

## New World Wide Workshops for 2009/2010

- "Troubleshooting Your Assembly Yields - On Site or Offshore"
- "Vapour Phase & Convection Reflow – Selecting a Reflow Process"
- "Counterfeit Component Workshop- Causes and Cures"
- "LGA (Land Grid Array) QFN (Quad Flat No-lead) Design, Assembly & Rework Guide"
- "Conformal Coating Application and Inspection Workshop"
- "Flexible Circuit Board Design and Assembly with Lead-Free Alloys"
- "Practical Failure Analysis in Printed Board Assembly"
- "Lead-Free Selective Soldering, Design, Quality Control and Practical Solutions"
- "BGA, CSP and Flip Chip PCB Design and Assembly"

**A selection of the practical workshops we are able to provide world wide:**

### **LGA (Land Grid Array) QFN (Quad Flat No-lead) Design, Assembly & Rework Guide**

Bob Willis [ASKbobwillis.com](http://ASKbobwillis.com)

#### **Workshop Introduction:**

LGA and QFN have fast become a common package type often used in many professional portable products. With any new device type there is always a learning curve for design, process and quality engineers who have to get to grips with the challenges that these packages bring. Each step of the implementation process for LGA/QFN devices will be reviewed along with results of practice process trials with these devices. Included with this workshop will be a set of optical and x-ray inspection charts for each delegate to use in manufacture. The workshop presenter is well known for his practical workshops and supported by Bob Willis unique process video experiments LGA/QFN are guaranteed to come alive.

#### **Who should attend?**

This workshop is designed for design, process and quality engineers responsible for introducing products containing LGA/QFN. Much of the material presented is extremely visual and practical making it ideal for manufacturing staff, like all the instructors workshops it not just theory, it's a "**How to Do It Session**"

#### **Workshop Topics Included:**

- Component Package Types
- Component Construction
- MSD Handling Levels
- Solderability Testing Packages
- Printed Board Layout on Rigid and Flexible Circuits
- Solder Mask Layout Options
- Lead-Free Stencil Printing Options
- Placement and Component Packaging
- Convection and Vapour Phase Soldering Yields
- Visual Inspection Criteria
- X ray inspection Criteria
- LGA/QFN Rework and Replacement
- Array Solder Joint Reliability
- Common Process Problems with LGA/QFN

## Counterfeit Component - Causes and Cures Workshop

Bob Willis ASKbobwillis.com

### Workshop Introduction:

Quality, purchasing, design and production engineers need to review the growing commercial and technical issues surrounding counterfeit electronic components. They can look right, solder to the PCB but just fail to function. A typical first assumption by test engineering, it's a component failed due to the assembly process, but it's what's inside the package that counts, sometimes it's nothing at all.

Rather than making complicated copies of parts the simplest thing is to remark the packaging or the component body. Remarking the packaging is simple and quick, provided the component identification is not checked all the parts would be placed and soldered to the board before the problem was identified. AOI should find incorrectly marked or variations on the parts but the level of sophistication in marking is now becoming very sophisticated.

The workshop will not only illustrate the problems raised by counterfeit components within the electronics industry but it will also show you some of the different test methods that can be used to confirm the integrity of the components. Failure analysis techniques are now frequently being used to see if components are what they say they are rather than finding failure modes. Regular workshops with ITRI innovation in the UK show that counterfeiting is on the increase, we can find them, there is no hiding place! The workshop also includes a **FREE** set 28 wall charts covering testing and counterfeit avoidance procedures for each delegate to use on site.

### Who should attend?

This workshop is designed for design, process and quality engineers responsible for introducing procedures and testing to avoid the counterfeit components being integrated to products.. Much of the material presented is extremely visual and practical making it ideal for manufacturing staff, like all the instructors workshops it not just theory, it's a **"How to Do It Session"**

### Workshop Topics Included:

- Component trends in industry
- Counterfeit Avoidance strategy
- Component Identification Checksheet
- Component obsolescence
- Impact of lead-free on component availability
- Typical examples of component counterfeits
- Guidelines on reducing the possibility of counterfeits
- The different types of counterfeit
- Mechanical testing component packaging
  - Destructive and non-destructive
- Electrical testing of components
- Visual & microscopic inspection
- Solvent testing
- XRF techniques
- X-ray inspection of passive and active parts
- Practical examples of counterfeit components found
- Using Free On Line Defect Database

