Binghamton Advanced Process Laboratory

- Founded in 1987
  - First and most complete advanced process laboratory in the equipment industry generally accessible to customers
- Founded first Consortium 1992
- Provides
  - Research and development
  - Process audits and support
  - Prototyping
  - Root cause failure analysis
  - Knowledge transfer and training
- Complete analytical laboratory
- ITAR-compliant
- ISO 9001-certified
Partnering Throughout The Product Life Cycle

- Concept
  - Process and Material Research and Development
  - Product Layout and Design
  - Process Design
  - Applications Review

- Definition
  - Process Development
  - Process Solutions
  - Prototyping on Manufacturing Equipment

- Implementation
  - Process Optimization
  - Design for Manufacturability
  - Process and Equipment Optimization
  - Reliability Testing
  - Qualification

- Machine Design
  - Process Development
  - Process Solutions
  - Prototyping on Manufacturing Equipment

- Ramp to Volume
  - Process Optimization
  - Design for Manufacturability
  - Process and Equipment Optimization
  - Reliability Testing
  - Qualification

- Efficiency
  - Assembly Equipment Solutions
  - Integrated Process Solutions
  - Process Scale-up
  - Failure Analysis
  - Incremental Production
  - Capacity Increase
  - Worldwide Scalability
  - New Products Support

- End of Life
  - Assembly Equipment Solutions
  - Integrated Process Solutions
  - Process Scale-up
  - Failure Analysis
  - Incremental Production
  - Capacity Increase
  - Worldwide Scalability
  - New Products Support
Root Cause Failure Analysis

- Enhance performance and profitability
- The APL has developed critical manufacturing processes for all component families
- Specialized, precision analytical tools
- The fastest and most cost-effective route to the failure data you need
- Detailed analysis of sample packages, including characterization of inherent weaknesses and recommendations to enhance product lifetime and yield
  - Identify and rectify the root cause of the defect
  - Provide evidence to support product liability cases or vendor returns
  - Deliver rapid return on investment (ROI)
- **Component-level Interconnect/PCB Failure Analysis:**
  - Microanalysis of failures
  - Dye penetration, cross section, shear test
  - Solder rupture and inter-facial failure modes identified
  - Prediction of "time zero" and long term field failures
  - Contamination studies
  - EOS/ESD die failures
  - PCB fabrication problems

Plated Copper
Dendrites
EOS failed die
Dry film lock-in void
Etched, thermal-cycled, lead-free solder
PTH barrel crack
Failure Analysis - Metallurgical

Sporadic Voiding in Cu3Sn

Sample 789 (PCB side, high mag.)

Sample 789 (PCB side, low mag.)

Solder Etching

Intermetallic Evaluations

Sample 789 (PCB side, high mag.)

Sample 789 (PCB side, low mag.)
Failure Analysis – Early Detection

- **Process Development – Underfill**
- **Life Testing – Infant Mortalities**
  - Component Alloy, Holder Alloy, Before Peak Reliability of Mixed Assemblies
- **Package Level – Warpage**
- **Board Level – Pad Breakout**

Definitions and examples related to these topics are presented, including images and graphs to illustrate the points.
Failure Analysis – Process

Cleaning Process, Compositional Analysis

Dye Testing

Stencil Bottom-side Contamination

Understanding of the process, material systems, components and the issues which drive production related failures
Failure Analysis – Mechanical

PEMI Moiré and Modeling

Typical mesh in a 3D octant symmetry model

Bulk Solder Failure
Intermetallic Fracture
Pad Cratering
Copper/Resin Delamination

Strain Gauge Analysis

Board-level Stresses
Failure Analysis – *Electrical*

**Die Level FA – ESD/EOS**

**CAF Formation**

**Voiding in Passive Adhesive**

**Dendrite Formation**
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