While many of us thought that 2007 was a difficult year, 2008 is turning out to be one for the record books in terms of economic turmoil. As falling housing prices led to credit market stagnation, governments in many countries began to apply stimulus to get economies moving again. SIA reported modest growth of the semiconductor industry through Q3 but then the October report began to show decline. There are some bright spots in all of this gloom. Energy prices are dropping quickly as demand for oil shrinks. While large capital items (e.g., automobiles) are not selling well in many markets, consumer electronics have not contracted nearly as fast.

In spite of the reduction in energy costs, we see increasing awareness of, and concern about, environmental impact on the earth due to human activity. The electronics industry has a major role to play as society looks for ways to increase energy efficiency, reduce carbon footprints and develop alternative energy solutions. We encourage all to read the Environmentally Conscious Electronics chapter of the 2009 iNEMI Roadmap to further understand the positive contribution that our industry can make to efficiency improvements. While iNEMI and its members have long been taking leadership positions on environmental topics, this year saw us taking a more strategic role as demonstrated by the Sustainability Summit (hosted by Motorola) and the Symposium on Environmentally Friendly Materials (a joint Intel/iNEMI effort held in China). These events then become springboards for new collaborative efforts.

As electronic solutions become more ubiquitous, the expectations of product reliability and up time are increasing at the same time that price performance is improving. Yet our supply web is dynamic and vulnerable as migration of manufacturing continues its march to Asia, Eastern Europe, and beyond. One outcome is an increased number of counterfeit components finding their way into electronics products (including military and other mission critical applications!). The creativity of our engineers, scientists, and logistics professionals will help create solutions to mitigate these risks.

While our efforts in North America remain strong, we enjoyed a significant increase of international participation as our Asian and European investments began to pay dividends. As you read this report you will understand that this is positively impacting our roadmaps, projects, membership growth and industry forums.

The 2009 iNEMI Roadmap is now complete and has been distributed to our members. In approximately three months we will begin to distribute the document on a worldwide basis to the entire industry, and we expect increasing global use and adoption. As we mine the 2009 Roadmap to develop new collaborative efforts, we will also emphasize research and innovation by creating a separate document on the research needs and priorities of our industry.

iNEMI is completely dependent on the support and participation of our members. Our efforts address common needs and challenges – best solved by working together. Member companies can gain the greatest value by participating in iNEMI initiatives to fill their specific needs and to develop business opportunities. Your continued participation is crucial to the successes we collectively enjoy.

Sincerely,

Nasser Grayeli, Ph.D.
Chairman, iNEMI Board of Directors
Vice President Technology & Manufacturing
Director Assembly & Test Technology Development
Intel Corporation

Jim McElroy
CEO & Executive Director
iNEMI
EXTENDING OUR GLOBAL REACH

This past year was a busy one and, while we continued a fast pace of activities in North America, we also ramped up our efforts in Asia and Europe.

iNEMI Asia

We began 2008 with a ribbon-cutting celebration for our Shanghai office, which included an industry forum entitled “Innovation for the Electronics Industry.” The January 16 event drew more than 115 people from 50 organizations, including dignitaries from government agencies, associations and other consortia. Most participants came from China, but we also had guests from Taiwan, Hong Kong, Sweden and the United States.

We participated in several industry conferences in Asia this year, in addition to the events that iNEMI planned and organized (e.g., the opening forum plus the iNEMI Roadmap Workshop and the Intel Symposium on Environmentally Friendly Materials).

The iNEMI Asia Steering Committee met regularly throughout the year, and one of their tasks was to develop a structure for iNEMI activities in Asia. We now have four Technology Groups under which activities will be organized: Board Assembly, Packaging, Materials and Substrates, and Test.

We launched a new project during 2008 that has its leadership in Asia — a first for iNEMI. The Solder Paste Deposition Project has nine participating companies with engineering resources in China, the United States, Taiwan, Hong Kong and Singapore. The project is investigating solutions for depositing different volumes of solder paste on the same high-density board.

