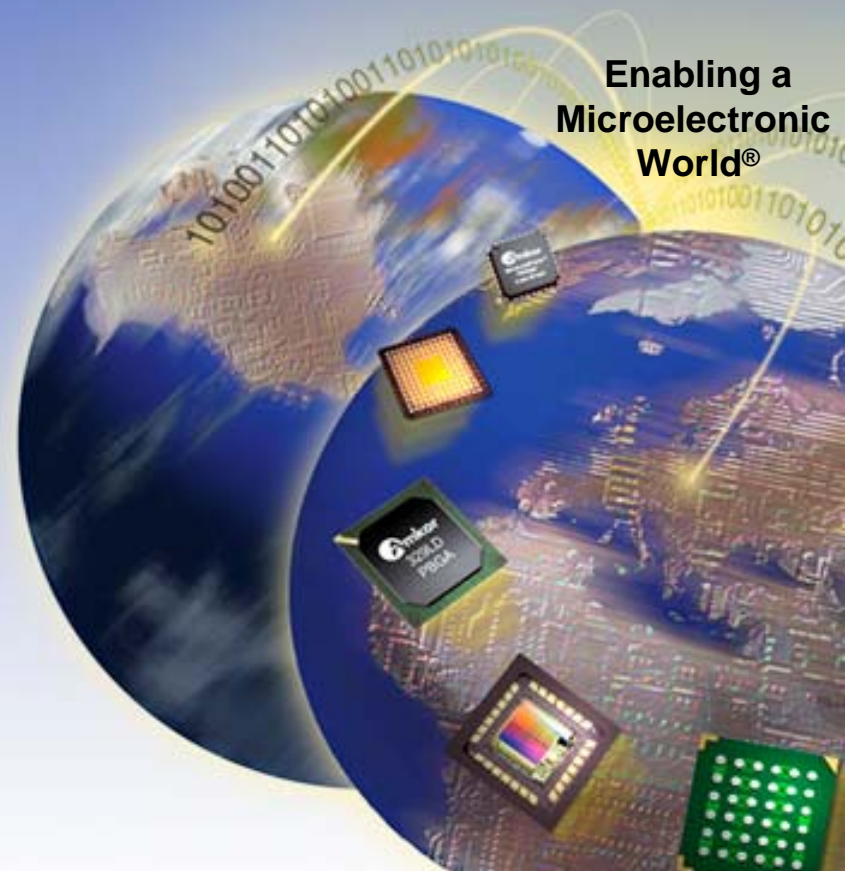


Whisker Testing Review

Feb 2007

KB Yang – WW Corp. PIC

Enabling a
Microelectronic
World®



Whisker Testing Review



- **Current accepted methods are those proposed by iNEMI, and published by JEDEC**
 - JEDEC “Whisker Test Methods” published in Q2 2005, Revision of JESD22-A121, May 2006 (JESD22A121.01)
 - Specifies test methods and equipment requirements
 - JEDEC Standard No. 201 published in March 2006
 - Specifies pre-conditioning, test method and test durations
- **Amkor will use the JEDEC documents as the basis for our whisker testing requirements**
 - Not accepting customer specific requests for non-standard conditions

Whisker Testing Review



- **The JEDEC JESD22-A121 standard includes:**
 - Storage test: 30°C/60%RH isothermal storage
 - Aging test: 60°C/87%RH* isothermal storage
 - Temperature cycling: -55 to +85°C
 - Approximately 3 cycles per hour
 - Pre-conditioning
 - Four options given
 - Inspection methodology
 - Whisker assessment*
 - Microscope correlation/validation

*** Standard 201 includes changes to these portions of the JESD22-A121**

Whisker Testing Review



- **The JEDEC Standard No. 201 defines:**
 - Scope of testing for technology and process changes
 - Sample size minimums
 - 3 lots, 2 sample components/lot
 - 96 terminations inspected per test leg
 - 3 Pre-conditioning requirements (when mitigation applied)
 - None
 - Simulated reflows at 215°C and 255°C
 - Test durations for technology acceptance
 - 4000 hr for T/H stress conditions
 - 1500 cycles for T/C condition
 - Criteria
 - Varies by component type and end use

