BiTS™ Burn-in & Test Socket Workshop 2011

Session 7

ARCHIVE 2011

OPERATIONS: THE BIG PICTURE

Product and Test Security in a Remote Manufacturing Environment
Don Richmond—Aehr Test Systems

The Removal of Burr and Oil From Socket Surface Using CO2 Jet Cleaning
'Rocky' J.M.Lee, K.P.Lee, J. S. Choi— IMT Co. Ltd.

Using Position Test History to Automatically Disable Rogue Sockets
Trent Johnson— Advanced Micro Devices

Product and Test Security in a Remote Manufacturing Environment

Don Richmond
Aehr Test Systems

2011 BiTS Workshop
March 6 - 9, 2011

Content

- Why secure a product
- What part of product security is covered
- What is a product flow
- Test step security
- Options for test step security
- Benefits to test step security
- Methods of test Security
- Summary

Why Secure a Product

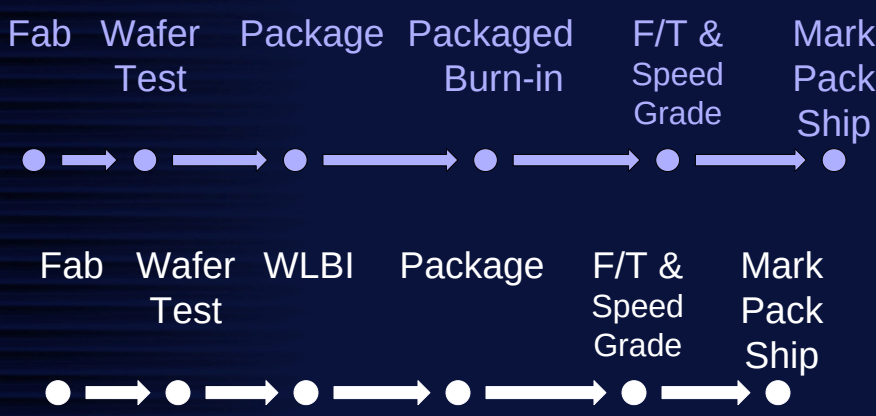
At some point in time IDMs controlled, most all if not all, their test and BI processes. This self contained model served to protect the corporate IP.

Now with the use of multiple subcontractors through out the world the problems have become that of controlling the quality of testing and BI while not loosing control of product IP.

Product Security

- Design security
- Fabrication process security
- Packaging process security
- Product test security
  - Die security (Die ID)
  - Test security
    - Test program security
    - Test results security
  - Shipment security

Product Flow



Test Step Security

- Die ID (source control implications)
- Test Program (quality and IP control implications)
- Test Results (planning, theft and cost accounting implications)

Options to Die ID Security

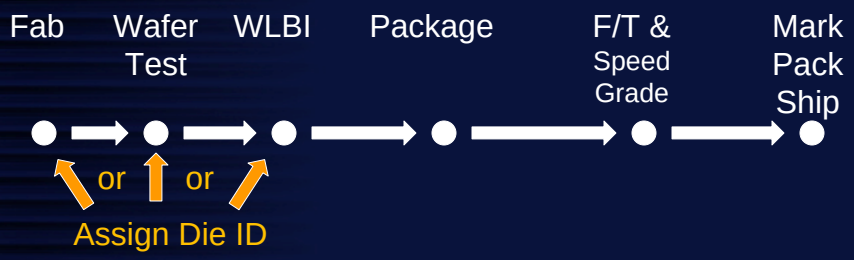
- Die ID
  - Unique
  - Type or family ID
  - Digital
  - Analog

Benefits to Die ID Security

- Die ID

  A Unique Die ID allows for a database log containing Wafer ID and other info to follow.

  This can serve the product planning, manufacturing, and quality teams.



Options to Test Program Security

- Test Plan (time & temp)
  - Not as controlled
- Test Code (signal timing & test data)
  - Version Control
    - Local
    - Centralized
  - File Transfer
    - Compiled Binary (encrypted?)
    - Source code (local compile?)
  - Test Code Visibility (local?)

Benefits to Test Program Security

- Test Program
  - Centralized version control can aid the product quality team and produce a consistent product from various vendors, sub-contractors or divisions.
  - Source code encrypted and transferred to a local tester, allows for test platform variations while maintaining consistency in test applied.
  - Visibility control protects IP.

Options to Test Results Security

- Test Results
  - Displayed local or not ?
  - Detailed binning available or not ?
  - Results database control
    - Local ?
    - Centralized ?

Benefits to Test Results Security

- Test Results

Local or tester display of 'Die ID test' results only Allows the local test team to debug fixtures and equipment but does not expose the product to theft. (no display of Die performance or binning)

Logging of detailed binning info to the centralized database can serve the product planning, manufacturing, accounting and test teams.

Benefits to Test Results Security

- Test Results

  Detailed binning info in centralized database:

  – Product planning can look at yield results and forecast shipments and wafer starts.

  – Manufacturing can streamline product handling.

  – Test teams can analyze results.

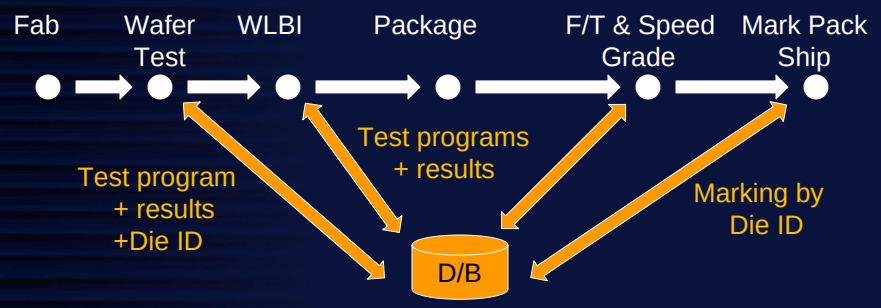
  – Protects Die by not exposing performance or binning info.