By the end of the year, preliminary organizational meetings were being held to develop two new initiatives...
that will also be led from Asia. The first will focus on evaluation of surface finishes and the second on reliability evaluation for QFN (quad flat no leads) packages.

Our success in Asia is best demonstrated by the new members we have attracted. Seven of the 11 companies that joined iNEMI in 2008 are based in Asia, and we expect this trend to continue in 2009.

**iNEMI Europe**

As part of extending iNEMI’s global reach, 2008 also saw the development of our presence and network in Europe. Although well-known to existing members, it has been important to increase the visibility of iNEMI activities to a broader range of companies based in Europe through presentations to individual companies and organizations as well as at workshops and industry conferences. The first half of the year leveraged the 2009 Roadmap process to introduce European companies and research institutes to iNEMI activities and the benefits of membership. This culminated in the first standalone European Roadmap Workshop, which was held at IMEC in Belgium in June. This workshop was attended by a number of companies that were new to iNEMI and generated additional participation in many of the roadmap’s Technology Working Groups (TWGs).

The Electronics Goes Green (EGG) 2008 conference in Berlin in early September also proved a very valuable venue for developing contacts and building awareness of iNEMI’s leadership in the environmental arena. With more than 500 participants, the EGG conference is one of the largest conferences on environmental issues in the electronics industry in Europe. iNEMI’s Grace O’Malley presented a well-received paper — “Future Initiatives for Sustainability” — as part of the technical program. This paper highlighted results from the iNEMI Environmentally Conscious Electronics Roadmap chapter.

**Bob Pfahl Receives Environmental Award**

In September, Dr. Robert C. Pfahl Jr., iNEMI’s Vice President of Global Operations, was recognized with an Electronics Goes Green (EGG) award at the EGG 2008+ conference in Berlin. This award was given for “his commitment to environmental protection and inspiring ideas concerning sustainable development in technology and business solutions.”

Bob’s history of managing environmental issues within the electronics industry, and his guidance in this and other areas, is a significant asset to iNEMI and our members. He is adept at framing challenges in a way that relates to both business goals and environmental performance so that everyone can understand and benefit.

Bob has chaired the environmental chapter for several iNEMI roadmaps, including the 2009 Roadmap. Prior to joining iNEMI, he was Director of International and Environmental Research and Development for Motorola Labs. He has been recognized by IEEE’s Components, Packaging and Manufacturing Technology Society (CPMT) and the US Environmental Protection Agency for his leadership in developing environmentally friendly materials for the electronics industry.

Bob Pfahl (center) is presented an Electronics Goes Green 2008 award from Conference Co-chair Albert Stevels (left), Delft University of Technology, and Nils Nissen (right), Conference Technical Chair, Fraunhofer IZM.
Throughout 2008, much of our activity focused on completing the 2009 Roadmap. We continued to expand our efforts to ensure a global perspective, recruiting participants in Europe and Asia in addition to North America, and holding workshops in each of the three regions. As a result, more than 550 individuals from over 250 organizations located in 18 countries on four continents got involved in our latest roadmapping effort.

The final roadmap, which was shipped to members in December, features chapters from five Product Emulator Groups (PEGs) — automotive, consumer/ portable, medical, office/large business systems, and netcom (network, datacom, telecom) — and 20 Technology Working Groups (TWGs). It includes three new chapters on topics not previously covered: photovoltaics, solid state illumination and RFID item-level tag (ILT). In addition, we significantly strengthened both the Environmentally Conscious Electronics and Optoelectronics chapters. Roadmap sales to industry (non-members) will begin in mid-March 2009.

As the semiconductor industry continues to evolve, “Moore’s Law” is complemented by “More than Moore” technology. System-level modules may be integrated at the packaging level (system-in-package) and also at the silicon level (system-on-chip). In either case, it is important that the final application drives both silicon and packaging solutions. The cross-roadmap efforts between iNEMI and ITRS have addressed OEMs’ system-level needs and identified specific requirements of packaging and silicon-level designs that will drive the needs for future semiconductor device technology.