## Vapour Phase & Convection Reflow – Selecting a Reflow Process

Bob Willis      ASKbobwillis.com

### Workshop Introduction:

Having grown up with IR and Vapour Phase Soldering VPS during the introduction of surface mount technology its fail to say that some processes never die they just get better. Convection reflow took over from IR technology and changed the way industry looked at vapour phase but now its back. For some companies VPS never went away a simple one profile process, in Japan high end application used VPS during the introduction of lead-free technology

Both convection and vapour phase can produce reliable lead-free assemblies, there are advantages and disadvantage to any technology but they both work well and can be very cost effective that is what our surveys have said. We also bring four years of experience with lead-free using both techniques to the conference.

In this workshop the instructor will look at all aspects of the different processes, soldering performance and yield from different joint terminations, solder finishes and joint structures. Each delegate will also receive a **FREE** set of Bob Willis Inspection Wall Charts covering reflow soldering of lead-free terminations and common defects found in manufacture.

### Who should attend?

This workshop is designed for process and quality engineers responsible for selection and running reflow systems, inspection or auditing staff visiting contract assembly facilities. The workshop presented is extremely visual and practical, like all the instructors workshops it not just theory, it's a "**How to Do It Session**"

### Workshop Topics Included:

- Vapour phase and convection reflow overview
- Process parameters
- Nitrogen/inert environment myths
- Advantages & disadvantages of the process options
- Design and layout considerations for VP
- PCB solder finishes for VP & convection
- Vapour phase materials and cost
- Batch or inline operation
- User experiences with VP materials and equipment
- Profiling boards assemblies in both processes
- Solder paste requirements
- Comparing single and double sided reflow yields
- Soldering flexible assemblies
- Inspection results for reflow soldering
- Microsection examination

## Lead-Free Selective Soldering, Design, Process Challenges and Practical Solutions

Bob Willis      ASKbobwillis.com

### Workshop Introduction:

For many organisations through hole components will remain a reality for many years. More and more surface mount components are used in design, through hole is in decline, however the reality is connectors, transformers, switches, LCD displays and electrolytic capacitors are still necessary in many products. So what is the most reliable and cost effective solution to through hole soldering in a lead-free environment? Selective soldering has become more popular in the last few years for small and large companies alike. Selective wave and point soldering are both options but what are the realities.

In this workshop the instructor will look at all aspects of the different processes, soldering performance and yield from different joint terminations, solder finishes and joint structures. Each delegate will also receive a **FREE** set of Bob Willis Inspection Wall Charts covering soldering of lead-free terminations and common defects found in manufacture.

### Who should attend?

Process engineers tasked with process introduction, quality staff, and supervisors wanting to understand the process issues with lead-free selective soldering. Design engineers will benefit from a better understanding of the process they are designing circuit boards to pass through. The workshop may also benefit material, equipment suppliers to have a better understand of all the issues and interactions with new alloys and modern printed circuit design.

This session will cover:

- Why use selective soldering
- User experience of selective wave point soldering with lead-free
- PCB design rules for selective soldering
- Flux requirements for selective soldering
- Compatibility of solder masks and lead-free solder
- Setting up lead-free profiles, you must profile a selective process!!!
- Solder alloy choices
- Inspection criteria for selective
- Copper dissolution with selective
- Soldering defects on selective – Causes and Cures
  - Dendrite growth - Solder balling
  - Poor penetration - Copper saturation - Copper needles

## Conformal Coating Applications, Inspection, Rework & Quality Control Workshop

Bob Willis      ASKbobwillis.com

### Workshop Introduction:

The use of Conformal coating has provided benefits to industry for many years either in the high reliability market sector or where products have to deal with extreme environmental conditions or simply in use in consumer applications. The use of coatings is seen in different industries like telecommunications, automotive and consumer products have benefited from the use of selective coating but for different reasons.

This workshop will provide a simple guide to the use of coatings, their application and process, product benefits, inspection and quality control. A practical session will also allow delegates to examine coated boards using different materials and inspect the coating application.

Each delegate will also receive a **FREE** set of colour Inspection Wall Charts covering coating application and common defects to use on their manufacturing shop floor. During each workshop there are opportunities to win some of Bobs interactive CD ROMs for best questions of the session.

