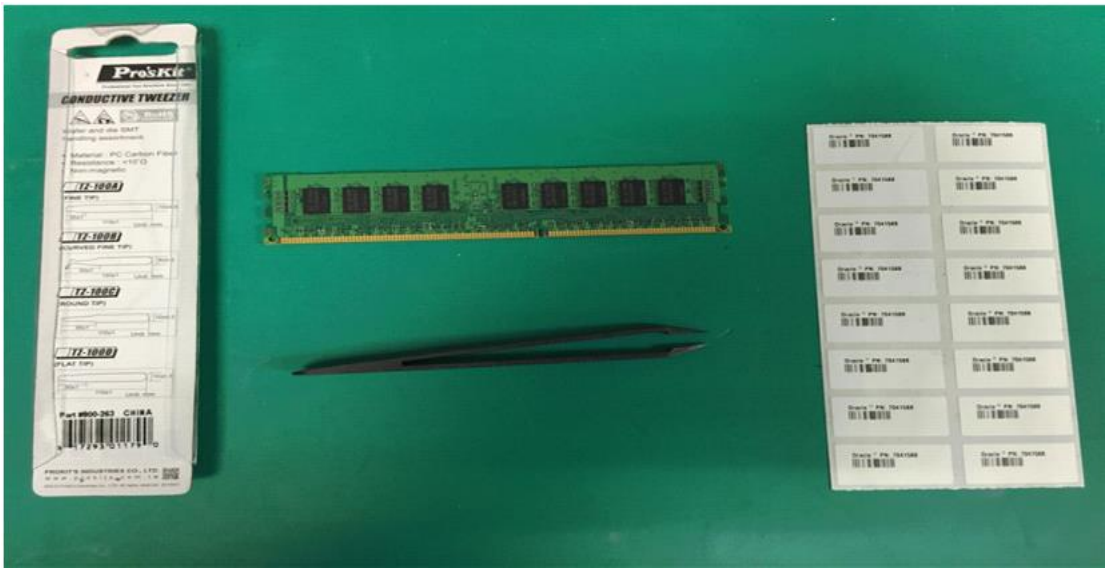


Figure 13 – Materials needed for DIMM Labeling

3. Use non-metal ESD compliant tweezers as shown below on Figure 14.

Figure 14 – Non Metal ESD Compliant Tweezers

4. Apply the label on the right side of the DIMM, see Figure 15 below:

Figure 15 – DIMM Label Application using Non-Metallic Tweezers

Note: If you are laying multiple DIMMs on the table for applying labels, ensure that the DIMMs ARE NOT stacked on top of each other; the DIMMs have to be lying flat on the table with enough clearance from each other to avoid the DIMMs getting in contact.

Alternate Procedure B:

This is the only DIMM handling procedure where the operator is **NOT** required to use gloves on both hands. From the DIMM tray; using the orientation of DIMM side without any label, lift the right hand side of the DIMM on an angle of no more than 30 degrees. Using the left hand without any gloves, stick the label on the DIMM component and slide fingers downward, carefully **avoiding** touching the gold pads with bare fingers while doing this procedure. Please see Figure 16 below.

Figure 16 – Alternative Method of DIMM Labeling

3.1.6 DIMM Label Removal

1. Handle the DIMM by the center. Avoid touching the components and contact fingers
2. Using the **non-metal** conductive tweezers, remove the label as seen on Figure 17. Non-metal conductive tweezers are the only tool allowed in this process when handling DIMMs.

Figure 17 – DIMM Label Removal

3.1.7 DIMM Label Removal with Heat Gun

This procedure must not be used as a default for DIMM label removal.

This procedure **will only be used** for labels that are difficult to remove, such as Brady Holographic labels or Plain Paper labels.

1. Setup the Heat Gun fixture by adjusting height between ESD mat to the Heat Gun nozzle from 6 inches to a maximum of 6.25 inches. See Figure 18 below.

2. Handle the DIMM by the center, avoid touching the components and contact fingers. Under the Heat Gun nozzle, aiming only at the label and using Low Setting, subject heat to the DIMM for a maximum of 5 seconds.

3. Remove DIMM label as per section 3.1.5.

Figure 18 – Heat Gun Set-up (6 to 6.25 inches from DIMM to Heat Gun Nozzle)

4 Environment and Chemicals

The environment in which DIMMs are inserted into a DIMM socket is very important to the success of achieving a good electrical contact. For the purpose of this document, the environment is defined as the temperature, humidity, cleanliness, and ESD sensitivity of a given area.

4.1 Temperature and Humidity

The temperature and humidity of a given area where product is built or stored must be compatible with product and component specifications. These limits are typically found in the component data sheets and in other product specifications/standards. Most products have operating and non-operating requirements. Ensure that you understand the limits of both conditions as they apply to the environment you will have product assembled in. *Note that Oracle non-operating and operating product specifications all require non-condensing conditions.* Rapid changes in temperature may cause a dew-point violation even if temperature and humidity limits seem to be within product specs.

Please also refer to the Oracle document 923-3695, *Systems Quality: Best Practices Guidelines for Manufacturing and Repair Vendors* that has more guidance around environmental controls.

Cleanliness and particulate avoidance plays a large role in minimizing DIMM re-seats and retest events. Oracle studies supply evidence that “dirtier” environments have higher occurrences of DIMM initialization failures which require a re-seat.

4.1.1 Particulates

Reference Oracle document 923-7051939, *WWOPS Manufacturing: Oracle Factory Qualification Particulate Count Guideline* to meet particulate requirements for areas in which DIMM Assembly, DIMM socket assembly and DIMM installation are performed.

4.1.2 Packaging and Contributions to Cleanliness

Packaging is defined as any container used to hold DIMMs. Note that containers may be nested within another container and the combination of those containers constitutes an entire package.

Packaging is broken up into a few different parts. First is the cardboard box packaging that the DIMM trays and other components are shipped in. These boxes are typically large sources of debris, not only because of the fibers introduced from the box making process, but because of the dust that collects on and in these boxes throughout the shipping process. It is therefore recommended that cardboard boxes are eliminated for use on the factory floor, or separated from assembly areas by walls.

DIMM trays can also be another source of contaminants. DIMM trays are shipped new from the DIMM vendors. Care must be taken to clean trays as required, if DIMM trays are reused for T-cap storage purposes as these containers also act as dust collectors. Always keep the lids in place on these trays. Pass/fail criteria must be established for tray cleanliness with Oracle. Minimum fail criteria for DIMM Tray cleanliness is any sign of visible debris, sticky or liquid or gel like substance. If after cleaning visible debris, sticky or liquid or gel like substance is present, DIMM tray is disqualified for use and scrap. Additional disqualification of DIMM tray use is any visible sign of damage, tear, crack or deformation. EM/IM is free to add additional fail or disqualification requirements and has to inform Oracle.

4.1.3 Factory Conditions

Debris due to factory conditions can cause problems with the DIMM to connector interface and other connector interfaces. Because of this, the whole manufacturing process must be looked at. Some points to consider:

- Is a separate area with tighter cleanliness controls required to do this level of assembly?
- Will laminar flow hood benches help my process eliminate troublesome particles?
- Will properly setup ionizers help with both particles and ESD concerns?

- Is the air filtered, to what extent? (For particle size and humidity). Is filtering properly maintained?
- Are the kitting/receiving/pack-out areas contributing to increases in particulates and contaminants in the assembly areas?
- Are traffic patterns around the assembly areas stirring up dust and dirt?
- Are floors and horizontal surfaces cleaned frequently to avoid dust and dirt buildup?

  Note that humid factory conditions can also contribute to corrosion or oxidation in contact areas which have exposed Ni or Cu (due to contact wear or improper plating).

4.1.4 Operator Conditions

Operator and operator area conditions that contribute to the cleanliness and particulate count of a given area are often overlooked. In an effort to be deliberate about the process, the following items must be given some attention. Note that these are examples and should not limit the scope of what an operation might require.

1. Use of clean gloves during handling operations prevent skin oil and particles from being transferred to critical contact areas of product such as DIMM edge fingers.
2. Use of hair nets or tying back hair (for hair below chin length) prevents loose hair and skin from contaminating a work space and assembly.
3. Clean, ESD-compliant smocks, worn properly, prevent clothing fibers from getting caught in sockets or stuck on contact areas. Smock sleeves must cover arms and clothing to the wrists. Smocks must be laundered on a controlled schedule and under conditions which do not damage the ESD properties of the smocks.
4. A clean work area that is free of food, makeup, personal items, etc., will prevent contamination of contact areas or accidents from happening to an assembly.
5. Operators need to maintain clean clothing and hands when moving from assembly areas to the cafeteria or break areas. Clean smocks and gloves must not be worn outside the areas where production material is handled.

In all these cases, pass/fail criteria must be developed to ensure and enable compliance. For example, we might have guidelines on glove quality, condition, and cleanliness.

Minimum fail criteria for glove/smock quality is any presence of sticky or gel like substance or stain that leave/transfer residue or foul odor requires cleaning. If after cleaning, presence of sticky or gel like substance or stain that leave/transfer residue or foul odor remains, the glove or smock is disqualified for use. Additional criteria for disqualification for use of glove/smock are any tear that impedes the function intended for its use, including ESD, or shredding. For smocks, missing or non-functional zipper requires repair. EM is free to add additional fail requirement and has to inform Oracle.

4.2 ESD

Oracle's governing specifications on ESD are compliance to ANSI/ESD S20.20-14. With the growing electrical sensitivity of components, ESD specification updates are frequent. Worth noting here is that DIMM sockets have been shown to carry a charge from the socket manufacturer. This charge can eventually build up on a PCBA and cause damage to other components on the PCBA. Necessary precautions, such as adherence to required Factory ESD practices, requirements and safety measures must be taken during assembly and repair to ensure that no ESD damage is being induced. This applies to all passive and active components used in a system or for assembly.

4.3 Chemicals and Associated Materials for Cleaning of Gold Contacts

If visually contaminated gold contacts are to be cleaned, Oracle only allows approved chemicals for cleaning. The choices are Ethanol or IPA (electronics grade, typically 95% and above) or a solder paste manufacturer-recommended chemical such as Alpha Tech Wash that has been approved and tested for use with other chemicals present in the manufacturing process.

Under no circumstances should erasers be used to clean gold finger contacts. Regardless of the eraser used; white, pink, or otherwise; the process leaves substantial residue behind and can damage the gold plating leaving the contacts subject to oxidation.

5 People Resources – Training

The DIMM installation process has many manual elements to it; therefore it's important that the operators or technicians performing this operation have adequate training, certifications, and recertification after a given time or incident.

The operator's ability to provide feedback to the engineering team is also valuable to the process engineer to develop effective yet operator friendly processes.