Paolo Gargini
Director of Technology
Intel Corporation

Roadmap Facts & Figures
1400 pages of information organized in 25 chapters covering 5 product sectors and 20 technology areas

Roadmaps needs for 2009-2019

Contributors:
> 550 individuals
> 250 organizations from 18 countries on 4 continents
One of iNEMI’s strengths is our ability to stimulate and encourage dialogue within industry. By bringing together a cross-section of the supply chain to brainstorm ideas, we can successfully develop consensus-based solutions. We sponsored three industry forums for this purpose during 2008. The first two are examples of how iNEMI is encouraging industry to take a more strategic approach to environmental programs. The third brought together industry and government efforts to establish reliability standards for medical electronics.

**What we’ve gotten out of iNEMI is an order of magnitude more than what we’ve put in. It’s worked out really well for us.**

*Mark Brillhart, Vice President, Cisco Systems Speaking at the iNEMI Sustainability Summit*

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**Sustainability Summit**

iNEMI’s Sustainability Summit was organized to focus the attention of the electronics supply chain on the challenges of creating a more sustainable industry. Held in September (prior to IPC Midwest), the summit was hosted by Motorola at their Innovation/Galvin Center in Schaumburg, Illinois. It brought together leaders from industry, government and academia to discuss areas where industry can take action toward greater sustainability, and to prioritize those areas, identifying where the electronics supply chain can collaborate on proactive environmental programs. Four project proposals emerged from these discussions, and two are currently in exploratory development. *(See below for additional details.)*

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**Sustainability Summit Generates Four Project Proposals**

Summit participants split into two break-out groups to brainstorm options and priorities. One group addressed reuse and recycling, while the other focused on sustainability. Four proposed projects emerged from these discussions:

- **Non-competitive lifecycle assessments (LCAs) for information and communication technology (ICT) products based on a building block approach using assembly emulators**

- **PVC replacement alternatives, using LCAs to compare PVC vs. PVC-free cables and technical evaluation to understand the electrical, mechanical and safety aspects of PVC alternatives**

- **Establish market for post-consumer plastics as “feedstock” for green products (e.g., polycarbonate and/or acrylonitrile-butadiene-styrene, or ABS)**

- **Establish new electronic applications for post-consumer blended plastics (e.g., housings for power supplies)**

The iNEMI Board supported these proposed projects for further action, and two are now in exploratory development. Tom Okrasinski (Alcatel-Lucent) and Todd Myers (Cisco) have volunteered to champion the LCA initiative; and Scott O’Connell (Dell) will champion the PVC replacement alternatives effort.
Deployment activities continued to focus on three technology areas: medical electronics, energy and the environment, and miniaturization. We launched several new projects in 2008 and, at the end of the year, had four more in the exploratory development stage.

The elimination of HFRs (halogenated flame retardants) changes the fundamental composition of FR4 material, and these changes affect material properties. As a result, industry needs to test processes and product performance to optimize product quality for a smooth transition. As with the transition to lead-free, the elimination of HFRs will require material compliance reporting and marking schemes to differentiate materials, parts and assemblies. Discussions at the symposium led to identification of several industry actions, including:

- Work with IPC standards committee to create a practical industry definition of “halogen-free.”
- Create a halogen-free component and board test specification and metrology.
- Through traditional volume learning curves, achieve HFR-free materials cost, delivery and quality parity.

Medical Electronics Meeting at the US FDA

In November, the iNEMI Medical TIG held a medical electronics forum, which was hosted by the US Food & Drug Administration. This forum reported on work to date by iNEMI’s Medical Components Reliability Specifications Project to define a set of requirements for life-critical medical components. These guidelines, based on use conditions and supplier risks, will provide an industry-standard approach to help ensure reliability of electronic components used in medical products.

The forum reviewed existing and related standards and test methods, the use conditions defined by iNEMI, along with recommended test and extrapolation methodologies, and discussed accelerated life test methods to determine long-term leakage and breakdown failures of MLCCs (multi-layer ceramic capacitors).

This open industry meeting served as a “sounding board” to get feedback, and it began the process of building industry support for wide adoption of recommended guidelines and methodologies. It also gave us the opportunity to identify additional industry collaborations to validate requirements for components other than MLCCs.