Methods of Test Security

- Test Programs

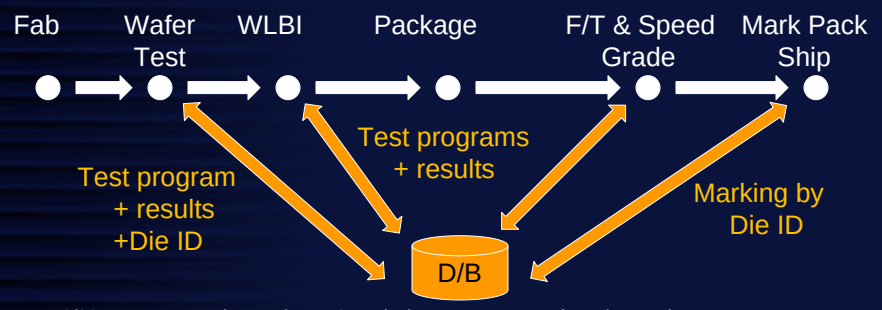
  – Encrypted transfer to tester, company specific pattern compile or translation and run on company specific pattern generator.

  – Not modifiable, not viewable at tester local.



Methods of Test Security

- Test Results
  - Encrypted transfer to database
  - Local or tester display of "Die ID test" results only, no specific performance results.



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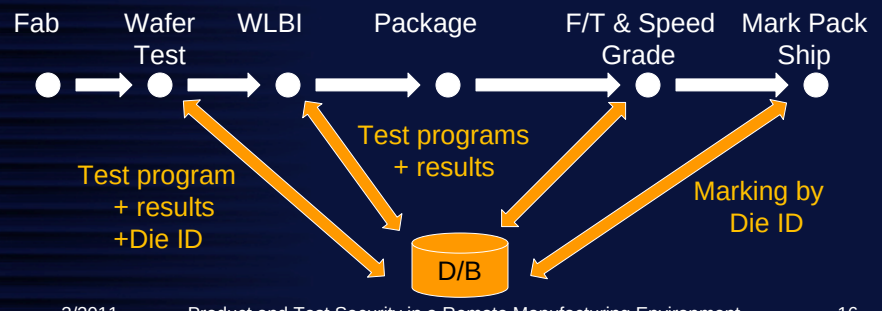
Summary

- Centralized Test Program control holds program safe from vendor alteration.
- Centralized Test Results Logging securely informs planning of step by step quality and quantity.



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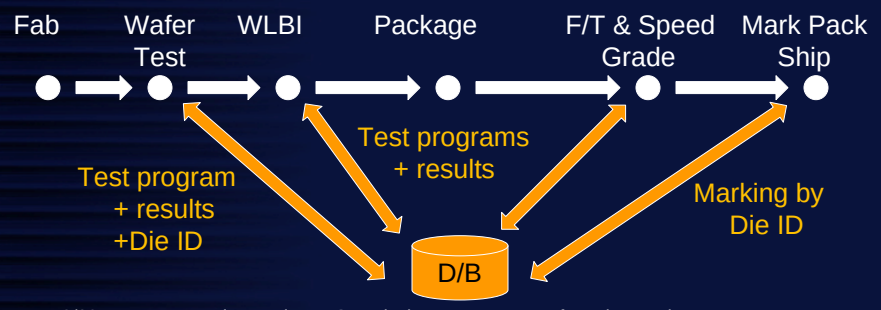
Summary

- Centralized Test Results (continued)
  - Complex product pricing Vs cost can be tested.
  - Shipping target times Vs WIP can be tested.

Both of the above can be automated using D/B



The Removal of Burr and Oil From Socket Surface Using CO2 Jet Cleaning

*Rocky J.M.Lee, K.P.Lee, J.S.Choi
IMT Co. Ltd

2011 BiTS Workshop
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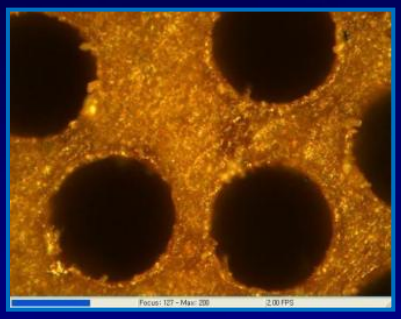
Contents

Socket Body Cleaning Issues

- Importance of Socket body cleaning

1. Have to **remove all burr and oil/flux** after machining
2. Have to **remove all residue** after pin assembly

=> To ensure the quality of the socket for testing



Conventional Cleaning & Problems

>> Conventional cleaning methods

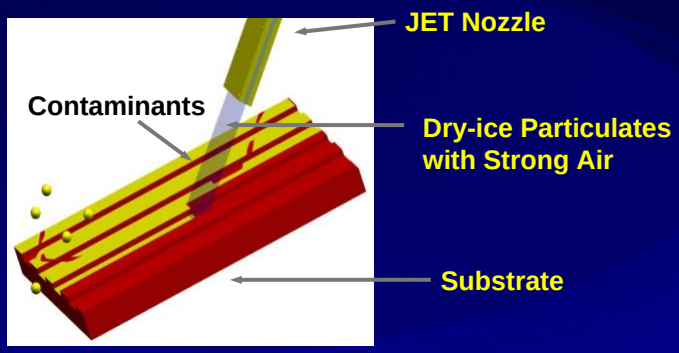
1. Air-abrasive cleaning: #300 Al2O3, SiO2
   - > Surface damage => delicate control required
   - > Particle removal process required
   - > Poor environment
   - > Hole blocking => sometimes very difficult to remove
2. Brush cleaning: repeated up-down touch
   - > Long time cleaning (> 10K touch downs)
   - > Particle removal process required
3. Wet chemical with ultrasonic: Alkali solution
   - > Only oil/flux and particle able to remove
   - > Rinse and dry process required

>> Effective, Simple, Fast, Environmental Friendly Cleaning required => CO2 jet cleaning

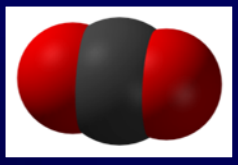
What is "CO2 Jet Cleaning"?

- Definition:

  Dry cleaning technique by applying soft dry ice particles onto the surface through specially designated jet nozzle.