6 Equipment and Tooling – Machine

Proper use of DIMM insertion tools (manual or automated) is encouraged. There are several methods for inserting DIMMs into a DIMM socket using tooling. Two methods that are approved for use by Oracle are manual press tools that are used to press in one DIMM at a time and pneumatic fixtures which can be qualified to final seat one or more DIMMs at a time. In either case the tools must be qualified using strain gauge methodologies and mechanical tolerance studies for fit. These tools are generally very important as operators that don't have these tools at their disposal quickly learn how difficult and damaging seating many DIMMs sequentially can be to one's fingers and hands. As a result, DIMM seating on a production level is often poor if operators do not use insertion tools.

Support fixtures for boards are generally required for DIMM insertion if the PCBA does not utilize a supportive carrier. A chassis may be used as a supportive carrier. Again, the support fixture must be validated using strain gauge testing and checked for mechanical interferences.

Unlatching the DIMMs can also become a tedious and/or finger-busting operation. Latch/unlatch tools can be developed to help operators ensure they've met the insertion and removal guidelines.

Vacuuming the DIMM sockets and other types of sockets has become a standard practice. This is favored over using a filtered air gun as we know where the debris in a vacuum goes. When using an air gun, we may be just moving the problem from one place to the other. Vacuuming does show improvement in the yields. The Appendix B provides information on Oracle-approved ESD-safe vacuums.

The time between a cleaning operation such as vacuuming and the DIMM insertion must be minimized to avoid re-contaminating the contacts. This delay should be no longer than *20* minutes.

If an air-gun is to be used, care must be taken to ensure that clean, dry, oil-free air is being blown through a nozzle with a minimum 5 micron filter in line. A process must be developed that minimizes risk of blowing contaminant from one area into another open socket.

As mentioned in the other sections, qualification and maintenance of above equipment is necessary.

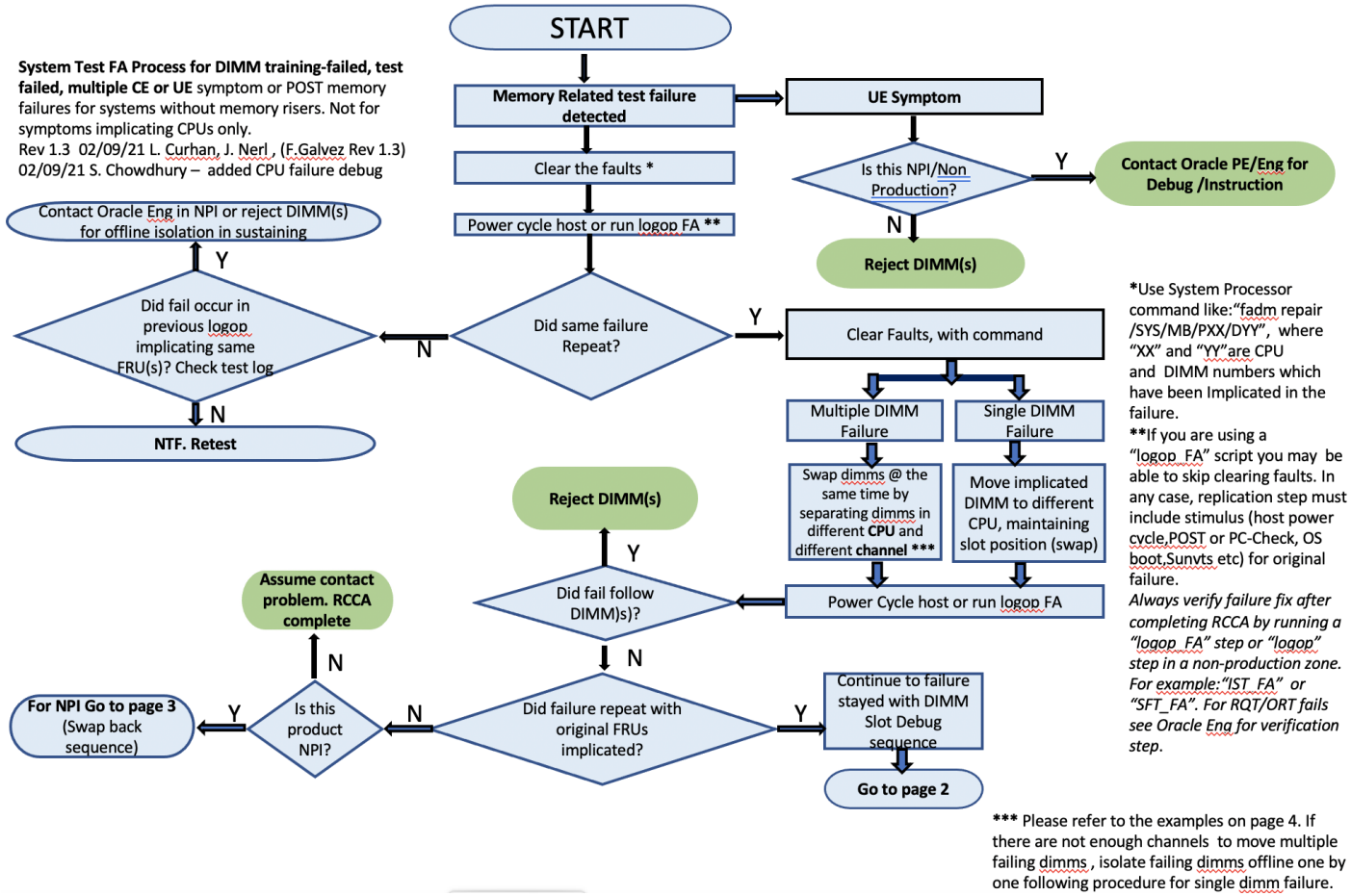
7 Components – Material

At times, the root cause to contamination issues or out of specification conditions will be a function of the DIMM or DIMM connector component. These issues require solid sub-tier controls, reasonable incoming inspection processes, and a diligent and knowledgeable failure analysis team.

Oracle documents, 923-2349, *WWOPS Supply Management: Sub-Tier Supplier Management Roles and Responsibilities*, and 923-3695, *Systems Quality: Best Practices Guidelines for Manufacturing and Repair Vendors* provide guidance on Oracle expectations with respect to component and sub-tier management.

Appendix A - Failure Analysis Process Flows for DIMM-Related Symptoms

A1 System Test FA Process Without Memory Riser



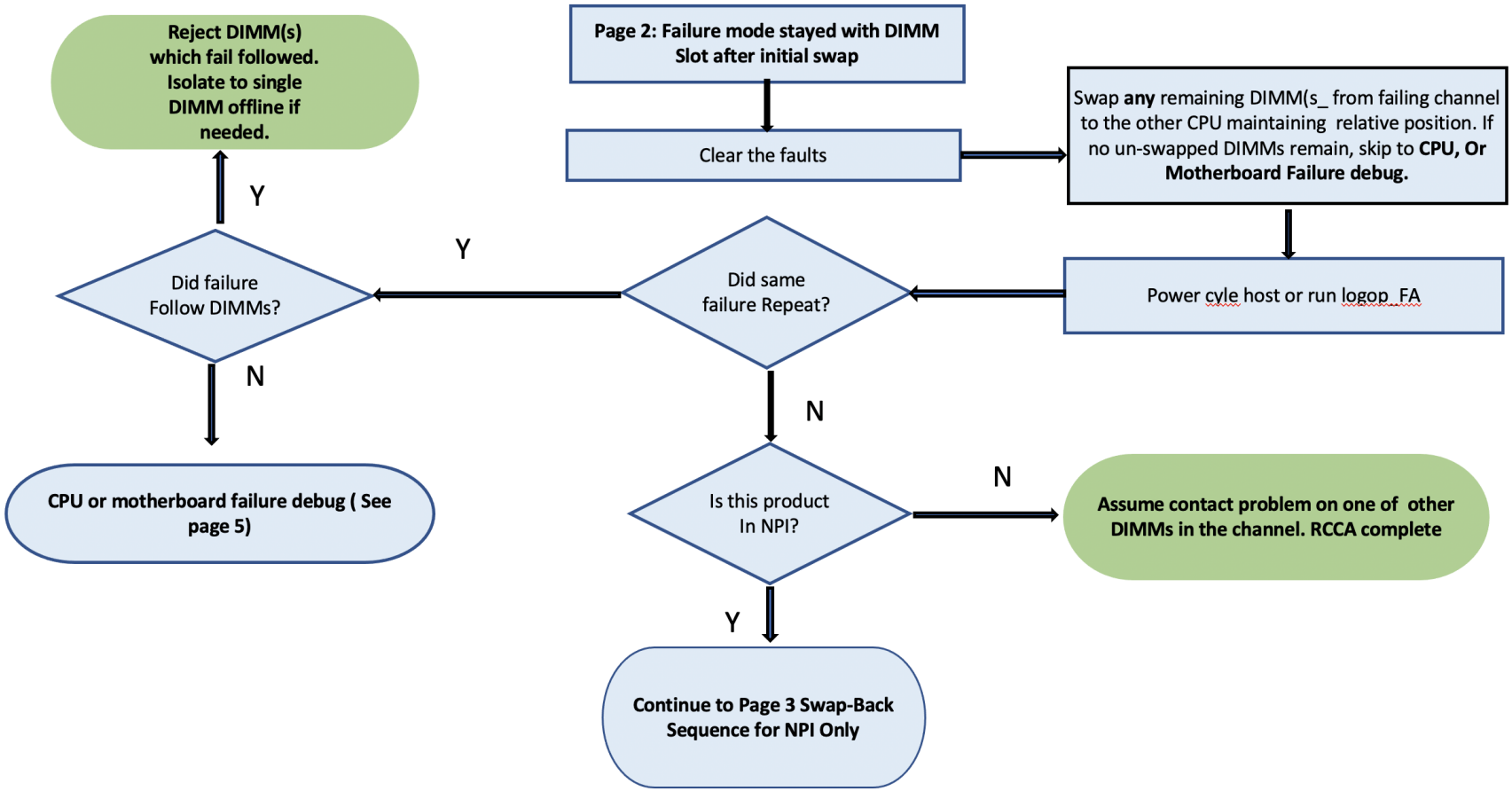
*Use System Processor command like:"fadm repair /SYS/MB/PXX/DYY", where "XX" and "YY"are CPU and DIMM numbers which have been Implicated in the failure.

**If you are using a "logop_FA" script you may be able to skip clearing faults. In any case, replication step must include stimulus (host power cycle,POST or PC-Check, OS boot,Sunvts etc) for original failure.

