RoHS/WEEE Electronics Manufacturing
Overview of Development, and Implementation

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National Electronics Manufacturing Initiative
The Transition to RoHS/WEEE

- Major undertaking of the Electronics industry
  - Driven by European requirements
  - Global impact to supply chain
- Much has been accomplished to get ready
  - Lead free technology/process
  - RoHS compliant materials
- But more work remains
  - Supply chain integration
  - Business processes
- EMS providers can be key enablers to the success of the conversion.
Outline of Presentation

• Drivers for Change
• WEEE and RoHS Timeline
• Overview of R&D on Pb elimination
• Status of Implementation on RoHS Directive
• Unique Role of EMS providers
• Next Steps to Meet the RoHS Directive Requirements

Connect with and Strengthen your Supply Chain
Drivers for Change

• **Pb-Bans in Products**
  – All Electronics-RoHS in Europe (July 1, 2006)
  – Cables (100 PPM) Proposition 65, California (2002)
  – RoHS in China

• **End-of-Life Disposal Legislation**
  – WEEE in Europe (August 13, 2005)
  – Automotive Legislation in Europe
  – EOL legislation pending in 20 states
  – WEEEP in China
RoHS and WEEE Timeline

- **Entry into force in the EU**: Jan 03
- **Entry into force in the Member states**: Aug 04
- **Take back system by country**: Aug 13, 2005
- **RoHs bans Pb, Hg, Cd, Cr VI, PBB, PBDE**: July 1, 2006
- **Recycling targets (50-75%) met**:
  - Product Marking
  - Documentation to recyclers
  - 4kg / person collection target met

**Responsibility within firm**
- Product Design
- EH&S
- Undefined
- Product Design, Sourcing, & Manufacturing

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NEMI’s Role

• NEMI is well positioned to bring together all critical links of the supply chain:
  – Leadership companies
  – Executive participation/support

• We have a well defined methodology to identify and close gaps.

• Forming collaborative projects on environmental topics has been straightforward:
  – Strong member interest
  – Few barriers to collaboration
  – Imposed deadlines
Industry Leaders belong to NEMI – OEM/EMS
Industry Leaders belong to NEMI – Suppliers

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Situation Analysis: R&D
Elimination of Pb

• Tin-silver-copper (SAC) alloy has been extensively evaluated:
  – Initial work by NCMS and others
  – Focus of NEMI Phase I efforts
  – Shown to produce joints more reliable than tin-lead eutectic

• Pb-free reflow soldering process is well defined
Work is still needed to implement/understand SnAgCu solders.

NEMI has five activities underway or emerging to address these needs:

• Component replacement & rework for commercial products-12/04
• Component lead finishes for high reliability applications-3/05
  – Tin whisker accelerated stress testing
  – Fundamental understanding of tin whisker formation
• Optimized alloy and process for wave soldering-6/05
• Optimized board finishes for SnAgCu soldering-6/05
• Board laminate temperature and testing specifications for commercial products-12/05
Situation Analysis: Implementation
RoHS and WEEE

- Widespread introduction of Pb-free solders in consumer products.
- Leading EMS firms have Pb-free capability.
- Limited introduction of Pb-free solders in commercial products.
- NEMI Survey indicates that, for all component types, 2/3 of suppliers can currently provide Pb-free components that meet thermal specifications.
- Lead finishes are still under debate for high reliability applications.
- Appears major conversion of supply chain will be in 3-4 Q 2005.
- There is no focused industry wide effort to address WEEE which goes into effect in 7/05!
- NEMI is active in facilitating the conversion of the supply chain to meet RoHS.
Closing Identified Technology Gaps: NEMI Projects to Eliminate Pb Solder

• 1998 Roadmap identified the technology gap.
• Phase I project developed the alloy, process, components and reliability from 1999-2002.

Results:
– The NEMI efforts accelerated the establishment of SAC alloys as the standard and reduced the effort in each member company.

• Phase II projects are expanding the technology base to include rework, wave-soldering, and reliability of lead finishes.
Closing Identified Technology Gaps: NEMI Projects to Eliminate Pb Solder

• 2002 Roadmap identified a number of business issues to convert to a Pb-free supply chain.

• Five Phase III project teams are currently addressing these supply chain transition issues.