Intel Symposium on Environmentally Friendly Materials

This Intel symposium, held in Shanghai, was sponsored by iNEMI. The two-day event addressed concerns about HFR-free/PVC-free technology and its impact on the electronics manufacturing supply chain, including material availability, cost and reliability. The meeting brought together OEMs, ODMs (original design manufacturers), EMS providers, substrate and PCB manufacturers, component suppliers and materials suppliers to share information, discuss implementation concerns, and work toward aligning industry on common solutions to implement HFR/PVC-free materials.

The elimination of HFRs (halogenated flame retardants) changes the fundamental composition of FR4 material, and these changes affect material properties. As a result, industry needs to test processes and product performance to optimize product quality for a smooth transition. As with the transition to lead-free, the elimination of HFRs will require material compliance reporting and marking schemes to differentiate materials, parts and assemblies. Discussions at the symposium led to identification of several industry actions, including:

- Work with IPC standards committee to create a practical industry definition of “halogen-free.”
- Create a halogen-free component and board test specification and metrology.
- Through traditional volume learning curves, achieve HFR-free materials cost, delivery and quality parity.

Medical

The Medical Components Reliability Specifications Project completed Phase I deliverables and began Phase II activities during 2008. This project is developing guidelines and methods to assess component reliability as related to implantable medical or other life-critical applications. The team’s approach has been to develop an understanding of the expected failure modes and mechanisms, use conditions, and comparative rate of each type of failure. Once established, test methods can then be developed to accelerate failures and can be used to improve reliability of those component types where a
correlation between failures and acceleration methods can be established.

Initial work in the project established the data used to create the working test DOE (design of experiments) matrix. The Medical Reliability for MLCCs Project, which is underway, will execute the test DOE and establish correlations between accelerated tests and failure modes. Testing is focused on MLCCs (multi-layer ceramic capacitors), and the results will be used to generate guidelines and recommended test methods for implantable or life-critical MLCCs and, subsequently, other devices.

In addition to the summit held at the FDA (discussed previously), the project team reported Phase I results to iNEMI members in a November webinar.

Environmental

The electronics industry’s interest in, and concerns about, environmental issues is not abating. If anything, activity may have increased as legislation becomes more pervasive and industry begins to drive change for market advantage. The industry is under pressure to remove potentially harmful compounds from products, the latest of which is the halogenated flame retardants (HFRs) that were once widely used in electronics housings and cases and are still used extensively in printed circuit boards. Several leading electronics companies have publicly stated their intent to remove brominated and/or halogenated flame retardants from some or all of their products.

iNEMI’s HFR-Free PCB Project was organized to determine the properties associated with the new class of HFR-free materials. The iNEMI project objectives are defined as follows:

- Build on industry knowledge and capability
- Consider unique market segment requirements
- Identify technology readiness and gaps
- Stimulate supply capability
- Recommend standards development opportunities

Scott Zellmer, Micro Systems Engineering, Co-chair, Medical Components Reliability Specifications Project

Jerry Peasley, Micro Systems Engineering, Co-chair, Medical Reliability for MLCCs Project

Anthony Primavera, Micro Systems Engineering (formerly with Boston Scientific), Chair, Medical TIG; Project Chair, Medical Components Reliability Specifications and Medical Reliability for MLCCs

The construction of the MLCC in Photo 1 is ideal. It is free of voids, has good wetting and fillet, there is no detachment at the ceramic, and coverage of Ag/Cu layers is uniform.

Photo 2 shows blemishes on the case of the MLCC. It is unknown whether these blemishes cause reliability concerns. The Medical Reliability for MLCCs team will develop an accelerated test method to help anticipate long-term leakage and break-down failures.

Photo 1 Photo 2
Working with the materials supplier base and printed wiring board manufacturers, the project team used known designs from IBM and Intel to judge the electrical, mechanical and reliability attributes of various HFR-free materials. Results were provided to iNEMI members in August while summarized results were presented at conferences.