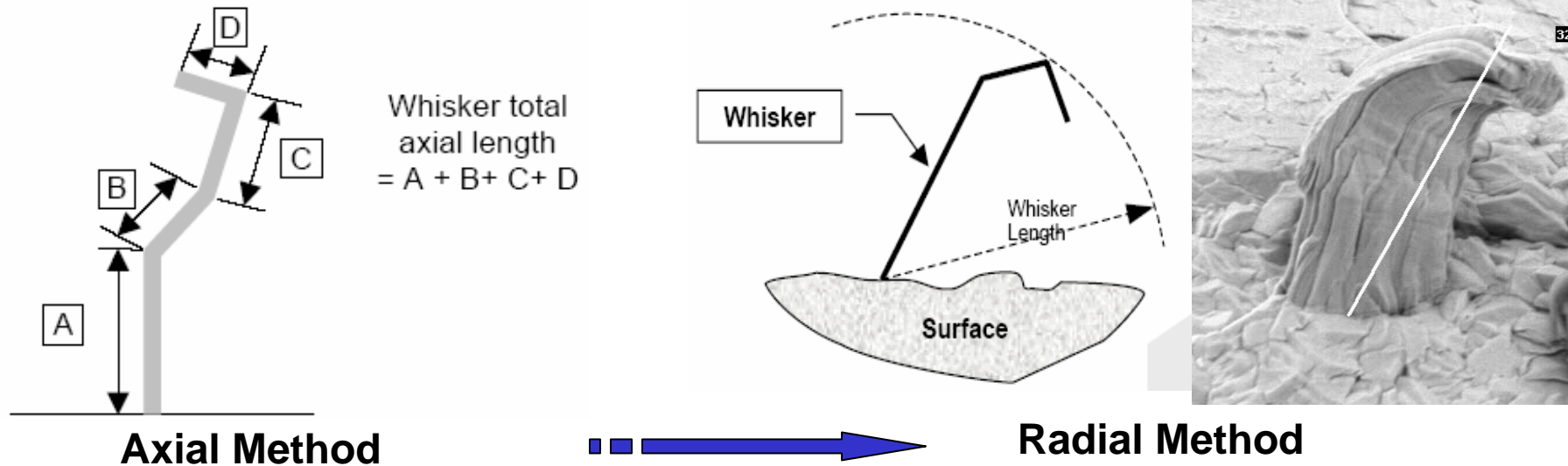
Whisker Testing Review



- **JEDEC Standard No. 201 introduces changes**
 - 60°C/87%RH changes to 55°C/85%RH
 - Total axial length method changes to radial method for measuring whisker length
 - May exclude results or samples with excessive corrosion
 - Temperature/Humidity tests end at 4000 hours
 - Whisker criteria based on component end use classifications

Whisker Testing Review

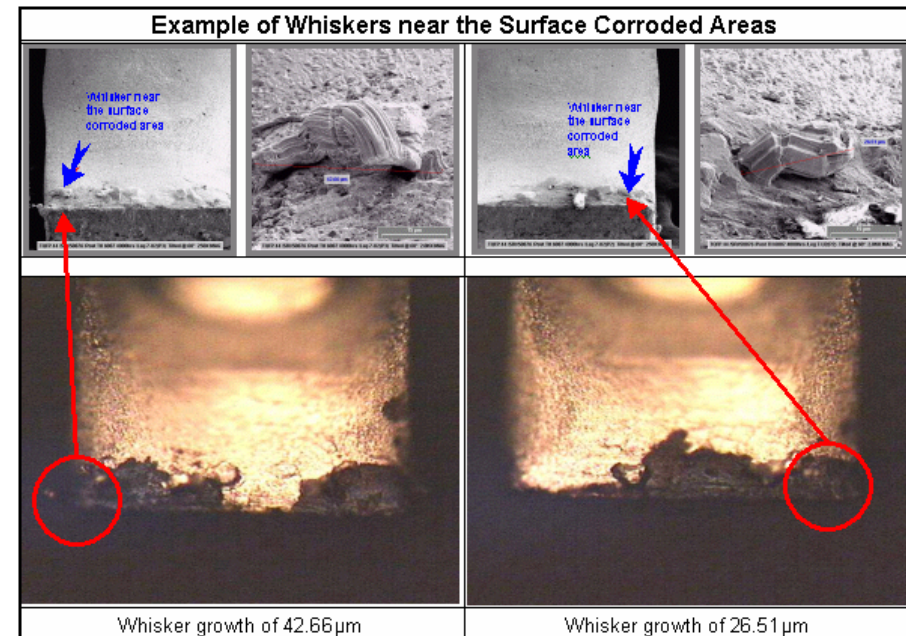
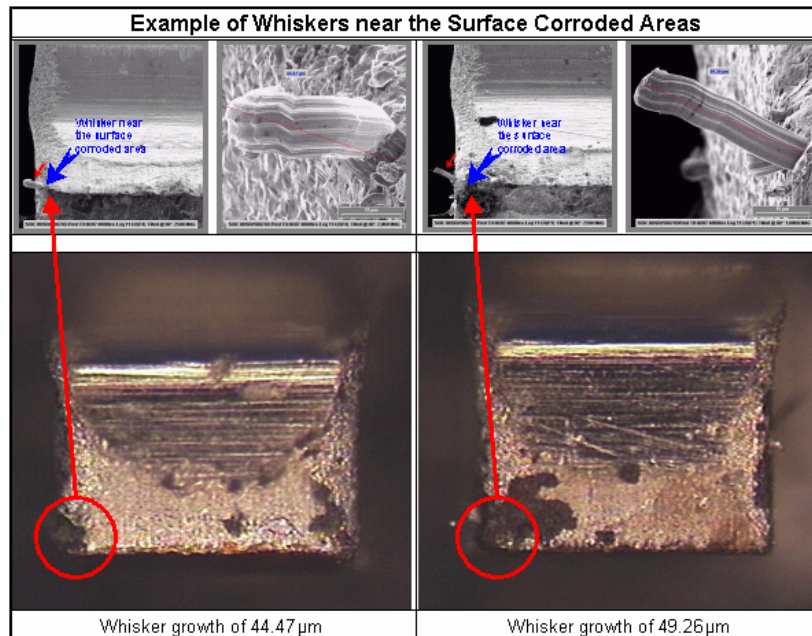
- Whisker Length Measurement Method