### Who should attend?

This workshop is designed for design, process and quality engineers responsible for introducing coating materials, inspection or auditing presented is extremely visual and practical making it ideal for manufacturing staff, like all the instructors workshops it not just theory, it's a **"How to Do It Session"**

### Workshop Topics Included:

- Why Conformal Coat
- Clean or No Clean
- Coating Material Options
- Coating Process Options
- Cost of coating assemblies
- SIR and cleanliness testing
- Cleanliness testing methods
- Reliability of Coating
- Testing & Evaluation of Coatings
- Correct design for coating
- Masking options and methods
- Inspection & Quality Control of Coating
- In-house or Contracting Services
- Inspection of coatings & methods
- Rework & repair of board assemblies

## Troubleshooting Your Assembly Yields - On Site or Offshore

Bob Willis ASKbobwillis.com

### Workshop Introduction:

Lead-free assembly can contribute to higher defect levels in manufacture; however, this is not necessarily seen at each assembly process. Common process problems today relate to the selection of PCB materials, surface finishes and soldering materials, some are cosmetic others potentially reliability concerns. During this workshop delegates will see problems mostly common in industry, what are the solutions or ways of investigating the root causes. Delegates will be shown how to use free online soldering defect databases to solve process problems 24/7. Delegates can also bring process problems, board assemblies for discussion and hopefully a resolution to their current manufacturing nightmare.

Each delegate will receive a **FREE** set of colour wall charts to aid lead-free inspection and the fault identification in manufacture. Delegates will also have the opportunity to win interactive training CD-ROMs on inspection, design and rework for best questions in the session.

### Who should attend:

This session aims to provide a practical introduction to issues of lead-free process yield improvements and troubleshooting and is suitable for engineers, supervisions and operators looking at the issues faced with lead-free assembly on site or off shore. It will also give an incite to equipment suppliers and component manufactures on what may need to be addressed on products in the future.

### This session will cover:

- Modern SMT assembly & common opportunities for failure
- Top Ten process failures in Lead-Free
- Practical failure analysis in manufacture
- Defining process parameters
- Key process checks during assembly
- Monitoring contract assembly process
- Solving defects 24 hours a day

## Flexible Circuit Board Assembly, Rework with Lead-Free Alloys

Bob Willis ASKbobwillis.com

### Workshop Introduction:

The flexible circuit is another packaging technology which has seen wider acceptance in the electronics industry. The advantages of surface mount reduced weight; decreased size can be further enhanced by flexible circuitry. In many cases, it is a misconception that flexible circuits have to flex, they don't many flexible are designed purely to aid the circuits design and assembly into a final product. In this case the substrate is only flexed or formed once. The range of constructions for circuit manufacture are wide but the basics are similar to existing printed circuit production. The design and selection of the manufacturing methods can affect on the final cost of the circuit and need to be considered in detail prior to manufacture. Were design department have limited experience useful reference material is available to engineers world wide with the release of Flexible Circuit Technology, Third Edition by Joe Fjelstad.

This workshop will focus on the assembly processes used for the flexible circuits. Each delegate will receive a **FREE** set of colour wall charts to aid lead-free inspection and the fault identification in manufacture. Delegates will also have the opportunity to win interactive training CD-ROMs on lead-free inspection, design and rework for best questions in the session.

Bob is happy to take delegate questions in advance of the workshop, these will be answered in the during the conference session. [bob@leadfreesoldering.com](mailto:bob@leadfreesoldering.com)

### Workshop Topics Included:

- Flexible Design for assembly
- Manual assembly and soldering
- Automatic assembly process requirements
- The need for baking flexible circuits
- Flexible circuit pallets for automatic assembly
- Screen printing, placement, reflow soldering & AOI
- Manual hand soldering and de-soldering
- Rework of conventional and surface mount
- Solder joint Inspection
- Process defects on flexible circuits and during assembly

## **Practical Lead-Free Experience 4 Years - The Full Story, So Far**

Bob Willis – SMART Group/LEADOUT Lead-Free Experience Co-ordinator

Duration : One or Half Day Workshop

### **Workshop Outline:**

For the last four years, SMART Group have organised and run a complete production feature on lead-free assembly. For the last two years LEADOUT has supported this unique event in the United Kingdom. LEADOUT is Europe's largest European electronics industry activity helping small and medium volume companies make the change to lead-free soldering and to improve their process yields in the assembly of PCBs and through this enable them to compete effectively in the open market. Bob Willis has organised and run the "Hands On Lead-Free Experience" and produced a 100 page report on all the practical experience gained from these events. The Lead-Free Experience has enabled many engineers to get hands-on experience from many of the industry experts and seek independent advice on the practical issues relating to lead-free manufacturing.