The project’s investigation showed that not all HFR-free materials are equivalent, nor were any of the materials tested equivalent to the FR4 baseline. Compared to the baseline, there were generally higher dielectric constant (Dk) values and lower dissipation factor (Df) values for the HFR-free materials. Findings include:

- **Material testing**: Pre-preg and laminate properties evaluation showed good thermal stability, comparable moisture absorption, slightly lower CTE in the Z direction and no impact of filler on adhesion.

- **Electrical testing (Dk/Df)**: In testing, bake/reflow did not significantly change the laminate dielectric constant — the Dk for HFR-free materials and the total loss for these materials is generally equivalent to or lower than the baseline.

- **Adhesion testing**: Through Pb-free solder compatibility testing, most HFR-free laminates did not show functional degradation; however, laminate cracking was observed in one of the materials tested during reflow.

The significance of the HFR-free material property and performance differences will be dependent on the design and demands of the products in which they are incorporated, and the project team recommends testing of any material for the specific application prior to mass production.

A follow-on project — the **HFR-Free High-Reliability PCB Project** — was launched this year. This new project will identify technology readiness, supply capability and reliability characteristics for HFR-free alternatives to conventional printed wiring board materials and printed wiring board assemblies, based on the requirements of the high-reliability market segment. The project team was formed in October, and Phase I of the project is underway.

Two additional projects that were in development at the end of 2007 officially launched in 2008. The first is the **Pb-Free Alloy Alternatives Project**, which is focused on providing guidance to help the electronics industry better manage Pb-free alloy proliferation. Initial activities are focusing on understanding what knowledge is available for the various alloys being deployed and the related gaps in data. The group will work with the supply base to help manage the variability as well as to encourage the closure of knowledge gaps.

In July, the project team released a set of recommendations to help the electronics industry.

The HFR-Free PCB Project assessed the chemistry type and shape or size of filler particles. Representative photographs for some of the materials are shown here. In general, fillers used as the source of flame retardance are composed of aluminum and magnesium inorganic compounds. In the case of P-based flame retardants, the source could be either reactive phosphorous organic components or particulates. (Photos courtesy of Kostas Papathomas, Endicott Interconnect Technologies, Inc.)
manage Pb-free alloy alternatives, which include the following:

- Drive convergence of Pb-free alloys
- Develop an industry-standard assessment methodology
- Establish performance guidelines
- Update standards
- Identify and differentiate alloys

iNEMI’s recommendations support the guidelines developed by the EMS Forum on Lead-Free PCB Assembly entitled “Guidelines for Lead-Free Solder Alloys for Wave Solder and Pin-Through-Hole Rework.”

The second new project is the Pb-Free Early Failure Project. This group’s goal is to determine whether a large sample size can reveal early failures in accelerated thermal fatigue testing of Pb-free solder joints.

There are significant physical and metallurgical differences between SnPb and Pb-free solders, which have a direct effect on thermal cycle performance. If the outliers identified in Pb-free soldering thermal fatigue studies are a function of the structure/properties, they may not be visible in the relatively small sample size used in thermal cycling tests. If so, the traditional SnPb sample size (32) is inadequate to characterize the reliability of Pb-free solders, and test data using these sample sizes could result in over-estimation of reliability (i.e., small sample size could mask early Pb-free failures).

The Pb-Free Early Failure Project has developed a unique test vehicle and is using a sample size of 256 components each of three component configurations to test BGA solder joints. The test boards have been designed and assembled, and thermal cycling began in late 2008. The three different component configurations under test will cover four conditions: small sphere joints, large sphere joints, low strain rate, and high strain rate. Real-time analysis will be used so that results are better understood, analyzing at regular intervals as well as at failure events. All testing will be done with a single alloy system and a single accelerated thermal cycling (ATC) profile.

The Pb-Free Wave Soldering Project is progressing with Phase II testing. The focus of this phase is to characterize the reliability of through-hole joints on a test vehicle specifically designed to test the norms and practices used in tin-lead wave soldering and develop new standards for lead-free wave soldering.

ATC testing is being performed by Hewlett-Packard, Delphi and Nihon Superior, and Cisco is doing shock and vibration testing.