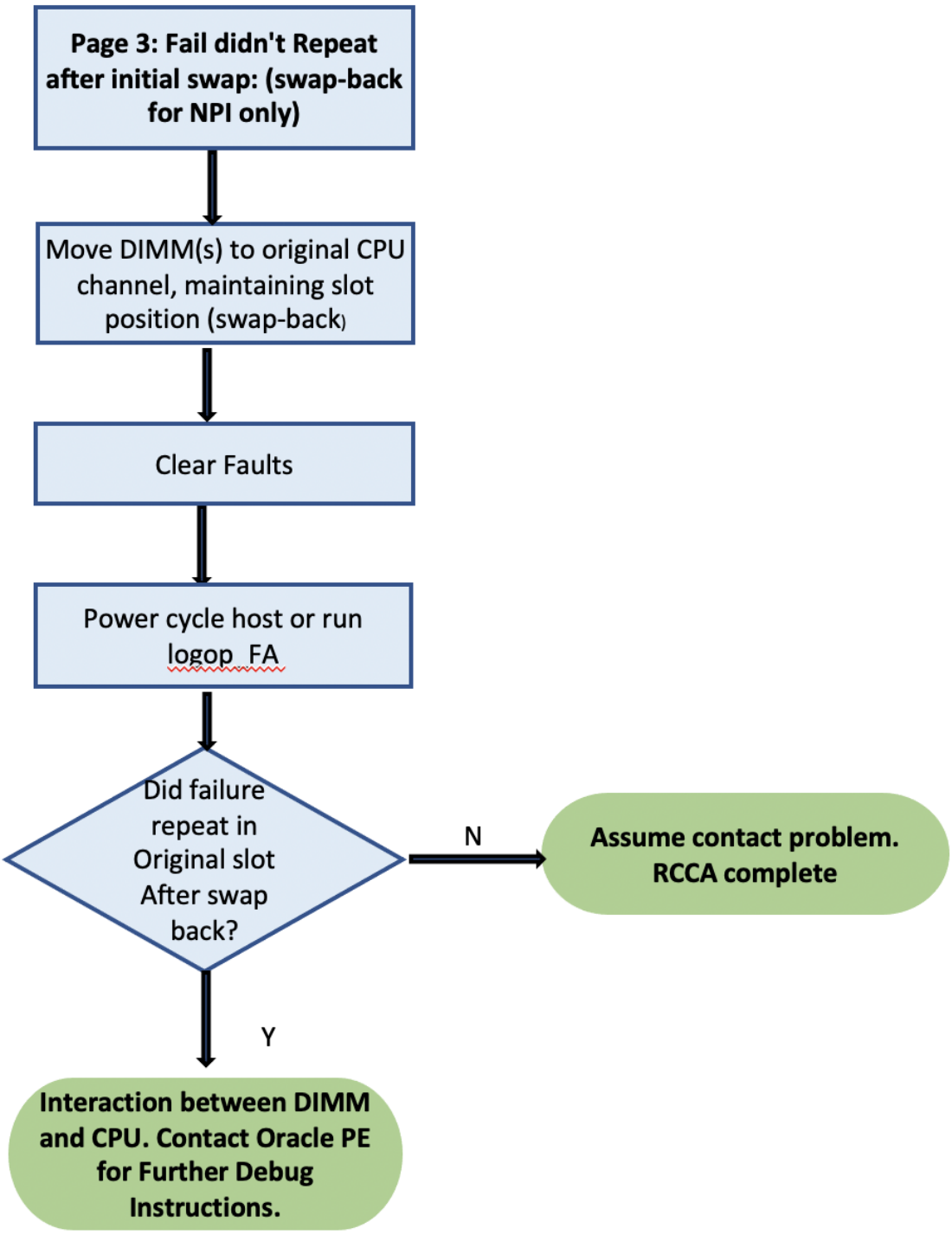
Always verify failure fix after completing RCCA by running a "logop_FA" step or "logop" step in a non-production zone. For example:"IST_FA" or "SFT_FA". For RQT/ORT fails see Oracle Eng for verification step.

*** Please refer to the examples on page 4. If there are not enough channels to move multiple failing dimms , isolate failing dimms offline one by one following procedure for single dimm failure.

System Test FA Process without Memory Riser (continued)



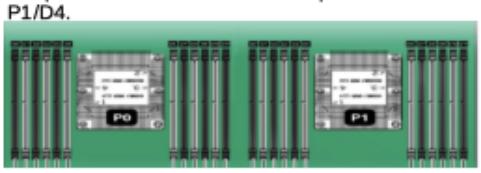
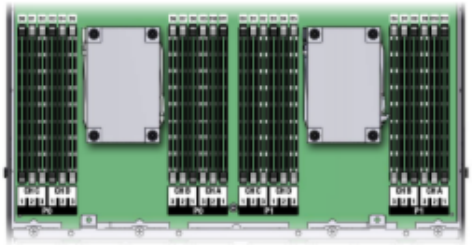
System Test FA Process without Memory Riser (continued)



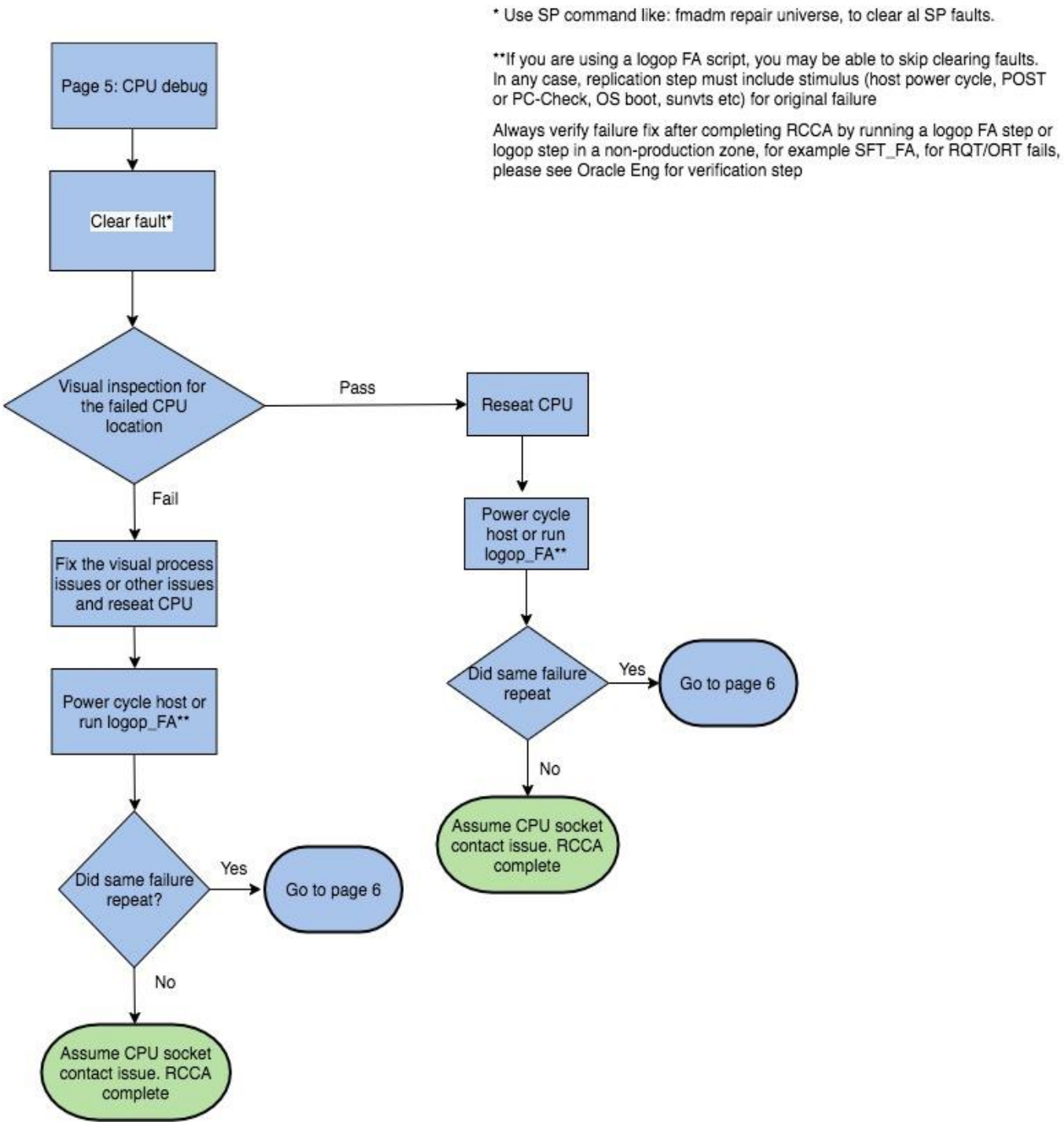
System Test FA Process without Memory Riser (continued)

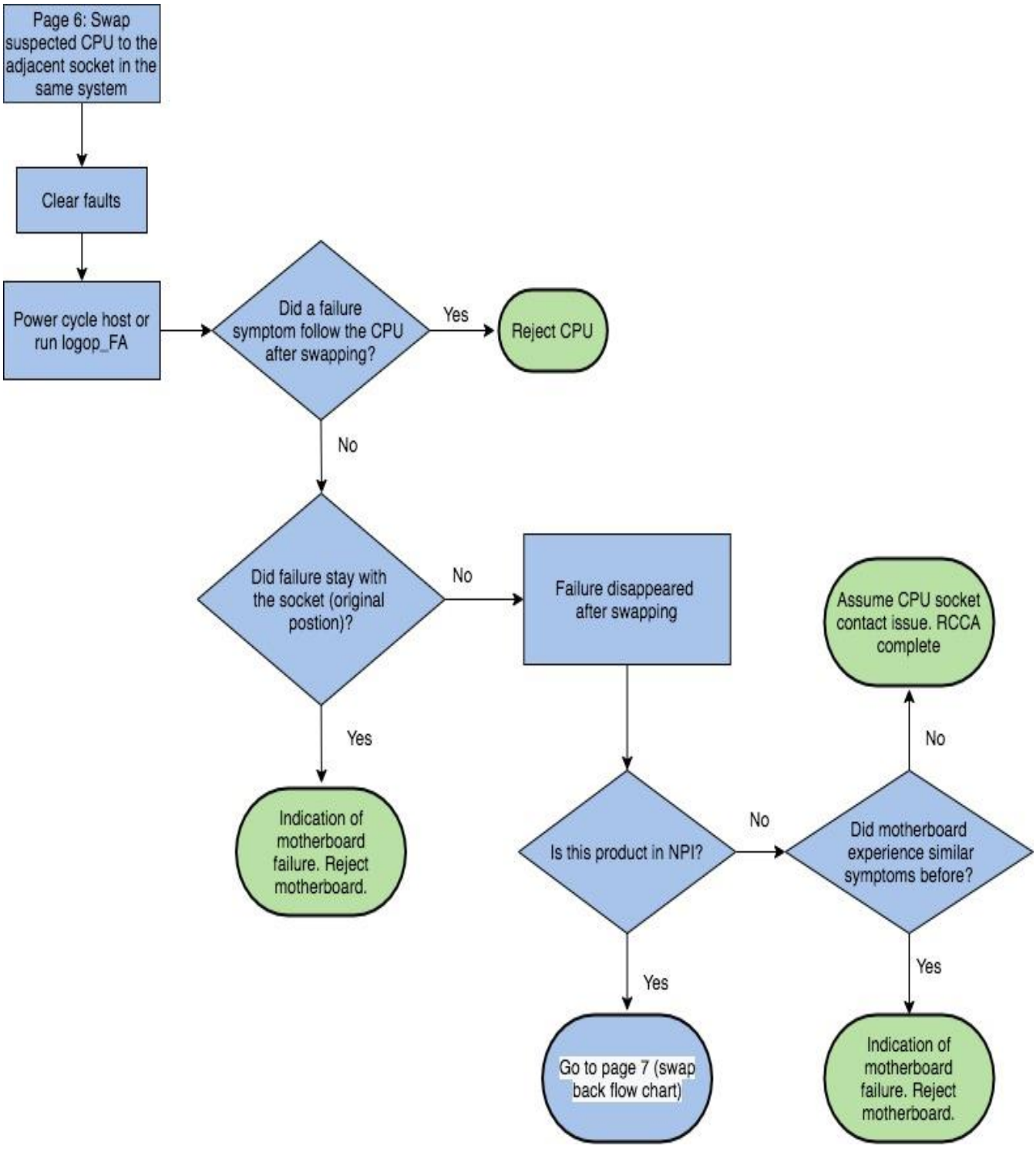
(Page 4)
***** Multiple dimm failure examples. Please refer to platform specific documents, service manuals or specs to accurately identify dimm channel grouping for swapping dimms.**