Four different PCB finishes, three laminates, solder alloys, reflow technologies, rework options, inspection techniques and mechanical testing has been made available at each event. After the events microsection analysis and further testing has been conducted to back all the process parameters gathered. This workshop presentation will offer delegates some amusing but helpful and practical feedback, stories and process parameters from behind the scenes of this lead-free feature. Delegates will receive a copy of the presentation, a set of lead-free inspection standards and a copy of the Lead-Free Experience Report to download. Question & Answer Session on Lead-Free design and production process issues can be included after the workshop; delegates can pose questions prior to the workshop to guarantee a detailed answer; which can be emailed in advance.

### **Who should attend?**

Process engineers tasked with process introduction, quality staff, and supervisors wanting to understand the process issues with lead-free. Design and procurement staff will benefit from the impact of component selection and design on process yield. The workshop would also benefit material and equipment suppliers to gain a better understand of all the issues and interactions with new alloys.

### **Topics Included:**

Assembly of rigid and flexible circuit boards

Solder finishes evaluated

– Gold, Copper OSP, Tin, Silver & Solder

Levelled

Component and plating finishes testing

Stencil printing and aperture design

Through hole reflow results

Reflow with vapour phase and convection

Using wetting tests to compare yields

Wave soldering surface mount and through hole

Temperature profiling results

Cleaning lead-free residues and cleanliness

AOI and X-ray inspection results

Solder joint shear testing

Inspection PPM Process Monitoring results

Lead-Free defects and causes

## Introduction to Ball Grid Array Design & Assembly

Bob Willis      ASKbobwillis.com

### Workshop Introduction:

Ball Grid Array packages have been used in the industry for some years but only now are they widely available for commercial use. Just like surface mount, the use of BGA's can affect printed board layout, assembly, inspection and repair process. BGA's do however provide significant advantages over fine pitch components particularly in terms of process assembly yield. Correct design, printing and profiling is necessary to obtain the highest yields and reliably interconnection.

Everyone blames the BGA often because you cant see under the package but is it the real failure mode. Bob produced the first video tape and interactive CD-ROM on BGA technology, practical advice is what you get on any of Bobs' sessions supported by unique video clips to make the session come alive.

### Who Should Attend

All staff involved in the process of area array soldering with tin/lead and lead-free BGA assembly processes; including procurement, design engineers, reliability, quality personnel, failure analysts, and management involving is setting standards, inspection and product assessment of boards containing BGA, CSP, LGA and other area array components. As this workshop deals with many of the common issues in manufacture its also valuable to shop floor staff.

### Topics include:

BGA advantages and disadvantages  
BGA suppliers  
Design rules  
Printed board layout  
Pad and resist footprints  
Surface finish selection  
Inspection/assembly marks  
Assembly process

Solder paste printing  
Flux reflow methods  
Temperature profiling  
Reflow by convection and vapour phase  
Rework procedures  
BGA failures, Package cracking  
Solder balls, Misalignment, Non reflow  
Inspection criteria

## Step by Step Ball Grid Array & Surface Mount Rework and Repair

Bob Willis      ASKbobwillis.com

### Workshop Introduction:

Surface mount and BGA rework and repair can be straight forward if simple rules are followed. This workshop will give each delegate a step by step blue print to introduce rework successfully into manufacture. Guidelines will be given on selecting rework equipment, materials and training procedures for defect free soldering. Using Bob Willis unique video clips during the workshop each delegate will be shown how to conduct successful rework and what are the potential problems.

Bob Willis was the creator of the Worlds first video tapes and interactive CD-ROM on BGA Technology, X-Ray Inspection and BGA Rework. Your company will receive one copy of his interactive CD-ROM covering surface mount and BGA rework and repair procedures valued at £100 plus wall charts for rework and inspection standards.

### Who should attend?

Process engineers, quality staff, and supervisors tasked with setting up a rework area. Staff wanting to understand the process issues with lead-free. The workshop would also benefit material and equipment suppliers to gain a better understand of all the issues and interactions with tin/lead and new lead free alloys in rework and repair.