Pull testing was completed during the third quarter. This test compared the pull test performance of as-built test boards with different surface finishes (OSP, NiAu, HASL, ImmAg), alloys (SnPb, SAC, SnCuNi, SACx), and thicknesses (62 and 93 mil).
Miniaturization

As the size of electronic components and circuitry continues to shrink, there are an increasing number of issues that must be addressed. Miniaturization affects everything from design and test to materials and packaging. Several iNEMI projects are addressing challenges related to miniaturization.

The Board Coplanarity in SMT Project officially launched in July. The project team intends to identify limitations metrologies or test methods of systems that currently exist today and, in addition, will propose new metrologies or test methods if needed. The project will also make recommendations to enable the measurement and specification for board land coplanarity to ensure high-quality, high-yield SMT processes for current and next-generation components and boards. Deliverables include:

- Determine metrologies needed to measure board flatness in land area of components at both room and elevated temperatures
- Develop strategy on requirements for differing board features to recommend to IPC for standards development
- Recommend acceptance criteria for board flatness, and conditions for sampling and measurement requirements
- Collect data regarding first pass yield and solder joint quality/reliability based on package and board interaction

The project team completed their matrix of metrology requirements and started data collection by the end of 2008.

The Nano-Attach Project completed Phase I activities in 2008. This project was investigating low or room temperature assembly processes that could improve field reliability, streamline manufacturing and reduce costs. Their focus was on dry adhesive technologies (e.g., nano-velcro or biomimetic systems) that could be used to replace solder attach systems.

The project team identified electronic assembly applications that could benefit from nano-attach adhesion techniques. These were then narrowed down to the most promising applications, and those that were of greatest interest to the team, which included:

- RF shield attach
- Heat sink
- Power module heat sinks
- Temperature-sensitive surface mount components
- Low-temperature flex components
- Discrete surface mount components (active and passive)
- ICs (fine pitch/low contact area)
- Array devices
- Perimeter devices
- Die attach

Project participants discussed the necessary requirements to adapt these applications to nano-attach techniques and identified technology gaps through benchmarking. The team discussed the possibility of extending the work into a second experimental phase, and concluded the technology was not yet mature enough to warrant further action at this time.

The project team explored various options for attaching nano-structures to substrates and components. The simplest attachment scheme (and most desirable) would be to have a single nano-structure attached directly to the substrate without using an intermediate layer or any component interface.
The goal of the iNEMI Pb-Free Nano-Solder Project is to research and develop a nano-solder paste that can effectively suppress the melting point temperature of Pb-free solders. This team is demonstrating the feasibility — and manufacturability — of such a solution.

Some very interesting observations have been recently made (albeit not yet verified). It is worthwhile to recall some of the unique features of nano-scale materials. As one transcends from the bulk world to that of the nanoscale, the surface area to volume ratio becomes immense. In the example above, a 1 nm particle has a surface area to volume ratio that is akin to the surface area of a football field around a rain drop. The number of atoms on the surface of such a particle is approaching nearly 30%. This energetic surface is enabling the lower melting point of nano-particles.

The Solder Paste Deposition Project launched this year and work is underway in their investigation of solutions for depositing different volumes of solder paste on the same board for high-density layout. As mentioned previously, this project is our first that is being led from Asia.

As product size decreases, board density increases and smaller, fine-pitch components (requiring smaller volumes of paste) often appear next to larger components (which require more paste). In these situations, a step stencil is the most common solution; however, determining the proper distance between the various components can be a challenge because the step stencil can affect the thickness of the solder paste deposition. The first phase of this project is focused on investigating the keep-out distances of step stencils and developing design rules for high-density layouts. The second phase will identify potential solutions and determine whether development of integrated functional equipment is warranted.

During 2008, the project team completed a comparison of available techniques and approved an experimental scheme optimization for PCB design, components selection, sample size, etc. By the end of the year, data collection had begun. The team completed its first printing experiments at Speedline during the fourth quarter, collecting more than a million experimental measurements. After an initial review, the project team met in December to address the statistical analysis of the data collected.