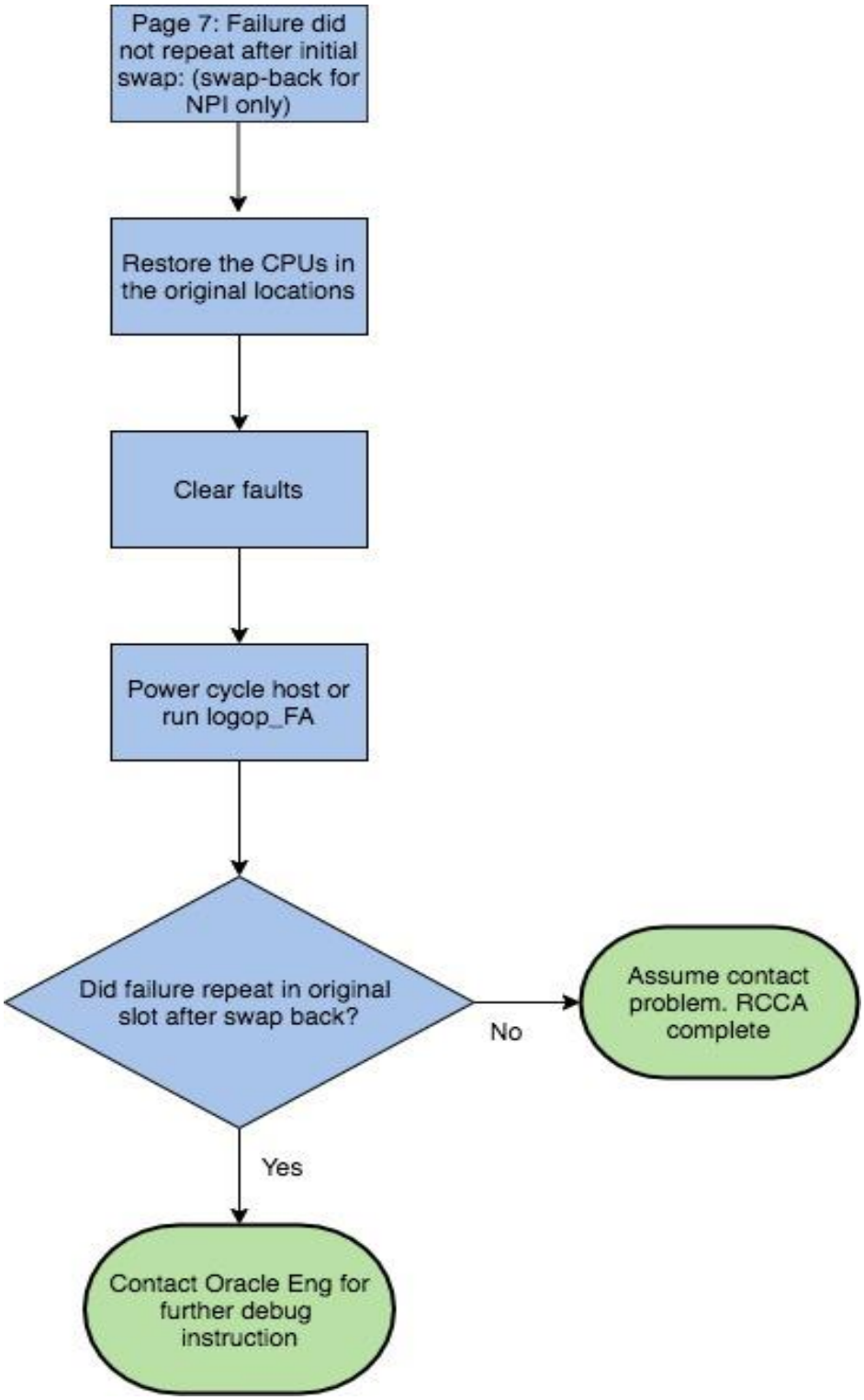
General Rule:
- A channel is comprised of adjacent DIMMs. Slot numbering begins with D0.
  Ex 2DPC : D0 & D1, 3DPC : D0,D1,D2
- Starting with X7, all DDR4 are 2DPC : X7, X8, X9, E2-2c, E4-2c, A1-2c
- 3DPC platforms are X4, X5 and X6.

Scenarios:	Swap	CPU, Channel, Slot example , NOTEs:
1. Training Failures taking down a channel or a group of DIMMs (2DPC – two dimms, 3DPC – three dimms)	Swap Dimms on different CPU and different channels for each dimms relative to the slot positions (near to near socket and far to far socket on a different channel.) If there are not enough channels to move multiple failing dimms , isolate failing dimms offline one by one following procedure for single dimm failure.	**Ex: X7** - 2DPC : P0/D0 and P0/D1 are both failing, swap P0/D0 with P1/D11 and swap P0/D1 with P1/D4.   **Ex: X6** – 3 DPC : D0/D1/D2 are in the same channel. 
2. UE/CE Pair	Replace CPU if you see Intel CE storm BUG 26803311 signature. If not, swap both dimms at the same time to a different CPU and channels, (near DIMM goes into a different channel's near DIMM socket, far DIMM goes into a yet another different channel's far DIMM socket).	Intel CE storm BUG 26803311 signature: In host_debug_err.log. If you scan for the string chip_sel and see multiple values in this field (0, 1, 4 and/or 5), especially if on the D8/D9 or D2/D3 pair. Usually see thousands of Ces which ultimately lead to Ues.
3. Multiple DIMM Failures (two or more failing dimms)	Swap Dimms on different CPU and different channels for each dimms relative to the slot positions (near to near socket and far to far socket on a different channel.) If there are not enough channels to move multiple failing dimms , isolate failing dimms offline one by one following procedure for single dimm failure.	Refer to the specific platform configuration for dimm channel grouping.

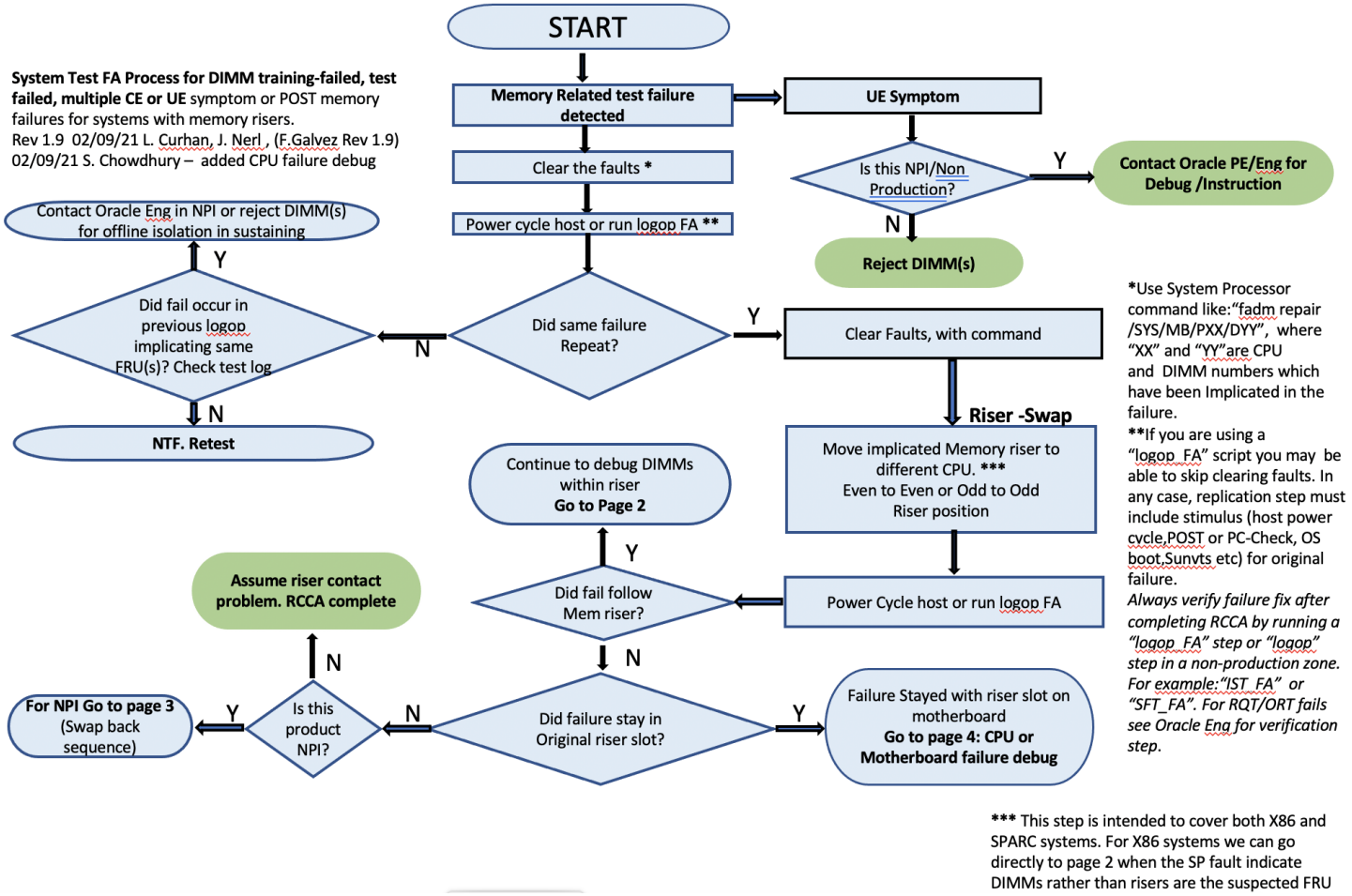
CPU/Motherboard debug sequence w/o Memory Riser