### Topics include:

Introduction to rework, where + why rework  
Soldering standards & defects, IEC, IPC, BT standards  
Temperature profiling rework sites  
Rework methods for:  
SOIC, QFP, TSOP, BGA & CSP

Hot gas systems  
Soldering irons  
Conductive tweezers  
Reflow blocks  
Rework of single/double sided boards  
Replacement methods for:

SOIC, QFP, TSOP, BGA & CSP  
Reballing BGA  
Practical demonstrations  
Rework related defects

## Step by Step Practical Failure Analysis in Printed Board Assembly

Bob Willis      ASKbobwillis.com

Simple Guide to Failure Analysis Techniques - How & Why Failures Occur in Electronics

"Different levels of failure analysis exist, from the very basic with virtually no equipment, to the use of a full failure analysis laboratory. Often simple analysis methods can point engineers in the right direction, but proving the root cause of failure often needs the electronic pathologist with all his investigation tools. When conducting any failure analysis it is important the results prove the cause of the fault. The true reason for failure needs to be clear and proven with hard facts, not just opinions."

### Workshop Outline:

This workshop is unique as it outlines the techniques you should consider along with practical case studies from the instructor's many years in manufacture. Many practical case studies using different techniques to examine failures on different interconnections will be examined with extensive examples and recommended corrective action. Delegates will also be able to see what different analysis techniques exist and find what a laboratory service will require when you need to arrange your own study. The workshop is conducted by **Bob Willis** who offers failure analysis services to the industry on-line and has long been regarded as one of the leading specialist in printed board assembly problem solving.

Printed circuit boards  
Solder joints  
Conventional components  
SMT components

Area array, BGA, Flip Chip devices  
Wire wrap joint  
Crimp terminals  
Connectors

### Workshop topics include:

Destructive and non destructive analysis techniques will be reviewed including:

Microsectioning  
Optical microscopy  
Real time X-ray analysis  
Scanning Electron Microscopy SEM  
Acoustic microscopy  
XRF Measurement

Borescope  
Chemical Analysis  
Crack detection  
Contamination assessment  
Bond & shear measurement  
Solderability measurement

Package opening techniques will be explained with their advantages and disadvantages:

De-lidding  
Grinding  
Jet etching

Chemical swelling  
Cutting & sawing

### Who should attend this workshop?

The workshop is designed for engineers, supervisor and quality engineering staff who need to solve manufacturing and product failures. It is also ideal for procurement staff who may be faced with supplier related failures. Many component, material and printed board suppliers have attended this course in the UK and have benefited in understanding the process problems that can occur.

## ***Pin In Hole/Intrusive Reflow Implementation with Lead-Free***

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

### ***Course Objectives :***

Surface Mount Technology (SMT) is part of mainstream electronic assembly with virtually all market sectors benefiting from the use of SMT. One problem that has always proved an issue to design and process engineers is the use of existing through hole components where no direct equivalent SMT parts are available. Hence the interest in Pin in paste, intrusive reflow, multi spot soldering, regardless of the name it's a perfect option to eliminate the wave soldering process.

Bob produced the Worlds first training video, interactive CD-ROM, inspection standards and manual on intrusive reflow. His unique micro video clips provide an ideal way of understanding the technology and how to succeed. Selective soldering can provide excellent results but requires capital equipment investment. One method of soldering all surface mount and through hole components in a single operation is Pin-In-Hole-Reflow which simplifies the manufacturing process. Each delegate attending will receive a set of intrusive reflow inspection posters to aid their process introduction.

The workshop will cover the following key points:

- PCB Design and Component Requirements
- PIHR Advantages and Disadvantages
- Paste Application by Stencil Printing, Double Stencil Print, Dispensing
- Stencil Aperture Calculations
- Stencil Design Rules
- Solder Pallet Support
- Placement Options Manual and Automatic
- Reflow Soldering Profiles for Convection & Vapour Phase
- Inspection Requirements
- X-ray voiding assessment
- Microsection Analysis
- Practical Implication issues
- Process Defects
- Reliability of through hole joints

*Question & Answer Session on Lead-Free design and production process issues can be included after the workshop, delegates can pose questions prior to the workshop to guarantee a detailed answer; these can be emailed to bob@leadfreesoldering.com*

The following workshops are also available on site with a combination of theory or hands on content which allows more flexibility for on site training. Soldering workshops can be based on tin/lead or lead-free technology. If you need something special we can create a workshop for you.