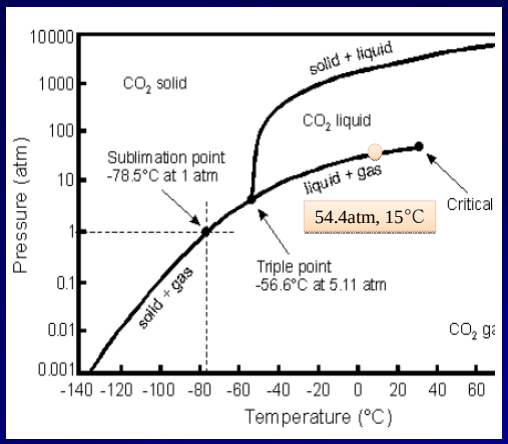


CO_2 [Carbon Dioxide] & Dry Ice Generation



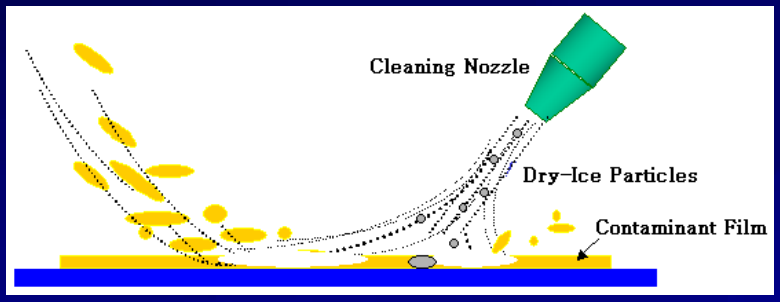
O=C=O

CO2 Properties	
Mole Weight	44.101 g/mole
Sub. temp	-78.5°C
Critical temp.	31,1 ℃
Critical pressure	73.8 bar (ATM)
Critical density	464 kg/m³
Triple point	-56.6 ℃ / 5.11atm
Properties	No color, No flavor, No flammable, 0.03% at AP

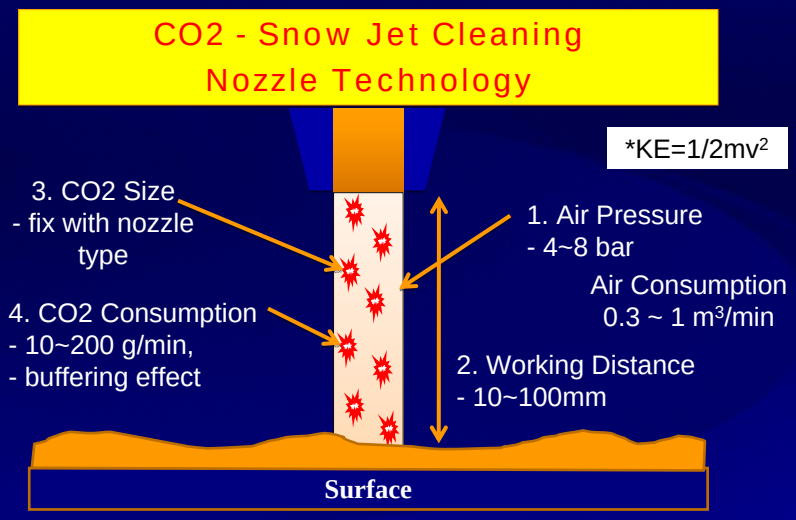


CO2 Jet Cleaning Mechanisms

1. Physical blasting: momentum transfer => particle removal
2. Thermal shock/freezing (-78.5C): layer cracking & breaking
3. Sublimation expansion (x800): layer lifting & destroying
4. Organic solubility (S.Coeff: ~23): Oil and flux removal



CO2 Jet Cleaning – Processing Parameters



CO2 Jet Cleaning – Unique Characteristics

1. Dry cleaning: Environmental friendly process
2. Versatile cleaning: Particle, organic & inorganic layer etc
3. Fast cleaning: No post-cleaning treatment
4. Soft cleaning: No damage on the substrate
5. In-situ & On-line cleaning: Time and labor saving
6. No hazardous to human and workplace

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CO2 jet Equipment for Experiments


1 Port Module (201JET)


2 Port Module (202JET)

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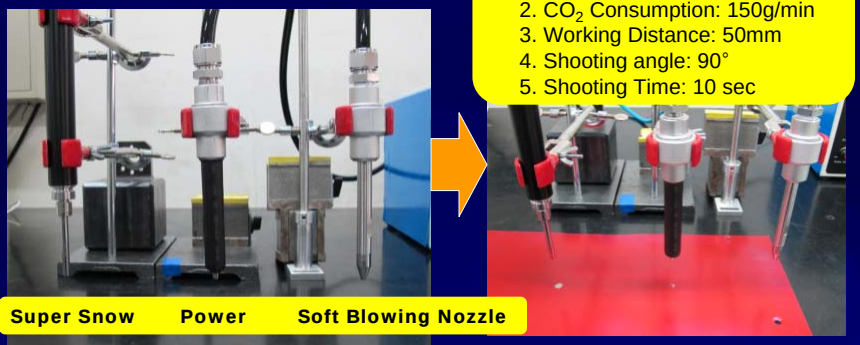
Cleaning Results: Parameter Study

- Effect of Size of CO2 dry ice

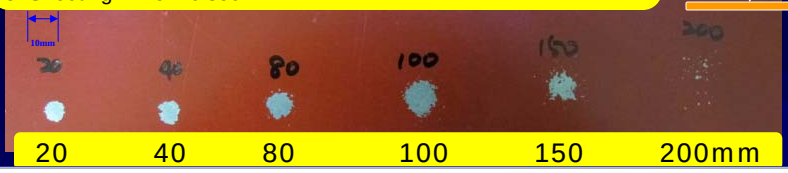
*** Conditions
1. Air Pressure: 5 bar
2. CO_2 Consumption: 150g/min
3. Working Distance: 50mm
4. Shooting angle: 90°
5. Shooting Time: 10 sec