- Per the JESD201, this is the method to use for measuring whisker length
 - Locate the mid-point of the base of the whisker
 - The base is where the whisker exits the original deposit surface, as sometimes you will see sunken areas around the whisker base
 - Measure a straight line to the farthest point of the whisker

Whisker Testing Review

- **Surface Corrosion Check at Higher Temp Humidity Conditions**
 - If surface corrosion is observed, the termination/component showing corrosion is invalidated from the whisker inspection; any termination/component invalidated is replaced with another termination/component to maintain the total required sample size.
 - Any invalidation of terminations/components due to corrosion is documented in the Whisker Test Report under Appendix section (sample as below).



Whisker Testing Review



- **AWW Whisker Test**

Amkor is doing the whisker test according to industry standards, based on JEDEC Test Method but do not have a pass or fail criteria.

What we know is that this is the whisker behavior we have based on iNEMI /JEDEC whisker test requirements. Whisker behavior is not yet fully understood at present and these test conditions will only provide us certain whisker lengths on different test conditions. We cannot declare nor guarantee that we will pass certain criteria.

Amkor has been applying PPB and a minimum 10um plating thickness as our standard process for matte Tin plating. We expect these practices will be effective for whisker mitigation as an industry understanding.

Whisker Testing Review



- **AWW Whisker Test Center**
 - Full capability established in P3 Reliability Lab
 - All Amkor factories will use centralized testing site
 - Reduces required capital
 - Reduces variability in testing procedures
 - Test chambers and new SEM in place
 - Optical microscopes and sample fixtures
 - Dedicated staff trained and in place
 - Standard whisker report format developed
 - Follows JEDEC guidelines