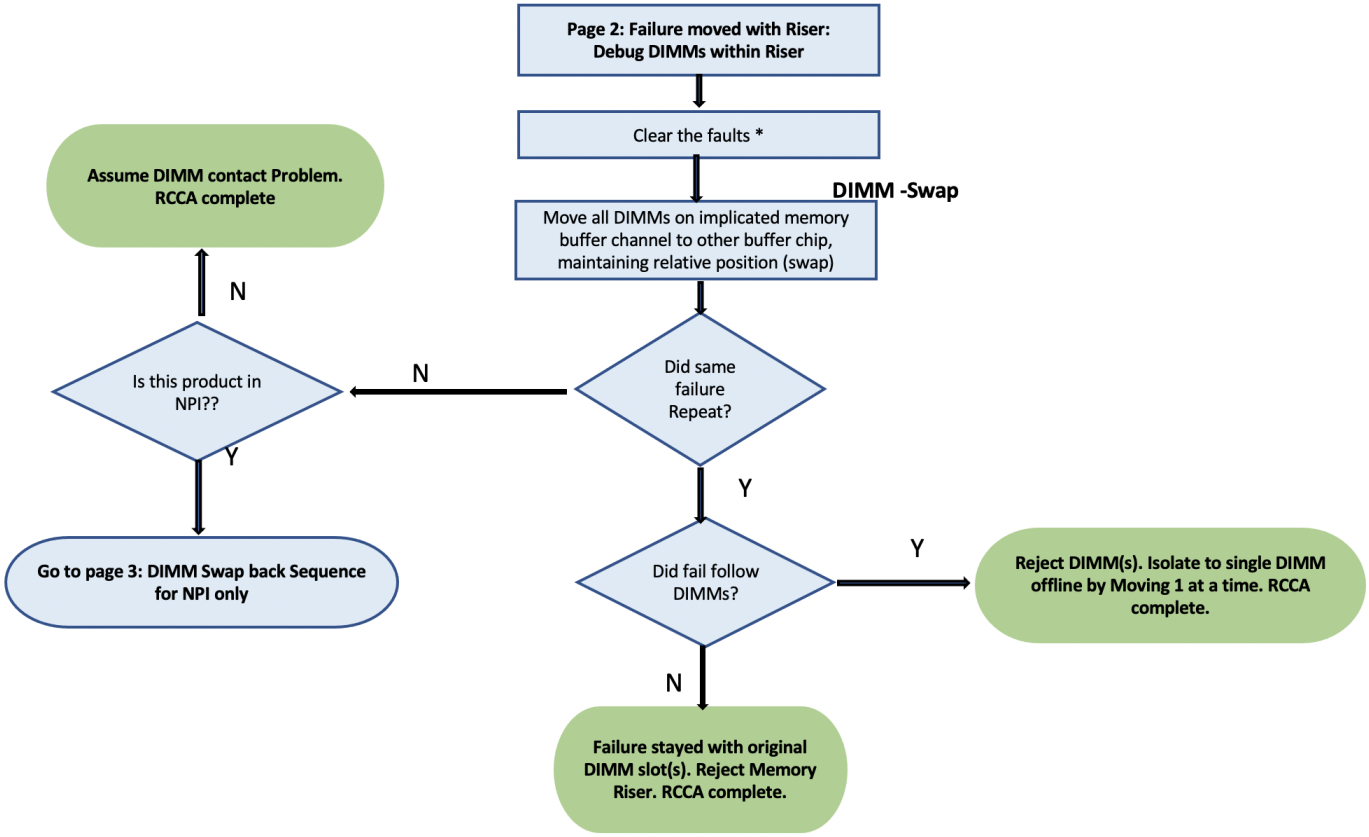


A2 System Test FA Process with Memory Riser

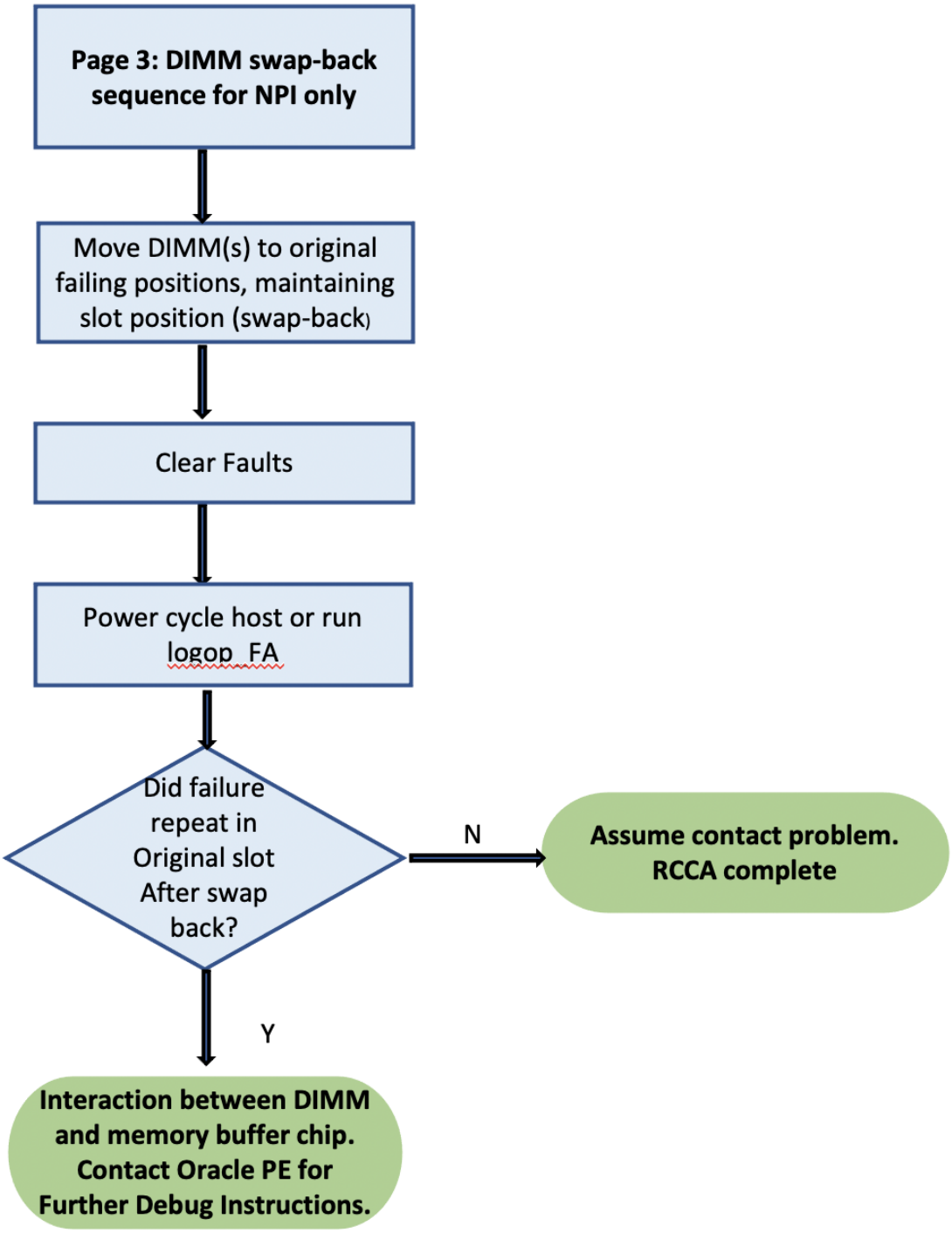


*** This step is intended to cover both X86 and SPARC systems. For X86 systems we can go directly to page 2 when the SP fault indicate DIMMs rather than risers are the suspected FRU

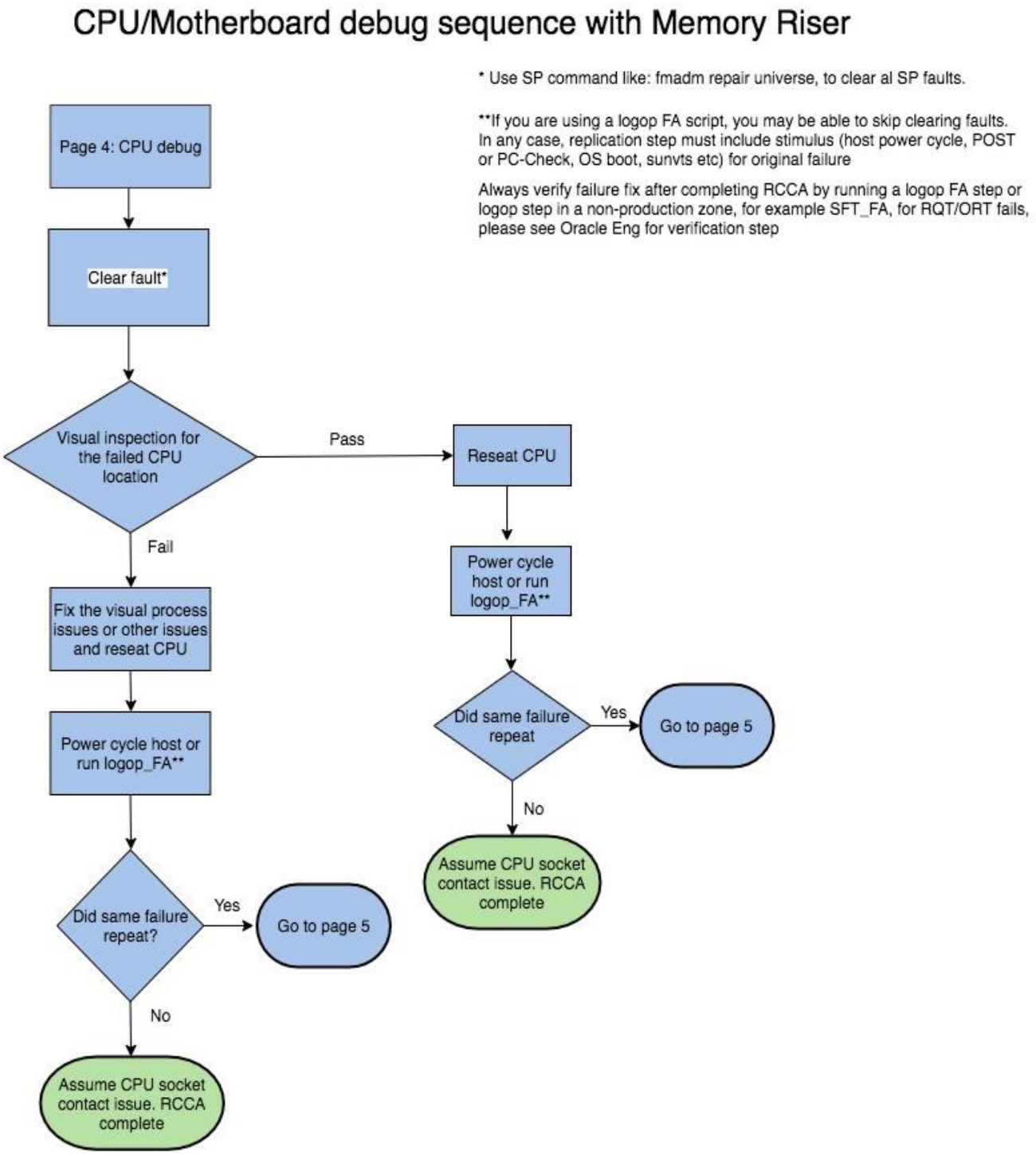
System Test FA Process with Memory Riser (continued)