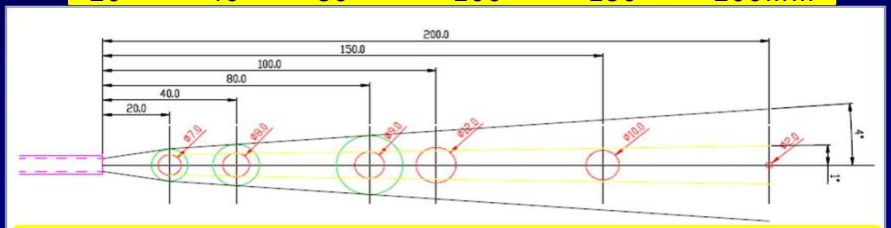


Cleaning Results: Parameter Study

- Effect of Working Distance of CO2 dry ice

*** Conditions
1. Nozzle: Super snow(500~1000㎛), 2. Air Pressure: 5 bar,
3. CO_2 Consumption: 150g/min, 4. Shooting angle: 90°,
5. Shooting Time: 10 sec



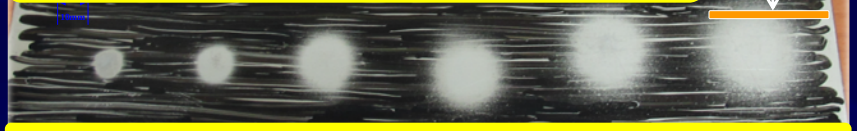


*** Max. Effective Working Distance: 100mm at Spray Paint removal

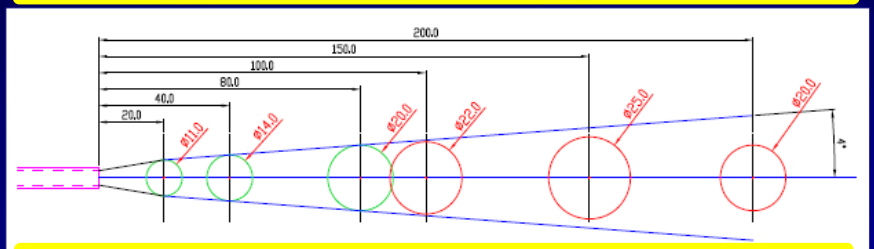
Cleaning Results: Parameter Study

- Effect of Working Distance of CO2 dry ice

***** Conditions for Marker Ink Removal**
1. Nozzle: Super snow (500~1000㎛), 2. Air Pressure: 5 bar
3. CO_2 Consumption: 150g/min, 4. S. angle: 90°, 5. S. Time: 10 sec



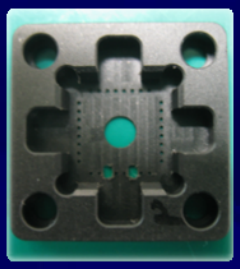
20 40 80 100 150 200mm

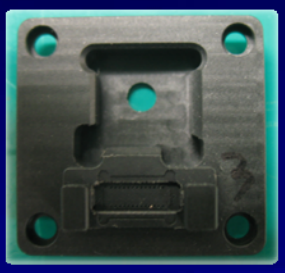


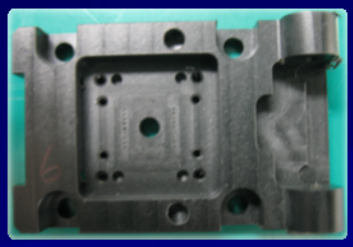
***** Max. Effective Working Distance: 150mm @ Marker removal**

