

LEAD-FREE SOLDER JOINT RELIABILITY

TWO-DAY TUTORIAL DESCRIPTION - NEW IN 4Q 2005

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Overview / Objectives

This seminar provides an extensive coverage of lead-free attachment reliability issues and trends and offers practical guidelines to assess the reliability of lead-free solder joints and circuit board assemblies. Participants will gain an in-depth understanding of the multitude of material, design and manufacturing parameters that affect solder joint reliability and that are critical to the deployment of lead-free circuit board assemblies. Following a review of the basics of solder joint mechanics, test procedures, failure modes and mechanisms, the seminar puts in perspective a wide range of lead-free data, material properties, test and modeling results from across the industry. Test results are discussed for common components (leadless, leaded, BGA, Flip-Chip, CSPs), including the effect of board and component finish on lead-free reliability, and a comparison of tin-lead, mixed assemblies and lead-free reliability data. Metallurgical risks, creep properties and fatigue curves are examined that explain differences in the reliability of tin-lead and lead-free assemblies. Examples of strain-energy based life prediction models and acceleration factors are presented, comparing test efficiency for SAC and SnPb assemblies and illustrating how to extrapolate lead-free test results to product use conditions, the true measure of lead-free assembly reliability.

The tutorial is technical in nature and pulls together a wide range of data, material properties, test and modeling results from across the industry. Lessons learned from the tin-lead experience and fundamental differences between SnPb and lead-free solders are highlighted as well as recent progress in the practical understanding of lead-free solder joint reliability. Pre-requisites: none although some basic understanding of the mechanical behavior of materials is helpful. In addition to the printed seminar hand-out, participants will receive the .pdf version of an extensive reference list on SnPb and lead-free solder joint reliability.

What You Will Learn

- The basics of solder joint reliability, plus an overview of trends in SAC vs. SnPb accelerated testing results.
- Fundamentals and lessons learned from the SnPb experience: solder joint mechanics, creep-fatigue interaction, life prediction techniques.
- Assembly quality and reliability: defects and their impact on product life.
- Accelerated testing procedures, failure modes and mechanisms, failure statistics.
- Identify potential risk areas (metallurgical risks, ductile-to-brittle transition, interfacial failures...).
- How to plan for lead-free product reliability assurance and why inferior test results – when compared to SnPb -- do not necessarily imply lessened product reliability.
- Gain an understanding of fundamental differences in microstructure, creep mechanisms and the thermo-mechanical response of SnPb and SAC alloys.
- Understand the effect of thermal cycling dwell times on the relative lives of SnPb and SAC assemblies.
- Find out how to optimize lead-free accelerated thermal cycling profiles for maximum efficiency (and reduced cost) without lengthening test duration.
- How to interpret test results; strain-energy based life prediction models; examples of acceleration factors for SAC assemblies, including validation data.

Topics (partial list)

- Thermal cycling reliability data for common components (SMT, flip-chip, BGA, CSP).
- Impact of components and test conditions on the reliability of lead-free versus SnPb assemblies.
- Effect of component and board finish on lead-free life.

- Effect of Pb-contamination on solder joint reliability.
- Backward and forward compatibility issues.
- Material properties and creep deformations, including the importance of primary and tertiary creep.
- Fatigue curves, failure modes, ductile-to-brittle transition temperature.
- Effect of dwell times on lead-free thermal cycling results: agreement between test and model predictions.
- Examples of lead-free solder constitutive models, life prediction models and acceleration factors.

Who Should Attend

Design, materials, manufacturing, quality or reliability professionals and managers who are responsible for, or plan to implement lead-free assembly technologies in their companies' products.

Instructor Biography

Jean-Paul Clech has over 20 years of practical experience in SMT design, soldering quality and reliability assurance. He maintains one of the largest databases of solder joint reliability data, material properties and life prediction models in the industry and is constantly challenged by problems brought about by new and emerging technologies. His current research interests are in BGA, CSP, flip-chip and lead-free assembly reliability, including the development of lead-free solder acceleration factors and life prediction models.

Jean-Paul is the founder of EPSI Inc. in Montclair, NJ. His responsibilities include technical consultation and problem solving for clients across the electronics industry worldwide, and the development of engineering tools and training programs to prevent or solve reliability problems in electronic packages and board assemblies. He is the principal developer of the "Solder Reliability Solutions" model and application software. He has also served as an expert-witness in product litigations involving solder joint field failures.

Jean-Paul previously was Manager of Electronic Packaging at a European super-computer start-up, a Member of the Technical Staff and then consultant at AT&T Bell Laboratories. He received the Diplôme d'Ingénieur from Ecole Centrale de Paris, France (Materials Science major), and the M.S. and Ph.D. degrees in Mechanical Engineering from Northwestern University, Evanston, IL. His technical interests include thermal, mechanical, structural and fatigue behavior of electronic materials, packages and assemblies, and the application of engineering principles to the physical design and manufacturing of electronic systems. He is the author of over forty technical papers, a frequent speaker at technical conferences, and has been an invited lecturer and instructor at various corporate events and professional venues in Asia, Europe and North America. He is an active member of ASME, IEEE, IMAPS, TMS and SMTA. In 2003, Jean-Paul received the SMTA Member of Distinction award.

IN-HOUSE WORKSHOP

This workshop is also available in-house at a site of your choice. The in-house version of this workshop can be customized to meet your organization or project specific needs. When offered in-house, the .pdf version of presentation files and related documentation are available on a CD-ROM with a license agreement for posting on your company web site.

CONTACT INFORMATION

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