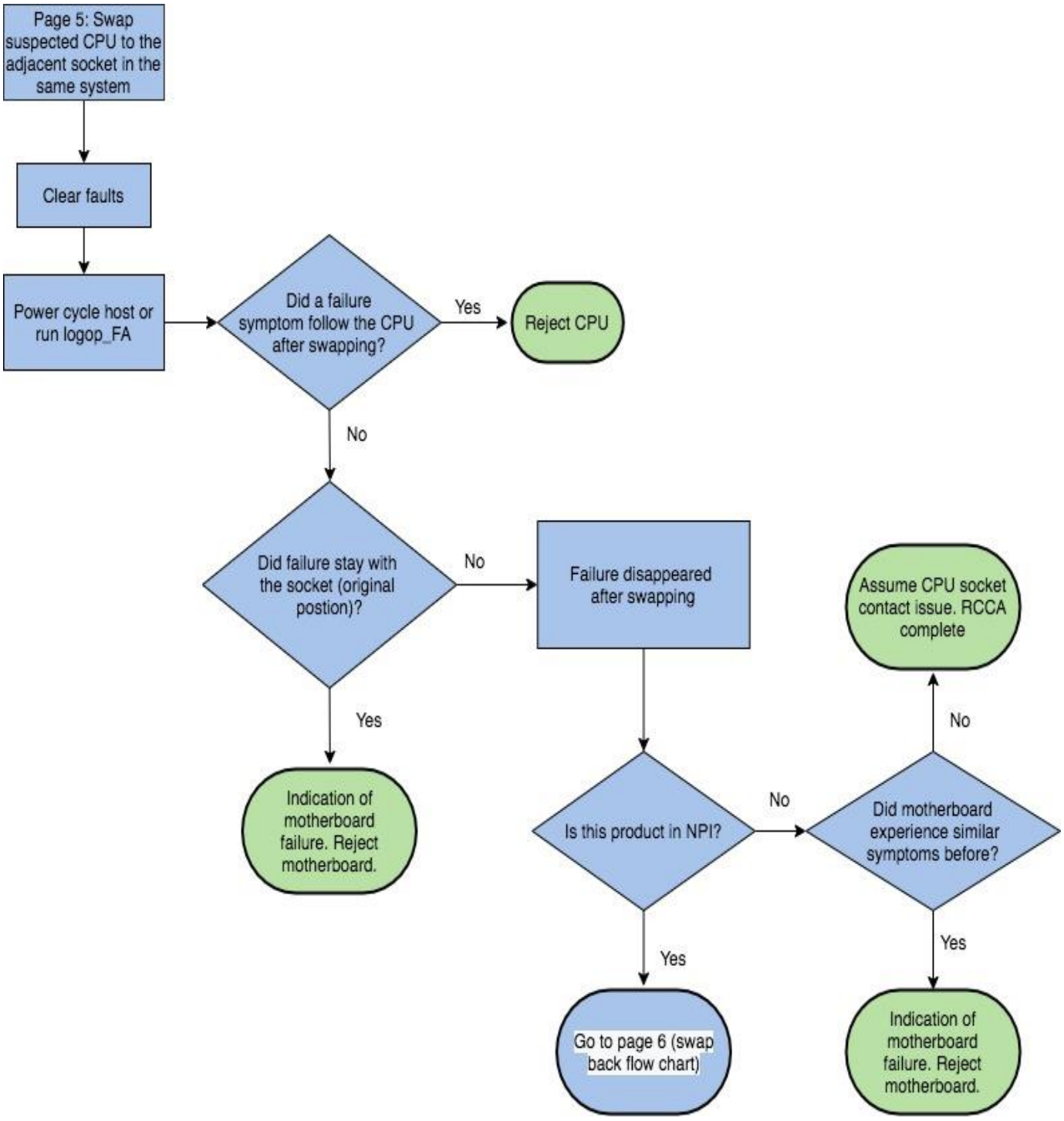
System Test FA Process with Memory Riser (continued)

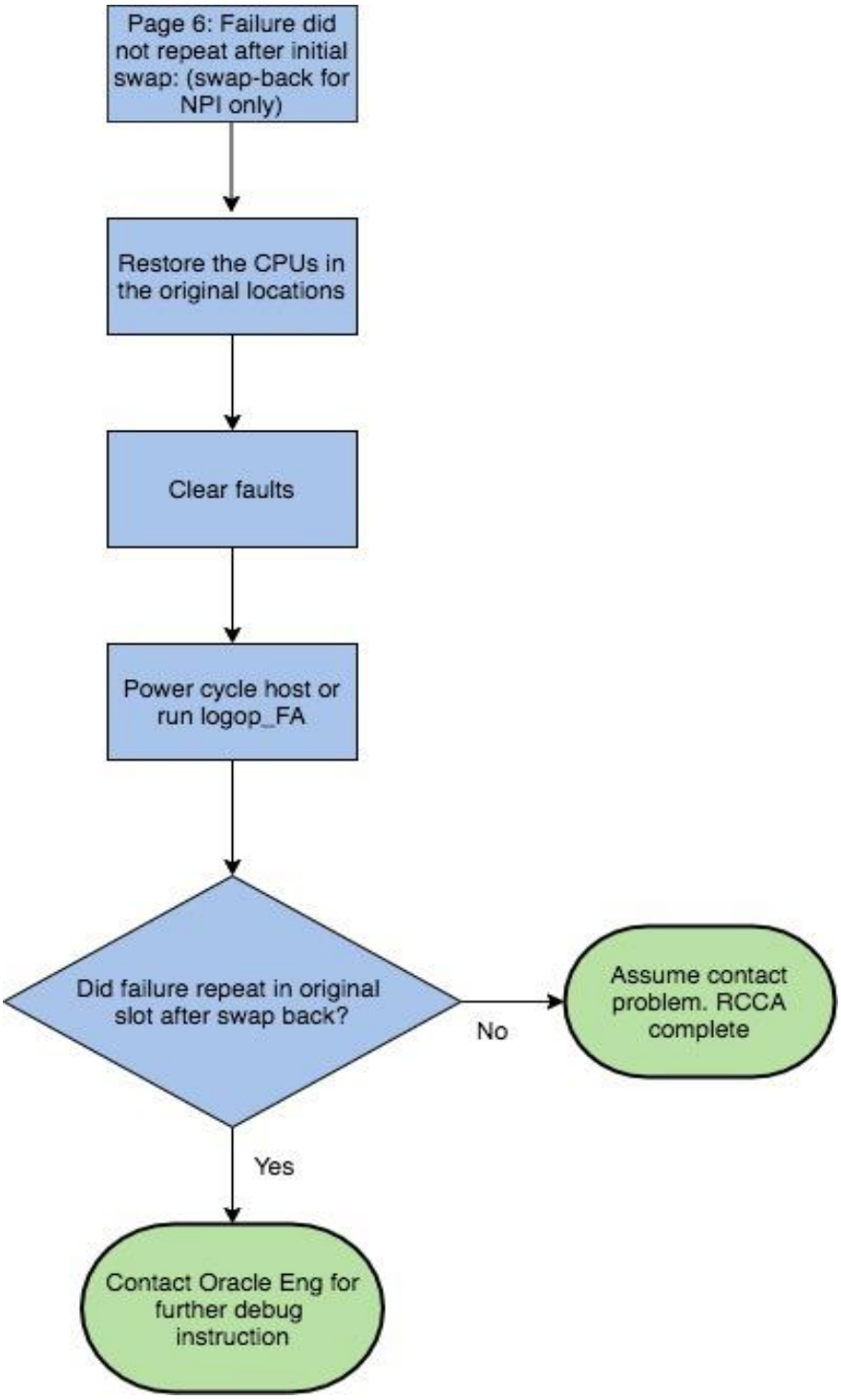


System Test FA Process with Memory Riser (continued)



System Test FA Process with Memory Riser (continued)





Appendix B - Oracle ESD-Safe Vacuum Use and Maintenance Guidelines

B1 Purpose

The purpose of this appendix is to insure that best practices in use and maintenance of ESD-safe vacuum cleaners used for electronics are followed.

B2 Application

This document applies to all electronic components that may require removal of particulate matter, primarily but not limited to edge-card connectors (DIMM sockets, PCI/PCIe sockets, etc.).

This document supersedes all previous individual documents covering the material provided herein.

B3 Approved Vacuum Equipment

B3.1 Atrix

Machines manufactured by Atrix International, Inc., with “Omega Supreme” product name are approved for use on our products. An Atrix Omega Supreme-based model specifically configured for our application, available by direct order in the US is the ESDVAC110 and ESDVAC220. Other Atrix models, including accessories approved for use are listed in Table B1 in Section B9.

Only the HEPA-rated (Atrix OF612HE) filter is tested and approved for our application.

Shown in Figure B1, the only nozzle tips approved for our application are the Atrix 31257 and 31657 flexible wands, which are a narrow tube that can reach target surfaces. No other tips are to be used without prior Oracle approval. No brushes of any type are to be used.

Figure B1 - Vacuum and nozzle tips approved for use on Oracle products

See Section B9.6 for full list of approved equipment.

B3.2 SCS and 3M

SCS (Static Control Systems, formerly 3M Static Control, is now a division of Desco Ind.) branded vacuums purchased after November 1, 2015 are not approved for use on our products. 3M-branded units purchased before that date may still be used. More information ***and other exceptions*** are provided in Section B9.

B4 Methods, Edge-Card Connectors

General use guidelines for particle removal on edge-card connectors are as follows in reference to Figure B2.

