

Course coverage and topics are as below:

Lead-Free Preparation for Implementation (Part 1 + Part 2 Combined)

The purpose of the course is to provide a broad-based information, as well as specific critical factors for preparing the Lead-free implementation. The course is based on the book: "*Environment-Friendly Electronics—Lead Free Technology*". The course includes two parts: Part 1 covers all relevant topics including global legislative status, technological base, product assessment and manufacturing considerations. The viable lead-free solder alloys will be ranked in their key performance parameters in relation to production process, potential defects and reliability; Part 2 covers the properties and performance of PCB surface finishes and the component coating/terminations, which are important to the circuit assembly's production yield as well as to its long-term integrity. A proper level of understanding of the important factors that determine the solderability and performance of surface finishes and component coatings under SMT manufacturing will be provided. The viable material and process options of PCB surface finish and component coating will be separately reviewed. The course will also discuss tin whisker. The combination of Part 1 and 2 completes the preparation for implementation. This course prepares the attendees for the Part 3 on Lead-free Implementation and Production and Part 4 on lead-free Reliability and Manufacturing.

Topics of Part 1:

- Driving forces
- Legislation update--US, Japan, Europe, China
- Global implementation status
- Pb-free criteria & definition
- Pb-free technological base
- Comparison of viable Pb-free alloy in key performance
- Pb-free SMT manufacturing in reflow and wave soldering vs. alloy melting temperature
- General manufacturing factors - cost vs. performance
- Implementation approaches
- Summary

Topics of Part 2:

- Purpose of surface finish and component coating
- Solderability--principle & definition
- Pb-free component coating/termination--viable options and examples
- Tin whisker--phenomena, factors, remedies
- Pb-free PCB surface finishes--viable options and characteristics
- Organic coating (OSP) vs. metallic
- Relative performance of Pb-free surface finishes with Pb-free solder joints
- Summary

Lead-Free Implementation & Production—(Part 3)

Based on the book: "*Lead-free Implementation—A Manufacturing Guide*", this course focuses on manufacturing know-how to achieve the yield, quality and reliability. The course will present the real-world process parameters and successful high-volume production results by OEMs and EMSs. The common Pb-free production defects and preventive steps will be discussed in comparison with SnPb. The course material is designed to illustrate the best practices in Pb-free production to minimize defects and maximize reliability. The objective is to provide best practices by not marginalizing the existing manufacturing infrastructure in Pb-free conversion, as well as demonstrate the production approach options. Information is applicable to all types of interconnections including flip chip, CSP, QFP, BGA, and passives. The course emphasizes on actual production results (> 70,000,000 PCB assemblies produced and in service).

Topics

- Define Pb-free manufacturing
- Clarify the prevalent notions
- Outline the existing SMT manufacturing conditions and process parameters
- Two most important production performance parameters
- --by melting temperature
- --by intrinsic wetting ability
- SMT process options
- Nitrogen--need or not-need
- Illustration of OEM/EMS production results (case studies) including drop-in production
- --Reflow, paste, double-side reflow
- --Wave soldering performance

- --Paste-in-hole application
- --Printing and Dispensing
- --Fine wire application
- --X-ray inspection--fillet, voids
- --Thermal cycling tests
- --Reliability results
- --Cost consideration
- Practices in paste printing, reflow, wafer bumping--Pb-free vs. SnPb
- Common production defects Pb-free vs. SnPb—0201 Tome-stoning, Black-pad issues
- Summary

Lead-Free Reliability & Manufacturing—(Part 4)

The course is designed to integrate the manufacturing know-how and the resulting solder joint reliability, based on three books: "*Environment-Friendly Electronics—Lead Free Technology*"; "*Lead-free Implementation—A Manufacturing Guide*"; and "*Modern Solder Technology for Competitive Electronics Manufacturing*". The purpose is to provide a proper level of understanding of Pb-free solder interconnection reliability in material basics, production process, and real-world performance, as well as the interrelation between them. The main factors affecting the reliability, particularly from manufacturing perspectives will be presented. The effects of gold, intermetallics and the estimation of gold threshold concentration will be discussed. Information is applicable to all types of interconnections including fine pitch QFP, BGA, flip chip, CSP, and passive components.