Deburring Samples

- Material - PEI

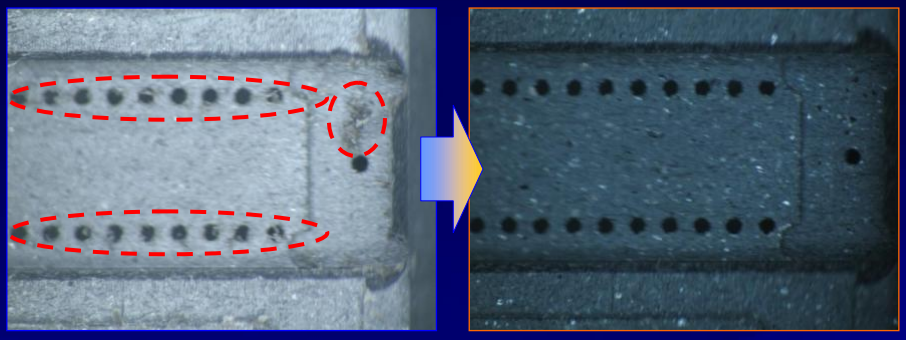






Cleaning Results

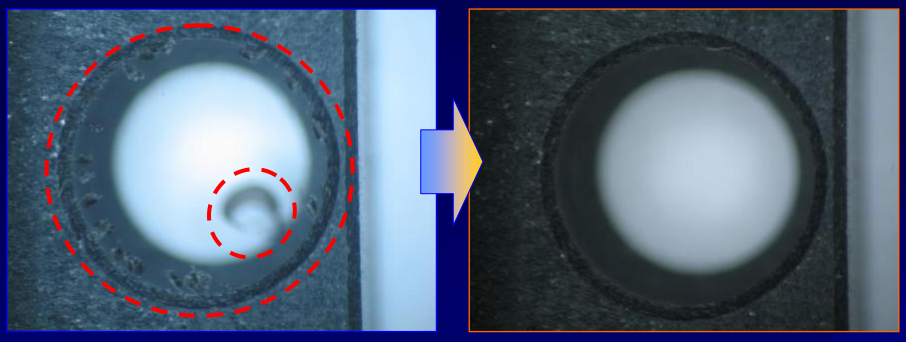
- Housing Hole Before & After Deburring



Before cleaning | After cleaning

Cleaning Results

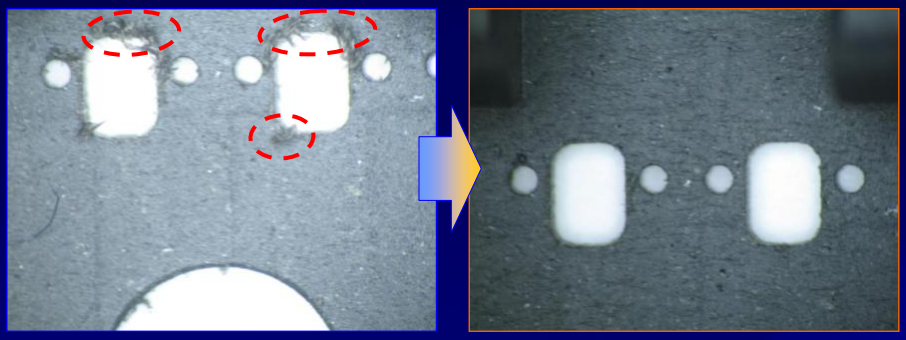
- Housing Hole Before & After Deburring



Before cleaning | After cleaning

Cleaning Results

- Housing Hole Before & After Deburring



Before cleaning After cleaning

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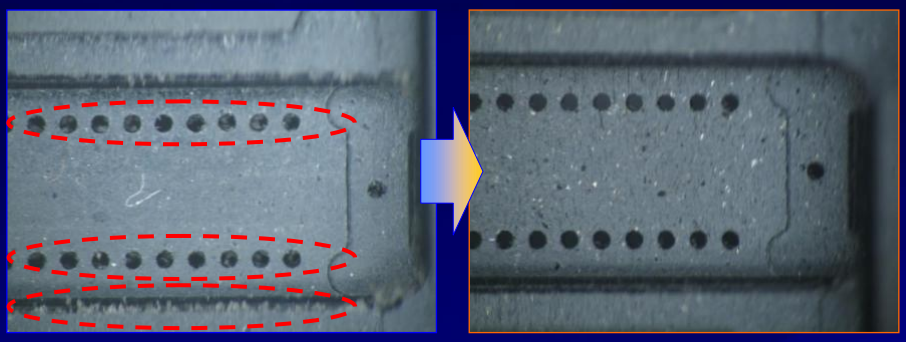
Cleaning Results

- Housing Hole Before & After Deburring



Before cleaning After cleaning

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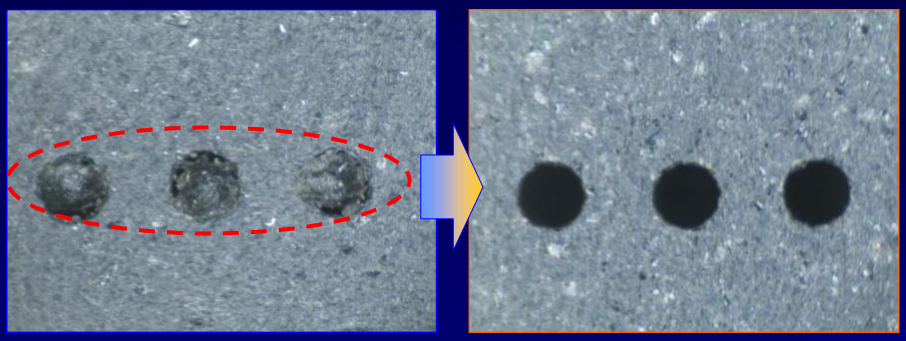
Cleaning Results

- Housing Hole Before & After Deburring



Before cleaning

After cleaning

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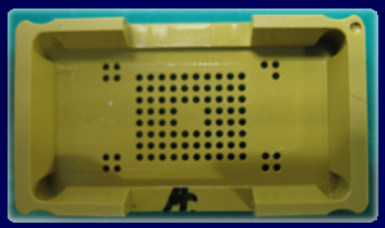
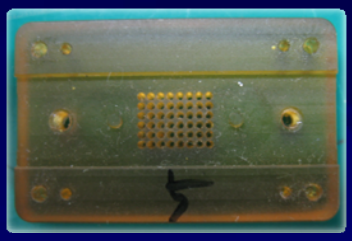
Deburring Samples

- Material - Torlon





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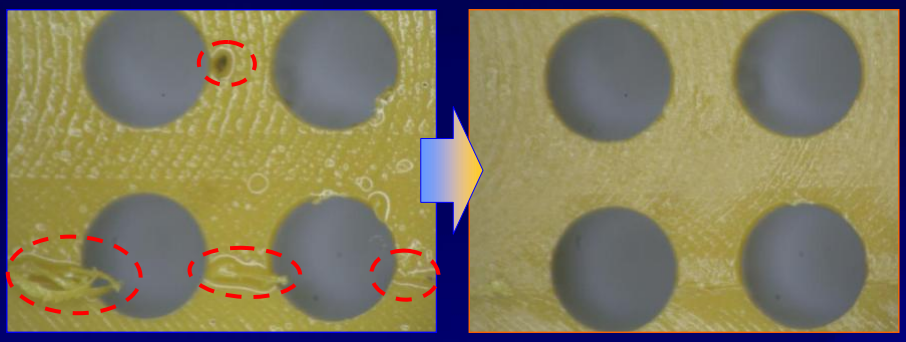
Cleaning Results