- **USE ONLY ORACLE APPROVED TIPS**
- Do not use any other tip unless approved by Oracle; NO brushes!
- All vacuums and tips must be validated ESD-safe (See Section B6)
- Contact only the top of the socket housing
- Orient tip -centered- on socket, with tool end flat on socket housing
- Do not enter the socket slot with any tool
- Make a single 3-5 second full length stroke on each socket
- Do not press hard on tip!
- If present, do not interchange Atrix and 3M tools/tips

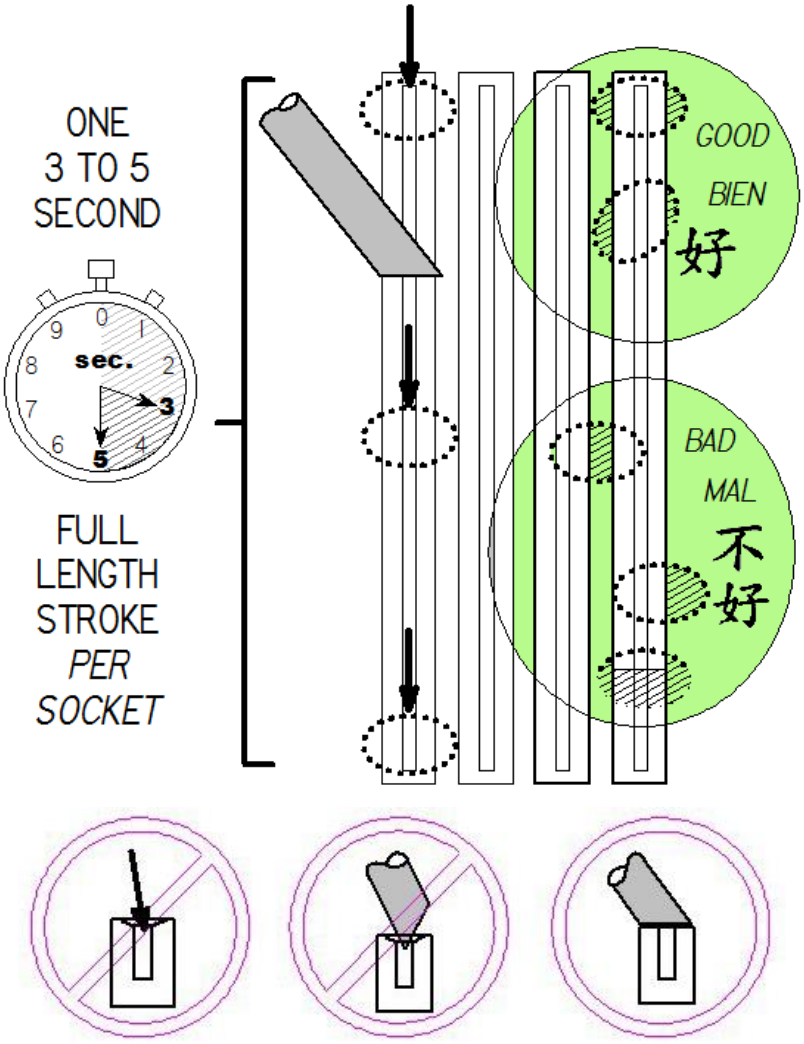


Figure B2 - Vacuum use illustrations for edge-card socket connectors on a circuit board

The single most important use method is keeping the tip square to and centered on the socket top surface. The shaded areas in the illustration are areas not over or in contact with the socket and comprise air "leaks" that reduce efficiency of the cleaning process.

B5 Work Station Ergonomics

B5.1 Unit Positioning

In order to improve the efficiency of cleaning electronic components, as well as to reduce operator fatigue and process cycle times, the following recommendations are made.

1) Locate the vacuum main unit below work surface level. This reduces noise and directs the vacuum exhaust away from components and work surfaces. Insure that the vacuum main unit exhaust port is not obstructed.

2) Provide a foot-controlled or other secondary in-line switch that is convenient to operator during vacuum use. A latching foot switch is the most convenient, but must be of industrial grade, proper rating, etc.

3) Provide a convenient hose racking/holstering solution at each work area. This allows quick access to the nozzle/hose and keeps it out of the way when not in use.

4) Minimize hard bending of the hose at the nozzle or main unit in positioning the vacuums, positioning the hose rack, and in use. The primary cost of maintenance for the vacuums is replacement of the hoses due to delamination of the outer rubber jacket from the internal wire coils.

B5.2 Nozzle Customization

While essentially only one nozzle tip is approved (the 31257 is just a shorter version of the 31657), some operators have found different tip geometries to be beneficial. The primary modification is cutting of the tip square to the tube axis. A square-cut tip more easily accesses the ends of DIMM sockets in tight places, for example, without having to reposition hands. In this case the nozzle tube is held vertical. All tip cuts must be clean and square/straight, done with a sharp knife. Re-cutting can also be a renewal method for the tips. Use of custom accessory hard plastic tips

have also been tried and have been shown to be beneficial. It is noted that excessive tip wear is a sign of excessive force during use, which must be avoided.

B6 ESD Validation Testing

This section details requirements and methods of ESD compliance validation of the units, including debug procedures.

B6.1 Equipment Required

- Surface resistivity tester (e.g. Desco19786, SCS 701-M, etc.)
- Shielded wire leads

B6.2 General

- Use of spring clips is recommended.
- Do not touch leads, clips, or vacuum during testing.
- All parts of the hose and nozzle must be on an insulating surface in test.

B6.3 Acceptable Resistance Range

- $1x10^5$ to $9x10^9$ ohms (both acceptance and diagnostic tests)

B6.4 Acceptance Test Method

This method, with setup shown in Figure B3 is to be used for regular checking of ESD compliance of the vacuums and related electrical connections. The vacuum unit is NOT powered on during this test, but must be plugged into a properly earthed circuit that is in common with local ESD ground wires at the station. This tests both the unit and the ground connections.

B6.4.1 Basic Method

1) Configure as shown in Figure B3. Unit is not powered on.
2) Prevent test leads from touching a grounded work surface or the unit/hose,etc.
3) Insure that the spring clip is connected to the nozzle end.
4) Take a reading with tester in the auto voltage mode, if present.
5) If a failing reading is seen, insure all components are configured properly and re-test.
6) Record the reading on a log sheet for the specific unit being tested.
7) If the unit failed the second time, move to the Diagnostic Test Method.

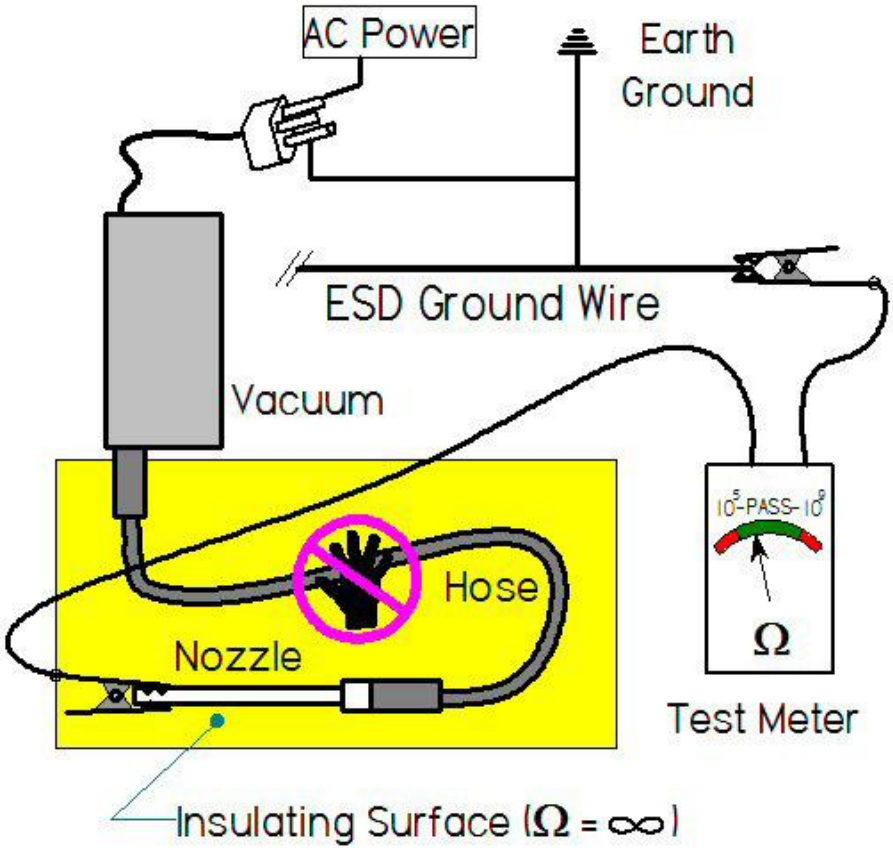


Figure B3 - ESD Acceptance Test Method configuration

B6.5 Diagnostic Test Method

The basic purpose of this process is to isolate and repair the failing component found during regular testing. The setup is the same as for the Acceptance Test Method, except only parts of the vacuum are tested.

B6.5.1 Basic Method

1) Remove the hose end at the vacuum main unit and attach the ground clip to it. Measure resistance (nozzle+hose).

2) If failing, separate the nozzle from the hose, attach clips and test each component. Repair/replace as necessary.

3) If passing Step 1, reattach the clip to the ground wire at the work station. Remove the filter from the main unit and attach the other clip to the grounding contact where the hose enters the main case. Measure resistance. Note: A reading in the conductive range (<10^5) is acceptable here.

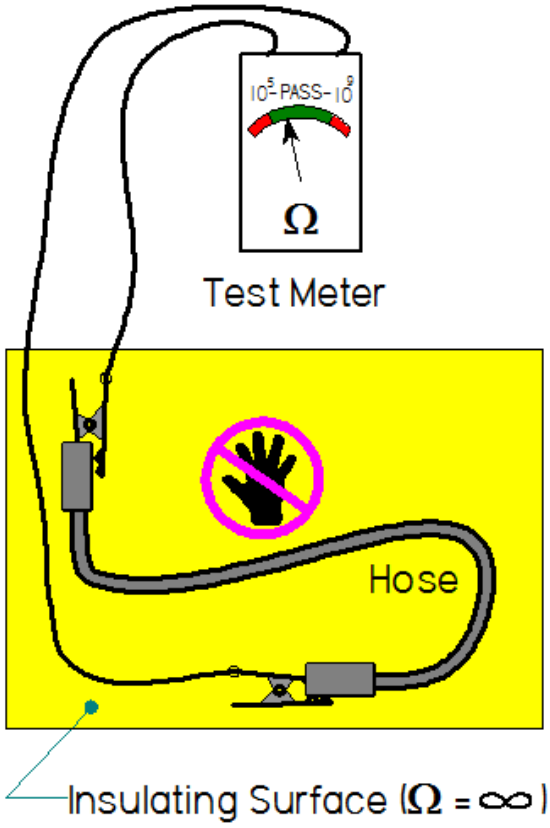


Figure B4 - ESD Diagnostic Test Method example

4) If passing Step 3, reinstall the filter but leave the cover open. Insert the hose end into the filter and check to see if the grounding contact is touching the hose end. If not, attempt to adjust the ground contact (bend) slightly to touch the hose end. Attach the test clip to the opposite hose end and re-test. If hose tested fine, but reading is still high, see Section B9.5 for possible trouble shooting. Do not force hose into filter as this will crack the filter inlet.