• Three new Phase IV projects are being established to close recently identified technology gaps.
Phase I Pb-Free Project Participants

**OEM/EMS**
- ALCATEL
- CELESTICA
- COMPAQ
- DELPHI
- IBM
- intel
- Kodak
- Lucent Technologies
- MOTOROLA
- SCI Systems, Inc.
- SOLECTRON
- STORAGETEK

**Solder Supplier**
- Alpha-Fry Technologies
- Heraeus
- INDiUM
- Johnson
- KESTER
- ChipPAC
- Texas Instruments
- FCI

**Equipment**
- BTU International
- Universal
- Vitronics Soltec

**Component**
- Others
- Binghamton University
- IPC
- ITRI
- NIST
Phase I Pb-Free Project Results

• Solder Alloy
  – Recommended Tin-Silver-Copper alloy for reflow and Tin-Copper alloy for wave soldering
  – Backwards compatible with lead based systems

• Components
  – Maximum component temperatures of 240°C for large ICs, 250°C max for small ICs on boards ≤ 0.92” thick were achieved
  – JEDEC revised J-STD-020B standard 250°C –5/+0

• Process
  – Manufactured with existing assembly process equipment
  – Performance of Pb-free pastes and fluxes are adequate

• Reliability
  – Demonstrated Pb-free joints are more reliable than tin-lead

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Phase II Pb-Free Projects

• Lead-Free Assembly & Rework (complex commercial products)
  – Assembly Process Development
  – Reliability
  – Rework Process Development
  – Components & Materials

• Tin Whiskers Accelerated Test
• Tin Whisker User Group
• Tin Whisker Modeling
Phase IV: Pb-Free Projects

Objective:
Address several recently identified technology gaps related to wave/selective soldering & surface finishes

Status:
Two projects are being started:
– Pb-free Wave Soldering Assembly Process
– Substrate Surface Finishes for Lead-Free Assembly

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Phase III: RoHS Transition Projects

Objective:

The RoHS Transition Task Group is working to address a number of supply chain and logistics issues related to the transition away from banned substances.

Scope:

• Identify projects
• Determine if industry standardization is appropriate
• Develop standards requirements
• Identify appropriate standards body
• Work with standards body to develop and deploy standard
• Communicate freely and openly to accelerate adoption of results

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RoHS Transition Task Group

Five projects have been organized to address the following:

- Assembly Process Specifications
- Component and Board Marking (including product number change management and labeling standards) JEDEC, IPC
- Component Supply Chain Readiness
- Materials Declarations
- Materials Composition Data Exchange
RoHS Transition Task Group
Importance of Involving the entire supply chain

• Small suppliers need cost effective solutions to data exchange
• Distributors face unique challenges.
  • Need unique part numbers to identify Pb free components
• Transition to Lead-free is first major industry wide technology change with EMS leadership in manufacturing
Unique Position of EMS Providers

- EMS providers will play a key role in the orchestration of the supply chain transition.
- Dealing with a variety of customers, suppliers, and market segments each with a different set of pressures/needs.
- Many of the EMS Providers have already provided materials declaration data for the automotive industry.
- While RoHS and WEEE are European initiatives, much of the volume manufacturing transition will take place in Asia.

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Some are more public than others in their offerings:

Press release on Aug 11, 2004

“Celestica first EMS provider to launch end-to-end Green Services solution

Company’s new offering enables fully integrated, cost-effective product conversion for RoHS/WEEE compliance

Celestica Inc. (NYSE, TSX: CLS) announced the expansion of its integrated services, with the introduction of the EMS industry’s first end-to-end Green Services offering. These include:

- Environmental Compliance Acceleration Program (consulting for compliance programs)
- Full Turnkey Product Conversion Services (supply chain services/engineering services)
- Technology Qualification Services”
RoHS Material Declarations
- a Driver for standard data exchange

The EMS Provider – caught in the crossfire
• OEM requirements often aggregate at EMS
• Liability tends to “roll downhill”
• Deadlines condense down the supply chain
• Feels the pressure to gather substantial amounts of materials data
  – Support multiple industries – including automotive
  – Support multiple levels of reporting
  – Support multiple proprietary formats
  – Quantity component purchases for multiple customers – with multiple reporting requirements
NEMI RoHS/Pb-Free Summit Meeting

Objective:

Provide a broad Overview of the Current Status and Issues of Implementing the RoHS/WEEE Directives.

Provide an open industry forum to identify remaining gaps and propose collaborative efforts.

Host: StorageTek, Inc. Louisville, CO

Co-Sponsors: AeA, EIA, IPC

Date: October 18-19, 2004

http://www.nemi.org/calendar/summit_meeting.html
Agenda: NEMI RoHS/Pb-Free Summit Meeting

**Monday, October 18**
- Regulatory Environment  
  Chair: Holly Evans, Strategic Counsel LLC
- Status of Manufacturing Process Technology  
  Chair: Bob Pfahl, NEMI

**Tuesday, October 19**
- Status of RoHS Standards  
  Chair: Fern Abrams, IPC
- Status of RoHS Implementation  
  Chair: Dave McCarron, Dell, Inc.
- Business-to-Business Data Exchange  
  Chairs: Jim McElroy, NEMI & Richard Kubin, E2open
- Town Hall Meeting to Identify Gaps and Next Steps  
  Chair: Dave McCarron, Dell, Inc.

**Wednesday, October 20**
- Working Discussions on Key Topics  
  Chair: Dave McCarron, Dell

*Connect with and Strengthen your Supply Chain*
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