**0201 Chip Design and Assembly**

**Basic Printed Circuit Board Manufacture**

**Producing and Presenting Technical Presentations**

**Double Sided Reflow and Assembly**

**Selecting Solderable Finishes for Fine Pitch Assembly**

**Introduction to Ball Grid Array Technology**

**X-Ray Inspection of BGA and Quality Standards**

**Printed Board Design for Manufacture and Assembly**

**Pin in Hole/Intrusive Reflow Design and Assembly**

**Wire Preparation and Crimping Workshop**

**Lead-Free Assembly and Soldering**

**Hand Soldering and De-Soldering**

**Hands On Solder Paste and Stencil Printing**

**Quality Control of Surface Mount Assemblies**

**Hands On Wave Soldering**

**Static Control in Electronic Assembly**

**Design and Assembly of SMT Boards**

**Rework and Repair of Surface Mount and BGA**

**A-Z of Modern Electronic Assembly of PCBs**

**Reflow Soldering and Temperature Profiling**

## **Ball Grid Array Inspection Lead-Free Defect Guide**

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

Area Array Technology is part of mainstream electronics but until recently very little inspection criteria were available in the industry. The assembly process for BGAs is fairly well understood for tin/lead alloys but with the move to lead-free assembly, new QFN and LGA packages there are critical issues to consider during inspection. The workshop covers optical and x-ray inspection of solder joints for both tin/lead and lead-free terminations. It includes an introduction to the lead-free assembly process with specific attention to BGA and area array devices. It provided a step by step guide to the procedure of inspection for optical and x-ray showing you how to do it. Inspection criteria are included for x-ray and visual criteria on different lead-free terminations and pad surfaces. Delegates will each receive a set of BGA optical and x-ray inspection posters, chance to win a copy of a interactive CD-ROM covering BGA Inspection and Lead-Free Defects and a copy of "X-Ray Inspection Criteria & Common Defect Analysis" a book Bob co-authored with Dr David Bernard of DAGE.

### Who Should Attend

All staff involved in the process of area array soldering with tin/lead and lead-free BGA assembly processes; including procurement, design engineers, reliability, quality personnel, failure analysts, and management involving is setting standards, inspection and product assessment of boards containing BGA, CSP, LGA and other area array components. As this workshop deals with many of the common issues in manufacture its also valuable to shop floor staff.

### Topics Covered

Modern Lead-Free Assembly Processes  
Lead-free Alloys - BGA – Area Array – Land Grid Array Reflow  
Inspection Techniques  
Inspection Procedures - Optical Inspection - X-Ray Inspection  
Plastic BGA, Ceramic BGA, Column Grid Array, Land Grid Arrays  
Moisture cracking  
Effect of incorrect profiling  
Dye crack testing (Dye and Pry)  
Common process problems  
Lead-free and tin/lead paste  
Defect Guide  
Inspection Criteria

Question & Answer Session on BGA and production process issues will be included after the workshop. Participants can pose questions prior to the workshop to guarantee a detailed answer.

## *Lead-Free Design for Manufacture Assembly Workshop*

Master Class Instructor Bob Willis [ASKbobwillis.com](http://ASKbobwillis.com)

Duration : One or Half Day Workshop

This workshop is aimed at Design, Production and Quality Engineers. It will provide a better understanding of the effect lead-free will have on printed board design, specification and procurement. Component specification and testing requirements to meet WEEE and RoHS will be discussed along with the simple guidance on ranking circuit board solder finishes. Layout changes that benefit a lead-free process will be highlighted as well as the subtle changes to improve yields on existing designs. Design modification that have been used to reduce or eliminate fillet lifting, pad lifting will be illustrated and their apparent success or failure.

Lead-Free Design for manufacture workshop will include:

Component specification, selection and WEEE & RoHS compatible

Laminate changes, options and industry trends

Through hole pad sizes & fillet lifting

PCB Supports – Eliminating Warp and sag

Via hole plating and reliability with lead-free processes

Copper thickness and Lead-Free copper erosion

Solder finish selection, storage life and process compatibility

Eliminating wave soldering with intrusive reflow

CAF and reliability in lead-free

Solder mask specification

Optimising hole fill with lead-free intrusive reflow

Multilayer thermal break design

Through hole solder thief designs

Modifying breakouts for lead-free

Optimising SMT placement for lead-free

Modification of paste stencil apertures

*Question & Answer Session on pin in hole reflow and production process issues can be included after the workshop, delegates can pose questions prior to the workshop to guarantee a detailed answer; these can be emailed to [bob@leadfreesoldering.com](mailto:bob@leadfreesoldering.com)*

