

iNEMI Statement of Work (SOW)
Test TIG
iNEMI Board Flexure Standardization Project, Phase 2
Guidelines for Printed Wiring Board Strain
Gage Testing in Pb-Free Assemblies

Version #2.1

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iNEMI Coach:

Basic Project Information

Damage can be induced in printed circuit assemblies (PCAs) by flexing during manufacturing and box assembly. To evaluate PCA risk, the bend-induced stress needs to be measured. Printed circuit board (PCB) surface strain is an indirect indicator of the stresses that solder joints experience. Due to strain gradients across bent PCB surfaces, it is critical that the placement of strain gages is consistent in order to properly evaluate stress conditions and risk levels.

Current standards that determine board strain (such as IPC/JEDEC-9704, *Printed Wiring Board Strain Gage Test Guideline*) have not been updated to encompass the impact of changing to Pb-free electronics and to incorporate strain gage placement industry best practices. Consistent strain measurement techniques are needed to reduce confusion and error.

Scope of Work

This project will develop recommendations to update IPC/JEDEC-9704 to reflect current best practices in strain gage technologies and measurement techniques. The present views of companies regarding the present state and future focus of strain gage placement will be gathered and consolidated. Decisions on proposed changes to current standards will be based on these industry views. These proposed changes will be presented to the IPC/JEDEC committee, and feedback will demonstrate what should be done to update standard IPC/JEDEC-9704 to reflect the current industry trends.

Dependency

This work is predicated on the assumption that there is sufficient data available in the industry to make the decisions required within the scope of this project. If it is found during the course of this project that additional data is required, this Statement of Work would be modified to include a test phase. The new SOW would be submitted to the iNEMI Technical Committee for approval prior to committing the project team to the tasks identified in the new SOW.

Purpose of Project

The purpose of this project is to recommend updates to IPC/JEDEC-9704 to:

- Address the importance of using a consistent strain gage placement (along package diagonal) to properly assess risk.
- Update the document to reflect new PWB strain guidance related to Pb-free technology.
- Discuss and incorporate best practices from experienced IPC/JEDEC-9704 users, especially when it is hard to follow the recommended gage placement (e.g., cutting package corners or new strain gage technologies).
- Update Appendix A (Strain Limits) of IPC/JEDEC-9704 to align with IPC/JEDEC-9707 test methodology.
- Update Appendices A&B (Strain Limits & Reference for Rate Limited Guidance) of IPC/JEDEC-9704 such that they are acceptable for Pb-free solders.
- Update Appendix B (Reference for Rate Limited Guidance) to clarify when these strain limits are and are not applicable (e.g., not for use in shock).
- Develop criteria for differentiating between qualitative and quantitative assessment methods (typical manufacturing environment vs. deliberately mishandling boards), such as when absolute limits can be used and when relative measurements need to be used.
- Identify key parameters to document during manufacturing evaluation
 - PCA properties: pad size, board thickness, PCB laminate type, etc.
 - Factory conditions: equipment, equipment conditions, etc.
- Determine appropriate Failure Analysis (FA) methods as an alternative for not being able to monitor strains.

Return on Investment

This project proposes to justify the changes to the current standard listed above by demonstrating a tangible return on investment. To this end we will present an ROI estimate using the following criteria:

Criteria:

- Impact if work is not done
 - Possible over-engineering of products, resulting in overspend
 - Possible inaccurate or inconsistent results from strain gage testing with current methodology
 - Possible solder joint interconnect latent failures going out of the manufacturing line
- Benefit to industry, as well as participating companies (cost, quality, yield, efficiency gained, process or test time, quicker diagnoses of issues, other resource savings, prevention of class failures)
- Basic calculation of ROI would be performed using “typical” products

Previous Related Work

- Describes how to perform strain gage testing for PWBs in the board manufacturing process
- Challenges:
 - This standard allows for multiple gage placement layouts, leading to ambiguity in data interpretation, since measurements cannot be directly compared between different gage placements
 - Maximum allowable strain is defined for tin-lead PCAs only (see Appendix A)
 - Maximum allowable strain is based on principal strain measurements, which require consideration of the angle of maximum strain for proper risk assessment or dictate that much more conservative limits be used
 - Criteria for defining a strain limit vary with different component, board, and strain rate parameters

Prospective Participants

- Semiconductor manufacturers
- Original equipment manufacturers
- Contract manufacturers
- Other: Reliability engineers, manufacturing engineers, test engineers, research and development, quality assurance, procurement, standards bodies

Project team members are expected to participate by sharing knowledge on board flexure and FA methods. The team will draft a recommendation for the IPC/JEDEC committee on proposed changes or additions to the current standard.