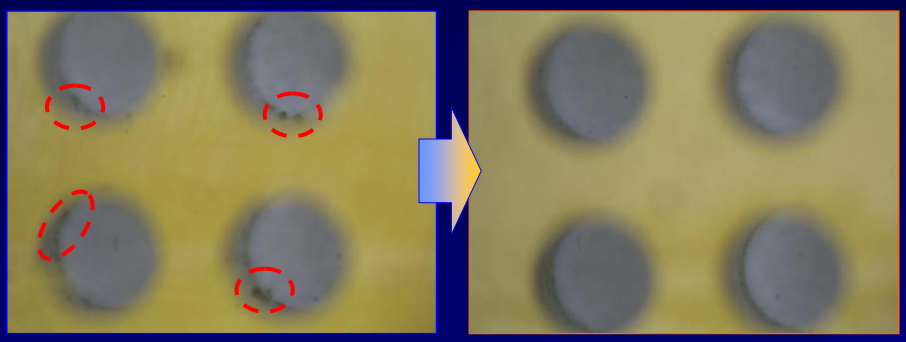
- Housing Hole Before & After Deburring



Before cleaning After cleaning

Cleaning Results

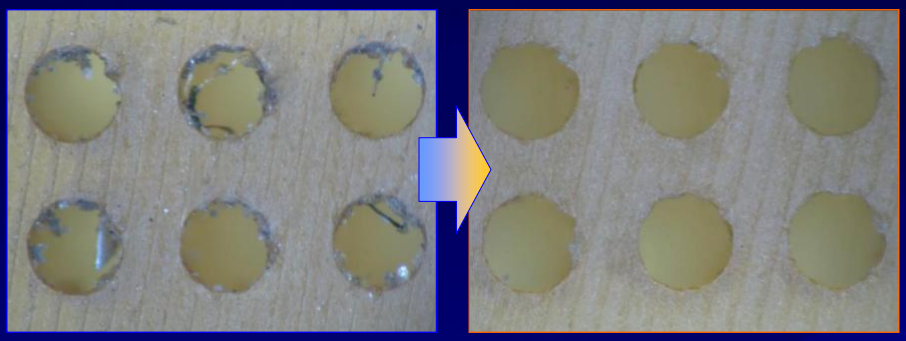
- Housing Hole Inside Deburring



Before cleaning After cleaning

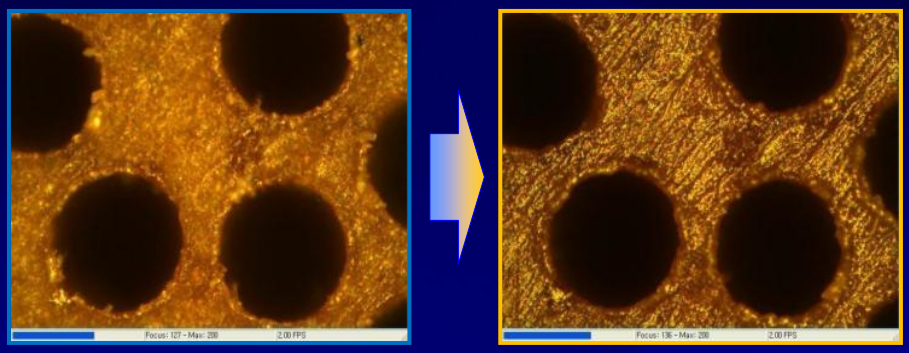
Cleaning Results

- Housing Hole Before & After Deburring



Before cleaning After cleaning

Cleaning Results – Engineering Plastic for PC

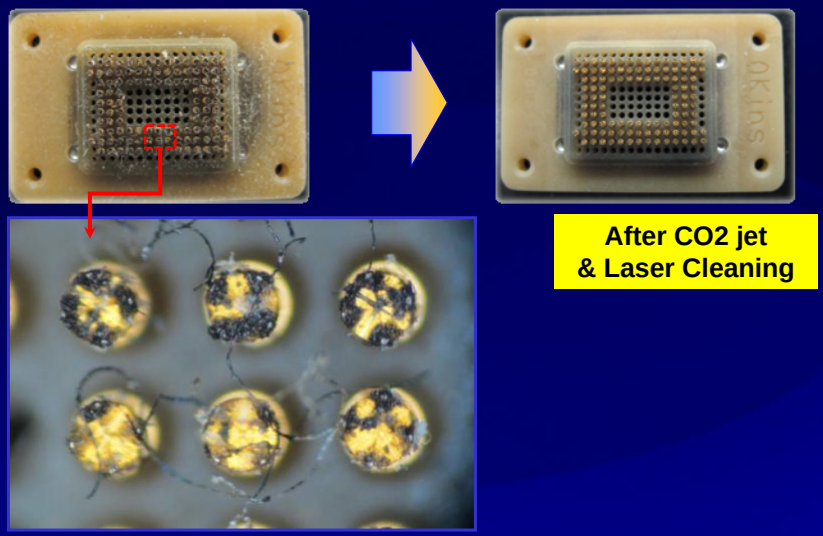


Before cleaning After cleaning

Cleaning results – After Laser Drilling

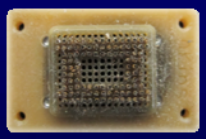
After Assembly – Residue & Contamination removal

- BGA pogo pin socket

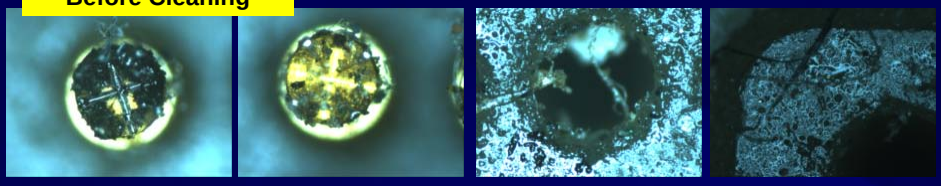


After Assembly – CO2 Jet cleaning

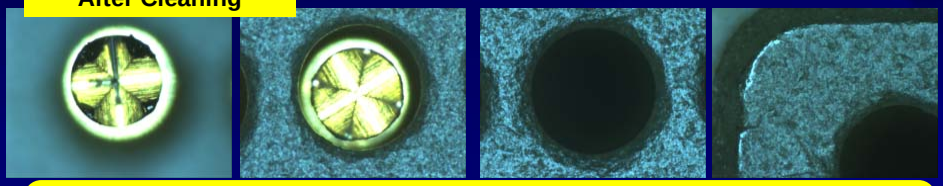
- BGA socket



Before Cleaning



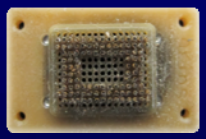
After Cleaning



***** Most of Residue and dirt on Pin and socket surfaces was removed successfully without any damage of the pins.**
***** However the contact areas of pins are not cleaned.**

After Assembly – Laser Cleaning

- BGA socket pogo pin

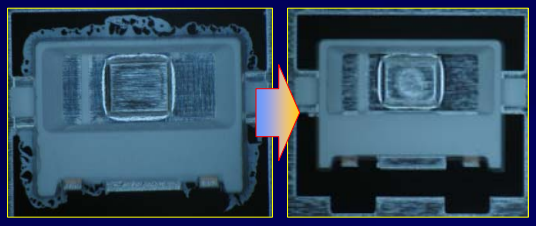


Before Cleaning | **After CO2 jet Cleaning** | **After Laser Cleaning**

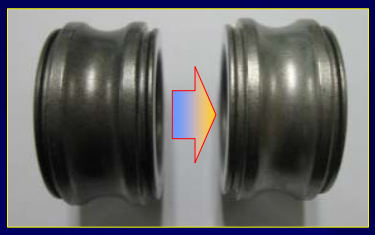
***** The Strong contamination (Sn based metallic dirt) on the contact area can be removed successfully by Laser cleaning.**