5) If failing Step 3, check the power cord and other connections to ground. Check the wire to the ground contact in the main unit and repair as necessary.

B7 Filter Flow Testing

A special gage was designed by Oracle to provide a means to assess both suction and flow capacity of the vacuums covered by this document. This section supersedes all previous methods published for HEPA filter loading assessment, including “Oracle Vacuum Filter Test Method_Rev_3.3” and preceding.

B7.1 Material and Equipment Needed

- Vacuum with filter, hose, and power cord
- Oracle Atrix HEPA Filter Test Gage, 150 ± 3 grams

B7.2 Test Configuration

- Vacuum on level surface, connected to AC, with hose attached
- Nozzle tips (e.g. Atrix 31657) *REMOVED* from hose

B7.3 Test Conditions

- +25 C ± 5 C, at sea level

B7.4 Filter Flow Test Method

1) Inspect vacuum to be tested: a) lay hose flat/straight on a table and sight through: remove any obstructions with a non-metallic rod of adequate length; insure that there is no damage to the hose (jacket separation, etc.) b) examine nozzle tip with unit for obstruction; insure that suction end is square and not damaged, and that the nozzle tube is not loose in its hose fitting. Replace components as necessary before continuing.
2) Arrange vacuum on table surface and attach hose only (nozzle tip not mounted to hose).
3) Place test gage on table surface with gage level in stand and side with marking and centering features (top) facing up (Figure B5). Power vacuum on.
4) Offer hose end to gage, centering hose on gage.
5) Attempt to lift gage plate from stand slowly, keeping hose end vertical, gage horizontal. Use a steady motion, do not shake or touch the gage. Keep gage ~1 cm from stand.
6) If gage can remain on hose end for more than (2) seconds, without falling off, the test is passing, indicating a not fully loaded filter. If the gage will not stay on the hose end for (2) seconds, the need for filter replacement, or other blockage is indicated.

7) Power unit off, record result by unit ID or serial number, and take action as indicated.

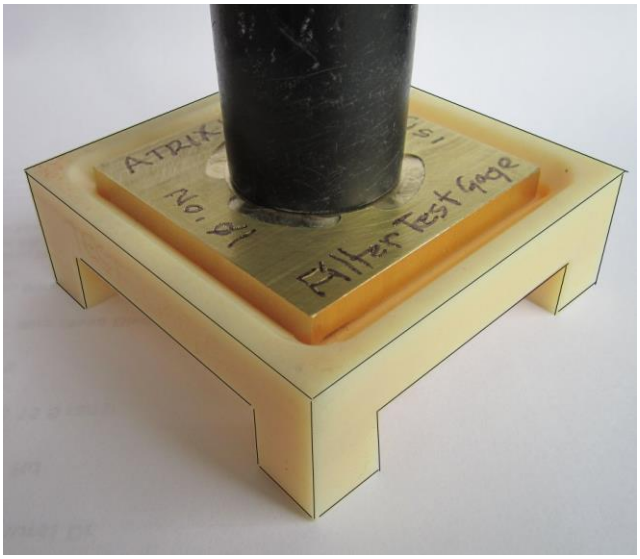


Figure B5 - Filter Test Gage with hose end centered in inset area on top face

B8 Maintenance Schedules and Record-Keeping

The following recommendations are given for vacuum maintenance and associated record keeping.

B8.1 General

- Each new vacuum unit is assigned an identification number and marking is made on the unit for tracking and logging purposes

- When new, each filter is marked with the date put into service

B8.2 Monthly

- ESD acceptance checking, and diagnostic evaluations if needed

- Filter flow testing

- Logging of results for above by vacuum unit ID

    - Notes to be made in logs as to what action, if any, was taken subsequent to ESD or filter flow testing

- Inspection and repair as needed of workstation related fixtures, cores, etc., used with the vacuums

B8.3 Yearly

- Filter replacement based on in-service date

B9 Additional Information

B9.1 Use of Non-Atrix Equipment

Equipment listed in this section that was already in use prior to the dates given may continue to be used as noted below. On failure, replacement with approved equipment is required. All other provisions of this guideline apply.

B9.1.1 3M Unit Use

Existing 3M-branded vacuums purchases before November 1, 2015 may still be used. The filter test method of Section B7 may be applied to them, provided the HEPA rated filter is installed. Atrix HEPA filters are direct replacements for 3M filters.

[!] Warning: Never place Atrix nozzles on 3M machines. This will cause overheating, and may cause premature motor failure. Use of a 3M nozzle on an Atrix vacuum will cause reduced suction and cleaning efficiency.

B9.1.2 Muntz Units

Existing Muntz-branded vacuums, specifically Model 555-ESD-S GS, purchased before June 1, 2016 may still be used with an ESD-rated hose, the PHU-20 or PHU-05 ESD nozzle, and the PH-726 HEPA filter. The basic methods and approach of Section B7 apply, but a special flow test gage will have to be designed and validated.

B9.2 Filter Tape Seal Cracking

A failure mode has been seen with the ***Atrix*** tape seal used to join the two halves of the filter housings. Due to higher cycle rates in our application, the tape can crack. For an otherwise good filter, the tape can be replaced to reseal. Common vinyl electrical or packing tape is acceptable for use. Do not apply excessive thickness of tape as it affects the position of the filter in the vacuum.

B9.3 Keeping of Spares

As noted above, components do wear out, and annual filter replacement is recommended. Therefore spare stock of nozzles, hoses, and filters must be maintained. Note that the 10 foot hoses (Atrix 31671) are recommended for greater extension range.

With good workstation configuration, hoses and nozzles may need to be replaced on a yearly basis. With high use, and/or poor handling, replacement may be needed in as little as a few months. This consumption must be monitored at a given site to be prepared to have spares on-hand as needed.

B9.4 Vacuum Accessory Kit

As only the ESD-safe Atrix flexible wands and hoses are to be used, all other accessories that may have come with the vacuum must be removed from the work site. If the Atrix ESDVAC110/220 units are ordered, they only come with the recommended accessories, and there will be no material to remove/waste. The basic kit to be at each workstation is given below. Note that the standard hose that comes with most off-the-shelf units is 6 feet in length. It can be used until a replacement is needed and a 10 foot hose can then be installed.

B9.4.1 Basic Kit for ESD-Safe Vacuums (Only items to be at work sites)

- Main unit
- HEPA rated filter (inside main unit), (Atrix OF612HE) (store filter cap in main unit lid)
- Power cord, different plug styles available
- 10 foot hose, ESD rated (Atrix 31671)
- Flexible wand nozzle (Atrix 31257, 31657)

B9.5 Anti-Static Coatings

In some cases, nozzles and hoses failing ESD testing, and not showing damage, have been seen to be repaired by the application of an anti-static spray coating. These spray materials are commonly sold for application to work mats. The most common place they would be applied is to the push-fit joints between the nozzles and hoses, but they may be applied more liberally. Any use of these materials must be well away from electronic products, and the material must be allowed to dry properly before re-installation at the work station.

B9.6 Approved Vacuum and Accessory Listing

Table B1 provides a list of approved vacuum systems and accessories from Atrix International.

Table B1 - Atrix International Approved Vacuums and Accessories

Model	Type	Description	AC Volt	AC Amp	Note
VACOMEGASLFH	System		110	5.4	Remove un-needed accessories
VACOSE110	System		110	5.4	Remove un-needed accessories
ESDVAC110	System		110	5.4	Direct order PN from the US. Contact: Mary-Shea Murphy, 800-222-6154 ext. 726
VACOMEGAS220FCT	System		230	2	Remove un-needed accessories
VACOSE220	System		230	2	Remove un-needed accessories
ESDVAC220	System		230	2	Direct order PN from the US. Contact: Mary-Shea Murphy, 800-222-6154 ext. 726
OF612HE	Accessory	HEPA Filter			Order spares
Atrix 31257	Accessory	ESD-safe nozzle tip, 12"			Alternate, prefer 16"
Atrix 31657	Accessory	ESD-safe nozzle tip, 16"			Order spares
Atrix 31671	Accessory	ESD-safe hose, 10'			Order spares
EF2	Accessory	Exhaust Filter Pack			Optional

Document History and Approvals

Rev	Date	Description of Change	Originator
01	22 Feb 2013	Initial release.	N/A
02	24 Jun 2016	Updated title, chart in Introduction, and Table 1, DIMM Connector Troubleshooting Matrix. Added pictures to illustrate DIMM handling requirements, Appendix B, and other major updates made. In Section 4.3, changed IPA grade from 99.95% to equal to or greater than 95%. Updated Section 4.1.1, Particulates. Corrected reference in Section 3.1.2. Removed previous step 1 in Section 3.1.5. Specified criteria for tying hair in production as an alternative to hair nets.	N/A
03	10 Feb 2017	Added maximum number of insertions allowed for DIMMs in Section 3.1.3.	N/A
04	16 April 2019	Updated Memory_test_failure_flowchart_no_riser in Appendix A1 to specify multiple dimm failure debug and added a table of examples for different multiple dimm failure scenarios.	N/A
05	03 Nov 2020	Updated Memory_test_failure_flowchart_no_riser in Appendix A1 to add a specific flow for UE failures. Expanded example table to include general channel configuration	N/A
06	03 March 2021	Updated Memory_test_failure_flowchart_no_riser in Appendix A1 and Memory_test_failure_flowchart_riser in Appendix A2 to modify the UE flow for NPI products and modify the "CPU/Motherboard debug " Adding a "CPU/Motherboard debug sequence" in Appendix A1 and A2	N/A
07	09 June 2022	Updated the document to remove references to Agile in section 4.1 and section 7. Updated confidentiality statement to Oracle Restricted. Updated alias from Ask_Document_Question@beehiveonline.oracle.com to eso_business_docs_us_grp@oracle.com	N/A

Related Information

REASON FOR CHANGE:
Updated the document to remove references to Agile in section 4.1 and section 7. Updated confidentiality statement to Oracle Restricted. Updated alias from **Ask_Document_Question@beehiveonline.oracle.com to eso_business_docs_us_grp@oracle.com**

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