Topics

- Industry trends vs. solder joint reliability
- Solder joint vs. bulk solder
- Life-prediction modeling--parameters to be considered
- Factors affecting reliability
- --Alloy selection
- --Substrate compatibility
- --Gold effects and threshold estimate
- --Intermetallics sources and effects
- --Effects of component coating
- --Effects of PCB surface finish
- --Effects of solder mask
- --Effects of reflow process
- --Microstructure
- --Service conditions
- Options of Pb-free solder paste alloys, solder spheres, component coating, PCB surface finish
- Examples of temp. cycling of Pb-free solder joints
- Basic failure processes
- Differentiation of solder joint failure modes between SnPb and Pb-free
- Fundamental alloy behavior vs. temperature including Pb-free technology
- Alloy strengthening mechanisms
- High fatigue-resistant Pb-free solder
- Reliability factors of BGA/CSP array solder joints
- Reliability factors of QFP solder joints
- Summary

Lead-free System Compatibility--Materials and Processes—(Part 5)

Based on the newly released book : "*Lead-free Implementation—A Manufacturing Guide*" and the book: "*Environment-Friendly Electronics—Lead Free Technology*", this course focuses on system <compatibility>. The workings among the components, BGA/CSP solder spheres, assembly solder paste and PCB surface finish will be covered. The estimation and effects of solder joint compositional fluctuation with various component coatings will be illustrated. The material compatibility of the mix of different Pb-free compositions and the mix of Pb-free and SnPb will be discussed in sixteen scenarios. The compatibility of material and process will also be addressed, including various scenarios of SMT reflow and wave soldering process parameters. Information is applicable to all types of interconnections including fine pitch QFP, BGA, flip chip, CSP, and passive components. Attendees are encouraged to bring their own selected systems for deliberation.

Topics

- Compatibility---process & material
- --Discuss 8 scenarios

- Compatibility---Pb and Pb-free mixed use
- --Discuss 16 scenarios
- Compatibility---Pb contamination in Pb-free system
- --Effects on viable alloys
- --Effects in solder pot in wave soldering process
- --Illustration of production examples
- Viable Pb-free alloys---compositional tolerance guidelines
- Compatibility---viable Pb-free alloys in mixed use
- Compatibility---Pb-free solder joint & component coating
- Estimation---solder joint compositional fluctuation with various Pb-free component coatings
- Compatibility---Pb-free solder joint & PCB surface finish
- System compatibility---solder paste, component coating, solder sphere, PCB surface finish
- **Discussion--your scenario**
- Summary

Lead-Free & the Role of Bi--All you should Know about Bi (Part 6)

Bismuth is becoming an inevitable element in Pb-free electronics. An adequate understanding of the properties and performance parameters of Bi is critical to the ultimate Pb-free success. This course addresses the relevant aspects on the role and effects of Bi, as well as issues and perceptions. The data and results of Bi in or with Pb-free solder joints, including Bi from the component leads and/or PCB surface finish, and of the performance of Bi-containing solder alloys will be presented. The course also covers the Bi effects on the physical and mechanical properties of 63Sn37Pb solder joint. The estimation of Bi concentration in Pb-free solder joints with various Bi-containing components will be illustrated. Whether the low temperature BiPbSn phase is present in the systems of interest will be discussed. Attendees are encouraged to bring their own selected systems for deliberation. The purpose of this course is to dispel misconceptions and demonstrate performance criteria related to Bi to assure the integrity of solder joints and the assembly.