Agilent Technologies

Celestica

Cisco Systems, Inc.

Delphi

Dell

Flextronics

Foxconn

Hewlett Packard Company

Intel Corporation

IPC

IST - Integrated Services Technology

Lenovo

National Instruments

Plexus

Quanta Computer

Sanmina-SCI Corporation

Stress Engineering Services

Stress Investigators Engineering Inc.

Oracle (Sun)

Test Research, Inc.

Vitronics-Soltec

Vishay

Project Plan

Schedule with Milestones

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Apr 2011
Task 1 – Determine areas where modifications are needed in the IPC/JEDEC-9704	X	X								
Task 2a – Develop consensus on standard gage placement			X	X	X	X				
Task 2b – Decide what needs to be updated in IPC/JEDEC-9704 related to Pb-free technology, and how to implement updates			X	X	X	X				
Task 2c – Consolidate best practices in using IPC/JEDEC-9704 (using strain limits, qualitative vs. quantitative assessment methods, key parameters during mfg evaluation, and alternate methods (such as FA))			X	X	X	X				
Task 3 – Develop and approve proposal with recommendations to the IPC/JEDEC Committee							X			
Task 4 – Present recommendations to the IPC/JEDEC Committee								X		
Task 5 – iNEMI Membership Report – Webinar									X	
Task 6 – Industry Report Presentation										APEX 2011

Methodology and Resources

Resources: Team members from participating companies

Task 1: Determine areas where modifications are needed in IPC/JEDEC-9704

- Review current document with team
- Identify issues in current document
- Agree on specific areas team will address

Task 2:

- a: Develop consensus on standard gage placement
- Review current gage placement standard with team
 - Identify all methods being used by participating teams
 - Evaluate pros and cons of each method
 - Agree on recommended method(s)

- b: Decide what needs to be updated in IPC/JEDEC-9704 related to Pb-free technology, and how to implement updates
 - Review team concerns regarding Pb-free technology and its effect on strain response
 - Identify which items to address within the new standard
 - If new data must be developed, sub teams will be developed to address this need
- c: Consolidate best practices in using IPC/JEDEC-9704 (using strain limits, qualitative vs. quantitative assessment methods, key parameters during mfg evaluation, and alternate methods (such as FA))

- Review utilization methods of participating team members
- Evaluate pros and cons of various methods
- Agree on best practices

Task 3: Develop and approve proposal with recommendations to the IPC/JEDEC Committee

- Incorporate modifications identified in Task 2 into draft of updated standard
- Review draft with team
- Resolve any issues with participating teams

Task 4: Present recommendations to the IPC/JEDEC Committee

Task 5: iNEMI Membership Report – Webinar

Task 6: Industry Report Presentation at IPC/APEX 2011

Project Monitoring Plans

This project falls under the general category denoted as Standards Development (i.e., given a set of materials and/or processes, these projects define a usable range for each set). The project would also identify an appropriate standards body to which a proposal could be submitted to make the sets part of the published standards. The purpose of specification projects may also be to prepare “white papers” for industry distribution with the ultimate goal of making new specifications into de facto standards.

Project monitoring plans are as follows:

- Ensure open lines of communication among participants
 - Bi-weekly conference calls
 - Meeting minutes provided through email
 - Follow-up with individuals on an as-needed basis
 - Workshops and face-to-face meetings as appropriate
- Mid-project technical review and progress reports at regularly scheduled iNEMI meetings.
- Track and document approximate Man-Months per quarter per team member (this will require the active members of the team to provide estimates).
- Track and document approximate number of people on the project per quarter (this can be tracked through iNEMI's WebEx account).
- Project results, including conference presentations, technical papers, end-of-project webinar, etc., will be published on the iNEMI website.

Outcome of the Project

- **Technical paper/whitepaper**
 - Present recommendations to the IPC/JEDEC Committee
- **Presentations at major test conferences**
 - Industry Report Presentation at IPC/APEX 2011

General and Administrative Guidelines

General and Administrative Guidelines for this project and all other iNEMI Projects are documented at http://thor.inemi.org/webdownload/join/gen_guidelines.pdf.