Other Successful Applications

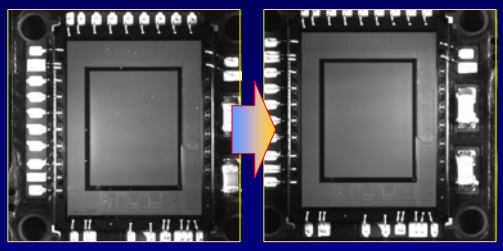
<Leadframe Deflashing>



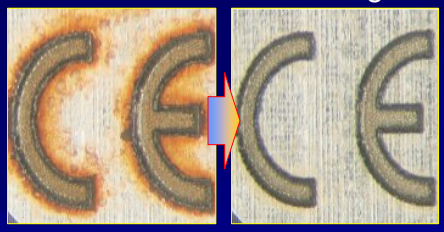
<De-oil, Defluxing>



<Particle & Residue Removal>



<Post Laser Processing>



Conclusions – CO2 jet cleaning can

Remove effectively

1. Burr and Oil/flux from Socket surface after machining
2. Residues from socket surface after assembly without inducing any damages on socket and pins.

Provide advantages compared with conventional ways

1. Effective, fast and simple process
2. Clean job environment due to dry cleaning
3. Compact system to users.

Using Position Test History to Automatically Disable Rogue Sockets

Trent Johnson
Advanced Micro Devices

2011 BiTS Workshop
March 6 - 9, 2011

Agenda

- Problem Statement
- Goal
- Challenges
- Solutions
- Tradeoffs
- Conclusion

Problem Statement

You suspect a piece of equipment is bad

- In production, the position repeatedly fails
- During preventative maintenance, the position passes diagnostics

What do you do?

Goal

- Minimize equipment's effect on yield
  - Failure Paretos with no equipment failures listed
  - Most failure mechanisms come from device defects

Why is this so difficult?

- Diagnostics can be inadequate
- We don't want diagnostics that are too strict
- Device-centric diagnostics eat into your inventory

Challenges

Yield versus availability

- Equipment group blames bad lots
- Yield group blames bad testers

Example: 5 fails in a row
Bad lot or bad tester?

Example: 90% failure rate
Bad lot or bad tester?

Challenges (cont)

Other root causes:

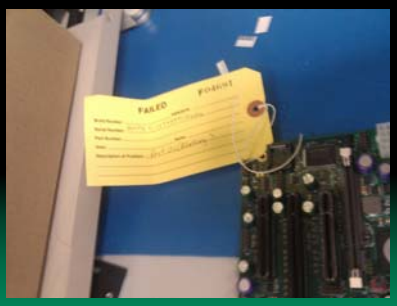
- Operator or procedural error
  - Device not seated properly
  - incorrect lot information

Solutions

- No Central Control
- Manual Disable
- Software Disable
- Software-Assisted Hardware Disable
- Hardware Failure History
- Categorized Hardware Failure History
- Remote Business Logic
- Remote Statistical Process Control

No Central Control

- AKA - The Stone Age
- If equipment is running, it is good. If it's in the junk pile, it's not good…or is it?
- Sometimes bad equipment is marked with a tag
- Usually seen in a lab environment (hopefully not in a production environment!)



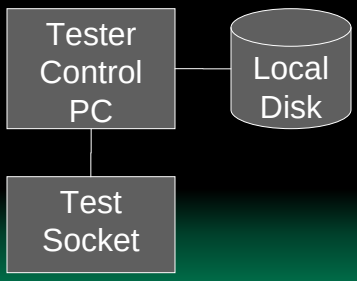
Manual disable

- Some diagnostic is run
- Indicate bad sockets with sticker or cover
- Maintenance personnel log equipment into a database

- Stickers fall off
- Any database used is usually manually populated
- Operators can populate bad sockets

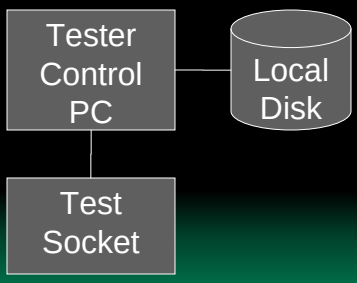
Software Disable

- Software disable with software memory
  - Local software cache to remember what is disabled
  - Software-tracked consecutive failure counts



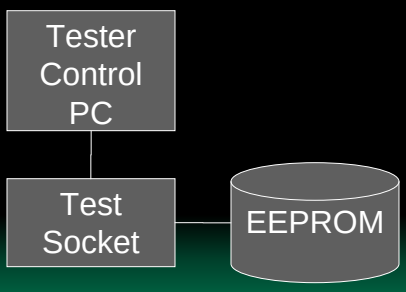
Software Disable (cont)

- Software can prevent test starts
- May or may not report up to a central location
- If software is re-loaded, memory is lost



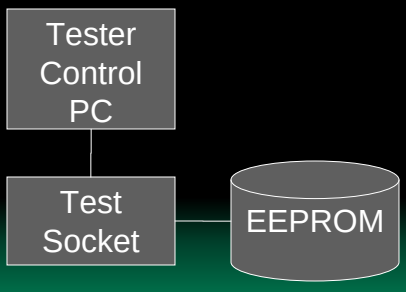
Software-Assisted Hardware Disable

- Software disable with hardware memory
  - Use local EEPROM to indicate a failed socket



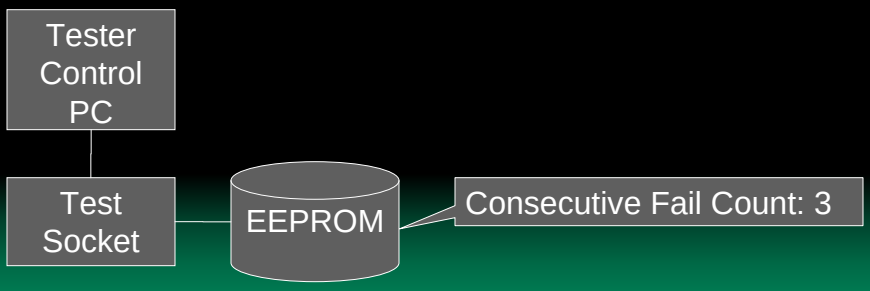
Software-Assisted Hardware Disable (cont)