Another challenge presented by miniaturization is the loss of physical access to test points. iNEMI’s Board & Systems Manufacturing Test TIG (Technology Integration Group) launched two new test projects to address issues related to loss of test access. The goal of the new Board Flexure Standardization Project is to promote the use of standard methodologies to establish strain limits for BGA components and printed circuit boards. Lead-free boards are more susceptible to mechanical stresses and, therefore, more prone to damage when bent. There is currently no consistency in the industry regarding the placement of gauges on boards to measure strain levels. The real estate challenges of board designs, variances in test methods to derive strain limits, and differences in strain metrics and failure criteria all make it difficult to standardize on a single methodology.

The Board Flexure Standardization team plans to:

- Promote the use of the spherical bend test method for determining PCA strain limits
- Recommend updates to IPC/JEDEC-9702
- Review the effectiveness of current failure analysis (FA) methods to determine PCA flexure damage
- Promote the use of a standard metric to measure PCA strain
- Recommend IPC/JEDEC-9704 updates to clarify the necessity of using a standard gauge placement so that measurements are consistent
By the end of 2008, the team had reviewed and adopted a spherical bend test methodology originally developed by Intel, which the group will propose to IPC/JEDEC for standardization. This new test method can better emulate worst bend mode/conditions on a PCA during manufacturing, test or assembly process. In addition, the group plans to publish new lead-free PCA strain limit guidance, so each company will continue to establish specific guidelines for components and boards based on their own analysis and level of risk. The group expects to present their first proposal for IPC/JEDEC in late January 2009.

The second new test initiative is the Boundary Scan Adoption Project. This group was organized to promote wider industry adoption of boundary scan (IEEE 1149.1, 1149.6, P1581 and others). Efforts will focus on encouraging semiconductor vendors to include the technology in their products, promoting the development of tools by ATE vendors to support boundary scan-based board test, and promoting the development, refinement and adoption of synthesis and verification tools to assist in implementation.

As a first step, the group is surveying individuals who use or produce boundary scan devices and/or board test development tools. An online survey was launched in December.

Work continued this year on the Functional Test Coverage Assessment Project. This project is attempting to develop a functional test coverage assessment method that will allow reliable comparisons of test coverage among different test environments, test conditions and different assessors. Creating more consistency in functional test coverage assessment will open opportunities to automate reports, which enables informed decision-making on issues pertaining to test.

To date, the team has compiled usage models of functional test coverage and developed and distributed a survey to gauge industry use of functional test coverage. Work is also progressing on the second phase of activities, which includes:

- Compile a list of defects that encompasses structural faults referencing existing categorization methods
- Add functional-test-specific defects to structural defects list
- Define assessment methods (e.g., paper assessment, assessment by observation, fault injection)
- Create confidence margin and weighting factors that allow emphasis for important assessment items
- Develop guidelines for assessing coverage and assigning confidence margin
2008 iNEMI ORGANIZATION

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**Environmentally Conscious Electronics**
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Eric Simmon, NIST; Jeff Pettinato, Intel Corporation

**Interconnection PCB – Organic**

**Interconnect Substrates – Ceramic**
Howard Imhof, Metalor Technologies USA; Ton Schless, SIBCO LLC

**Large Area Flexible Electronics**
Dan Gamota, Motorola; Jan Obrutz, NIST; John Szczech, Motorola Labs; Jie Zhang, Motorola

**Mass Data Storage**
Roger Hoyt, Consultant; Tom Coughlin, Coughlin Associates

**Modeling, Simulation & Design Tools**
Yi-Shao Lai, Advanced Semiconductor Engineering, Inc.; SB Park, State University of New York at Binghamton