Whisker Testing Review

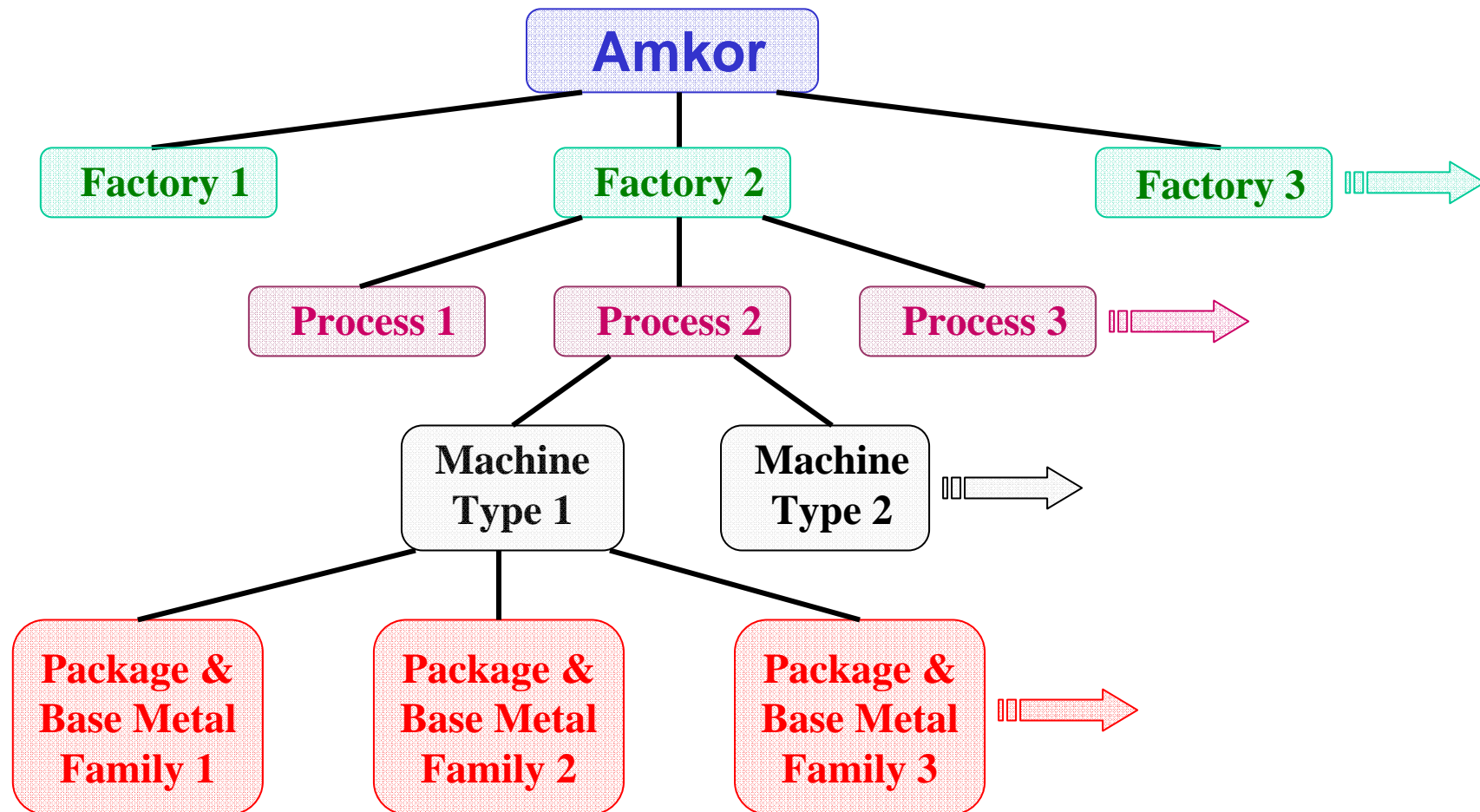


- **AWW Whisker Test Status & Plan**
 - Phase 1 (Technology Acceptance test) was completed
 - Phase 2 (Technology Acceptance test) will be completed around 3Q'07

- **Whisker reporting**
 - Reports to be located on RRS 2.5 database
 - Interim reports issued after:
 - 2000 hours for both T/H conditions is reached
 - 1500 cycles of T/C
 - Final report published at 4000 hour T/H
 - Plan to upgrade RRS3.0 for whisker test
 - Reports will be located on RRS 3.0 database after the modification

Whisker Testing Review

- Technology Acceptance Sample Requirements



- **Package Selection**

- Amkor will not be testing all packages within a package family. A representative package will be selected to represent the particular technology being evaluated.
 - A “technology” means a single combination of Factory, Process, Plating line type, Package & Base metal
- Package selection applies to technology acceptance, process changes, and monitoring

Whisker Testing Review



Testing Condition Summary

Technology Acceptance test condition

Test #	1	2	3	4	5	6	7	8	9
Precondition	None required	None required	None required	Assembly simulation @ 215°C	Assembly simulation @ 255°C	Assembly simulation @ 215°C	Assembly simulation @ 255°C	Assembly simulation @ 215°C	Assembly simulation @ 255°C
Test Condition	Ambient Temp/Humidity Storage	High Temp/Humidity Storage	Thermal Cycle	Ambient Temp/Humidity Storage	Ambient Temp/Humidity Storage	High Temp/Humidity Storage	High Temp/Humidity Storage	Thermal Cycle	Thermal Cycle
Read point	0, 1000, 2000, 3000 & 4000 hr	0, 1000, 2000, 3000 & 4000 hr	0, 500, 1000, 1500 cyc	0, 1000, 2000, 3000 & 4000 hr	0, 1000, 2000, 3000 & 4000 hr	0, 1000, 2000, 3000 & 4000 hr	0, 1000, 2000, 3000 & 4000 hr	0, 500, 1000, 1500 cyc	0, 500, 1000, 1500 cyc