- Disabled status follows hardware
- Software can read EEPROM and indicate in control GUI that it is disabled
- Software can prevent tests from starting
- May or may not report up to a central location



Hardware Failure History

- Consecutive failure counter in hardware
  - Use EEPROM to count number of fails
  - Hardware persistence
  - Set limits on allowable consecutive fails



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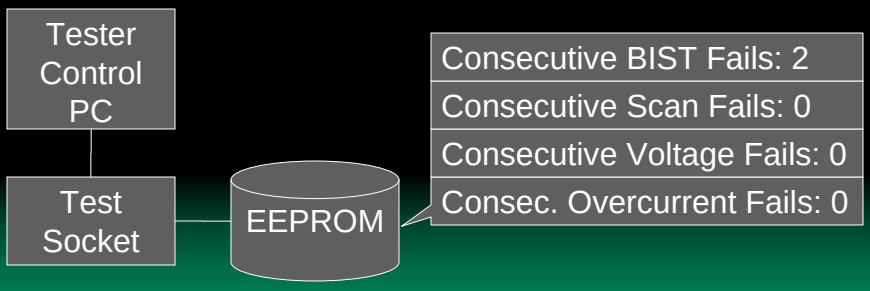
Categorized Hardware Failure History

- Consecutive failure counter with categories
  - Use EEPROM to count number of fails that are similar.
  - Customized Tolerances



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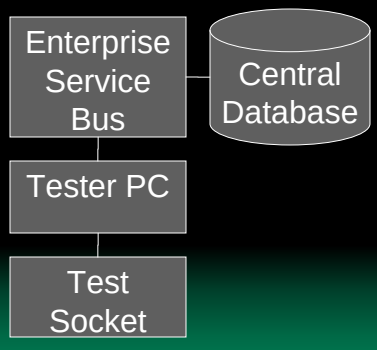
Categorized Hardware Failure History (cont)

- Improved accuracy
- EEPROM memory considerations become more important
- Problem with flip-flopping category
  - Example: alternately failing over-current limit and failing Vdd droop.
    - If the two failure modes are in separate categories, we may reset the counter each time a failure occurs

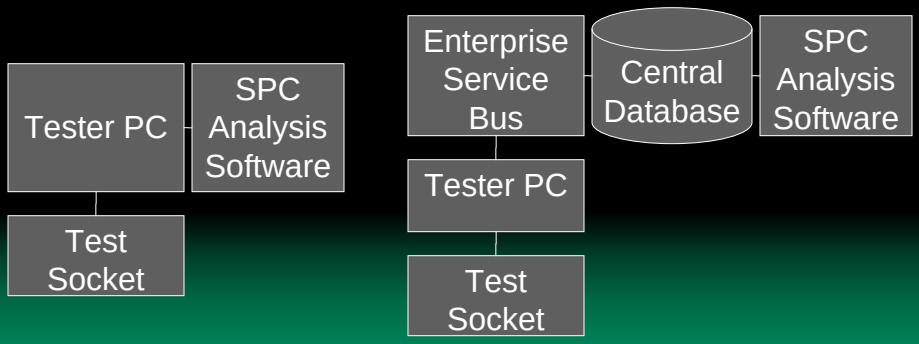
Remote Business Logic

- Central database holds failure history
- Positions are disabled based on failure history rules written by a human
- Failure history rules can be changed at a central location
- Requires the cost of setting up a network database infrastructure



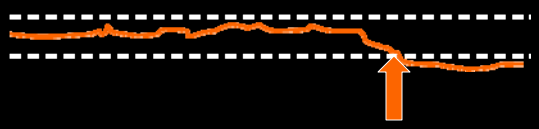
Statistical Process Control

- Allow abnormalities to identify themselves
- Need to define useful metrics
- Can be implemented on tester or at a central location

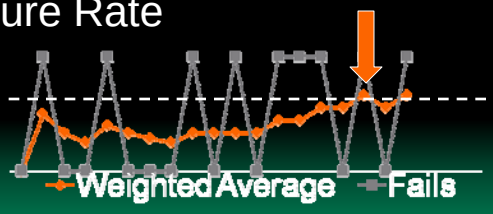


Statistical Process Control (cont)

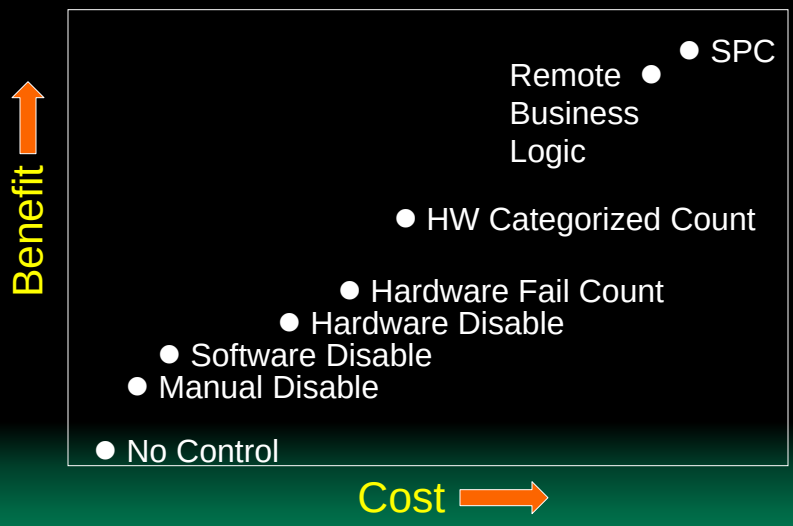
- Example: Monitoring Vdd



- Example: Monitoring Weighted Average Failure Rate



Tradeoffs



Tradeoffs (cont)

- Important questions to ask yourself:
  - Can I afford a software infrastructure team to support this?
  - Can I afford more components on my board?
  - Can my burn-in/test board be sufficiently tested without a device under test?

Conclusion

- There are benefits of enhanced position tracking, but they come at a cost
  - A strategy to count failures or track failure history is beneficial.
  - In many cases, you get what you pay for
  - Yield improvement efforts may require more engineering resources
  - You need to justify why you take equipment offline