**Optoelectronics**
Dick Otte, PROMEX; William Ring, WGR Associates

**Packaging**
Bill Bottoms, NanoNexus; Bill Chen, ASE

**Passive Components**
Philip Lessner, KEMET Electronics; John Galvagni, AVX

**Photovoltaics**
Alain Harrus, Crosslink Capital; Jim Handy, Objective Analysis

**RF Components and Subsystems**
Ken Harvey, Teradyne; Eric Strid, Cascade Microtech

**RFID Item-Level Tag**
Steve Brown, Celestica; Dan Gamota, Motorola; Prasanna Kulkami, Motorola

**Semiconductor Technology**
Paolo Gargini and Alan Allan, Intel Corporation

**Solid State Illumination**
Marc Chason, Consultant

**Test, Inspection & Measurement**
Michael Reagin, Delphi; Michael J. Smith, Teradyne

**Thermal Management**
Ravi Prasher, Intel Corporation; Azmat Malik, Consultant
Technology Integration Groups (TIGs) and Projects

**Board Assembly TIG**
Ian Williams, Intel Corporation

**Board Coplanarity in SMT**
John Davignon, Intel Corporation

**Pb-Free Alloy Alternatives**
Greg Henshall, Hewlett-Packard; Stephen Tisdale, Intel Corporation

**Pb-Free Component and Board Finish Reliability (in conjunction with Substrates TIG)**
Houssam Jomaa, Intel Corporation; Richard Coyle, Alcatel-Lucent

**Pb-Free Early Failure**
Joe Smetana, Alcatel-Lucent

**Pb-Free Nano-Solder**
Andrew Skipor, Motorola Labs

**Solder Paste Deposition**
Shoukai Zhang, Huawei Technologies Co., Ltd.

**Nano-Attach**
Hope Chik, formerly Motorola Labs

**Board and Systems Manufacturing Test TIG**
Rosa Reinoso, Hewlett-Packard; JJ Grealish, Intel Corporation

**Board Flexure Standardization**
Rosa Reinoso, Hewlett-Packard; Alan McAllister, Intel Corporation

**Boundary Scan Adoption**
Philip B. Geiger, Dell, Inc.; Steve Butkovich, Cisco Systems

**Functional Test Coverage Assessment**
Tony Taylor, Intel Corporation

**Environmentally Conscious Electronics TIG**
Chair is open

**High-Reliability RoHS Task Force**
Mike Davisson, Agilent Technologies; Thilo Sack, Celestica; Joe Smetana, Alcatel-Lucent

**Pb-Free Rework Optimization**
Jasbir Bath, Consultant; Craig Hamilton, Celestica

**Pb-Free Wave Soldering**
Denis Barbini, Vitronics Soltec

**Tin Whisker – Phase II**
Richard Parker, Delphi; Mark Kwoka, Intersil Corp; Jack McCullen, Intel Corporation; John Osenbach, LSI

**Medical TIG**
Anthony Primavera, Micro Systems Engineering, Inc. (formerly with Boston Scientific)

**Medical Components Reliability Specifications**

**Medical Reliability for MLCCs**

**Medical Substrates**
Thomas Jacob, DYCONEX, AG

**Optoelectronics TIG**
Chair is open

**Fiber Connector End-Face Inspection – Phase II**
Tatiana Berdinskikh, Celestica; Brian Roche, Cisco Systems, Inc.

**Substrates TIG**
Hamid R. Azimi, Intel Corporation

**HFR-Free High-Reliability PCB (in conjunction with Environmentally Conscious Electronics TIG)**
Stephen Tisdale, Intel Corporation

**Pb-Free Component and Board Finish Reliability (in conjunction with Board Assembly TIG)**
Houssam Jomaa, Intel Corporation; Richard Coyle, Alcatel-Lucent

**Thermal Management TIG**
Vadim Gektin, Sun Microsystems; Je-Young Chang, Intel Corporation
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iNEMI’s strength springs from the enhanced strength of our members as a collective whole, and our success is solely dependent on their participation. That is why we endeavor to attract industry leaders — companies that are focused on the future and have the vision and resolve to help shape the course of the electronics industry. The following companies joined iNEMI this year: ASSET InterTech, Inc.; Corelis; Dell, Inc.; Doosan Corp. Electro-Materials BG; Elite Material Co., Ltd.; IHS; IST–Integrated Service Technology, Inc.; ITEQ Corporation; ITRI (Industrial Technology Research Institute); Nan Ya Plastics Corporation; Test Research, Inc.

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