## *A - Z of Lead Free Soldering Master Class*

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

This Master Class is a practical introduction to the changes necessary in design, component selection, assembly and soldering with lead-free alloys. It covers the practical experience gained during lead-free trials, process introduction and running hands on lead-free lines and training events for the past 5 years. Bob presents a practical introduction to lead-free and illustrates many of the process stages and defects with his unique micro video photography which helps to bring the Master Class alive. Each delegate attending the Lead-Free Master Class will receive an interactive Lead-Free Training CD-ROM and a set of inspection posters to aid their process introduction.

Who should attend?

Process engineers tasked with process introduction, quality staff, and supervisors wanting to understand the process issues with lead-free. The Master Class may also benefit material, equipment suppliers to have a better understand of all the issues and interactions with new alloys.

Topics Covered

Component Specifications	Board Support
Shop floor solderability testing	Solder alloy control
Printed circuit board requirements	Dross generation
Production solderability testing coupons	Lead-free specific soldering defects
Comparison of board surface finishes	Secondary reflow
Solder paste printing	Copper erosion of pads
Changes to solder paste stencils	Fillet lifting of joints
Controlling paste alloys	Solder contamination
Inspection criteria	Copper removal
Component placement and alignment	Visual Inspection criteria
Reflow soldering requirements for lead-free	X-ray criteria for lead-free
Convection and vapour phase soldering	Rework and repair procedures
Profiles for lead-free	Hand Soldering and De-soldering
Wave soldering machine changes	Process monitoring
Soldering parameters	PPM Yield results

## *Lead-Free Inspection, Process Control and Defect Elimination*

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

Lead-free assembly does have an impact on the design, manufacture and the potential reliability of printed board assemblies. Although the fundamental processes do not change, process parameters do change and there are process issues what are coming to light that do affect yields. This workshop will provide a practical insight into the inspection criteria, changes to process conditions and how to monitor the process to obtain the highest yields. The session will also illustrate the potential problems at each stage of manufacture and how to avoid them and where necessary changes to IPC criteria will be required. Monitoring solderability of boards and components in production with simple tests will be illustrated. Many of the instructors short lead-free video clips are used during the workshop to show how different alloys reflow, joints form and defects occur, making this session totally unique.

Each delegate will receive a set of lead-free inspection criteria wall charts with this workshop. Also included is a lead-free interactive CD-ROM covering lead-free soldering featuring some of the instructor's unique video material to assist your company introduction.

Who should attend:

Inspection and quality control staff need to put in place controls to monitor the process and understand what will be different in a lead-free environment. Lead-free solder joints can look different, there are new cosmetic defects which need to be understood also new equipment parameters monitored in production. This makes this workshop suitable for inspection staff, process engineers and quality managers.

Modern PCB Assembly Overview

- Opportunities for defect with lead-free process changes

- Confirming component lead-free compatibility

- Testing for lead-free joints

- Monitoring lead-free materials control

- Marking lead-free components, boards and products

- Re-profiling, reflow, wave soldering & rework equipment

- Inspection criteria for reflow and wave soldering

- Changing IPC 610 inspection standards

- Defect types and corrective actions

  - Poor wetting

  - Fillet lifting

  - Secondary reflow

  - Lead contamination of joints

- Typical Joint failure modes

- Process yield monitoring guide

## *Reflow Soldering Lead-Free Alloys - Successfully*

Master Class Instructor: Bob Willis ASKbobwillis.com

Duration: One or Half Day Workshop

Reflow soldering with lead-free alloys is far less demanding to convert than wave. However there are new issues of material compatibility, higher temperatures, lead contamination and the benefits of using pin in hole/intrusive reflow to consider. During this workshop each of the key stages of the reflow process will be considered and delegates will see the results of many trials showing what works and does not in the real world of manufacture. With over six years experience with lead-free materials, processes and circuit board assembly most of the issues have now been overcome.

The workshop features many typical lead-free defects and possible causes. With Bob Willis's unique micro video clips delegates will easily understand the issues they may face. Each delegate will also receive a FREE set of colour Lead-Free Inspection Wall Charts to use on their manufacturing shop floor.