Topics

- Discussion--your issues & concerns related to Bi
- Bi characteristics, resources and safety data
- Historically known Bi electronic solder alloys
- Bi in 63Sn37Pb solder joint
 - effects on physical properties
 - effects on mechanical properties
- Bi in component coating
 - Dissolving into solder joint
 - Estimation of concentration of Bi in solder joint
- Bi in PCB surface finish
- Effects of Bi in Pb-free solder joint contributed from components
 - on SnAg
 - on SnCu
 - on SnAgCu
 - on SnAgIn
- Bi-containing Pb-free solder alloys
 - physical properties
 - mechanical properties
- Fillet-lifting vs. Bi
- Low temperature BiPbSn phase
 - presence or absence
 - general guidelines
 - detectable or non-detectable effects
- Summary

About the Instructor

Dr. Hwang brings her 25-year SMT manufacturing experience combined with her 15-year lead-free R&D and hands-on production implementation to this lecture series. She is a major contributor to SMT manufacturing since its inception. She has provided hands-on solutions to challenging production issues as well as served as an advisor to many OEM/EMS companies and the U.S. government.

Among her various awards and honors are citations by the U.S. Congressional Certificates of recognition; election to the National Academy of Engineering; being named the R&D-Stars-to-Watch; recipient of YWCA Women Achievement Award; and induction to the WIT International Hall of Fame.

Hwang is a holder of a number of patents and the author of over 250 publications including the sole authorship of several textbooks used worldwide. Her books, columns, and publications have been widely cited in the industry worldwide. As an invited keynote speaker worldwide, she shares her thoughts and vision with various audiences. Her topics range from commencement keynote speech at universities to the emerging technologies at the U.S. Patent and Trademark Office. Over the years, she has taught over 15,000 professionals and researchers in professional advancement courses, focusing on disseminating new technologies and providing the professional advancement education to the workforce. She is a popular keynoter and featured speaker at the national and international events across the US and abroad including Israel, France, Germany, Belgium, Sweden, England, Brazil, Hong Kong, Singapore, Malaysia, Taiwan, Korea, Japan, China, Puerto Rico, Australia, etc...

Being the member of a number of major professional organizations, she has served various leadership capacities including the National President of Surface Mount Technology Association and the board of ASM International. She has served as a reviewer for U.S. government programs and for numerous publications and research institutions.

Outside the industry, Hwang is a prolific writer and speaker on the topics of trade, business, and educational and social agenda. Additionally, Dr. Hwang is a member of the U.S. Commerce Department Export Council and the newly formed National Research Council Globalization Committee. She also serves on the board of Fortune 500 NYSE-traded corporations as well as on civic and university boards.

Hwang received her Ph.D. in Materials Science & Engineering from Case Western Reserve University and two M.S. degrees in Chemistry and Liquid Crystals Science from Columbia University and Kent State's Liquid Crystal Institute.

Having held senior executive positions with Lockheed Martin, SCM Corp., Sherwin Williams Co., IEM Corp., she is currently a partner of H-Technologies Group, Inc., providing business and manufacturing solutions to the electronic industry. Dr. Hwang is also an invited distinguished adjunct professor at the Engineering School of Case Western Reserve University, and serves on the University Board of Trustees. Her books have received a wide circulation throughout the world:

- (ISBN-0-07-143048-2) "*Lead-free Implementation: A Guide to Manufacturing*" McGraw-Hill, New York, 2005
- (ISBN-0 901 150 401) "*Environment-Friendly Electronics—Lead Free Technology*", Electrochemical Publications, LTD, Great Britain, 2001
- (ISBN-0-07-031749-3) "*Modern Solder Technology for Competitive Electronics Manufacturing*", , McGraw-Hill, New York, 1996
- (ISBN-0-90-115029-0)"*IC Ball Grid Array & Fine Pitch Peripheral Interconnections*", Electrochemical Publications, LTD, Great Britain, 1995
- (ISBN-0442-2075-49) "*Solder Paste: Technology and Applications for Surface Mount, Hybrid Circuits, and IC Component Manufacturing*", Van Nostrand Reinhold, New York, 1988

For book info/order: www.LeadFreeService.com/Book.htm