Who should attend?

Process engineers tasked with process introduction, quality staff, and supervisors wanting to understand the process issues with lead-free reflow. Design engineers will benefit from a better understanding of the process they are designing circuit boards to pass through. The workshop may also benefit material, equipment suppliers to have a better understanding of all the issues and interactions with new alloys and modern printed circuit design.

Topics:	Selecting laminate & solder finish
	Solder paste options
Lead free legislation and timescales	Convection soldering
What other people say about lead-free	Vapour phase for lead-free
Component requirements	Temperature profiling
Reliability of tin/lead plating with lead-free alloys	Confirming oven capability for lead-free
Concerns with MSD devices	Benefits of inert gas soldering
Printed board finish requirements	Lead-free reflow defects and causes

*Printed Circuit Board Solderable Finishes for Fine Pitch and Lead-Free Assembly*

Master Class Instructor Bob Willis ASKbobwillis.com

Duration: One or Half Day Workshop

Course Objectives:

The choice of solderable finishes applied to surface mount boards can have a significant effect on the assembly yield, bow and twist, misplacement, open joints and cost of the final circuit. Tin/lead solder levelled board are still in the majority but gold, tin, silver and OSP have been growing in popularity. The workshop will demonstrate all the options available and how to evaluate the best surface finish for assembly. Bob Willis will show some of the test methods used in production to test surface finishes along with some of his own no cost techniques. During the workshop delegates will see different process failure modes and be able to judge what is cosmetic and if reliability may be affected.

Topics:

- Review of solderable finishes
- Current supplier base for finishes
- Assembly and design advantages/ disadvantages
- Ball grid array and fine pitch requirements
- Process conditions for assembly process
- Specification of solderable finishes
- Cost of different finishes
- Assembly yield improvements
- Reliability of solder joints on alternative finishes
- Process rejects and joint failure in production
- Practical solderability testing of finishes

Who Should attend:

Ideal workshop for process and design engineers evaluating or fault finding different PCB finishes to improve existing yields or to implement for lead-free production. Beneficial to purchasing staff to better understand the products and materials and their availability in the industry.

## *Lead-Free Rework and Repair including Hand Soldering and De-soldering*

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

Rework and repair of lead-free solder joints requires higher process temperatures, this can impact on the printed circuit board and components used today. The rework fluxes used and the equipment also require consideration along with greater attention to profiling board assemblies for rework. The session will provide a step by step guide to rework of all types of terminations and look at the potential problems faced with lead-free products. Attention will be paid to the types of defects that can be introduced when rework is not conducted correctly and what corrective actions need to be put in place.

Each delegate will receive a set of lead-free inspection criteria wall charts with this workshop. Also included is a New lead-free rework interactive CD-ROM covering lead-free soldering featuring some of the instructor's unique video material to assist your company introduction.

Who should attend:

This session aims to provide a practical introduction to issues of lead-free rework and repair and is suitable for engineers, supervisions and operators looking at the issues faced with lead-free rework and inspection. It will also give an incite to equipment suppliers and component manufactures on what may need to be addressed on products in the future.

Topics:

Overview of the lead-free assembly process

Soldering theory and what is different

Cored solder wire

    cored wire selection

Soldering operation

Soldering iron care

Tip corrosion issues with lead-free

Removal & replacement of through hole

Removal & replacement of surface mount

BGA removal & replacement

De-soldering techniques

Reliability of mixed alloy joints

Lead-free inspection criteria

X-ray inspection of joints

Typical lead-free defects

## *Lead-Free Wave Soldering Process Troubleshooting*

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

Do we have all the answers to successful lead-free wave soldering? No, and to quote a well known soldering metallurgist, "We don't even know all the questions". Lead-free is new to many and the wave soldering process is the most affected by the change of materials with cost increase in alloy, solder bath and copper erosion plus increased temperatures all makes process change demanding. During this workshop we will look at the practical experience to date and try to provide answers to as many questions that have come to light during early introduction.

Each delegate attending this workshop will receive an interactive CD-ROM valued at \$175 covering all aspects of wave soldering and an interactive defect guide with the most common lead-free defects. Also delegates will receive a set of inspection posters for lead-free solder joints.

Who should attend?

This session aims to provide a practical guide to lead-free wave soldering for engineers, supervisions and operators looking at setting up, operating or selecting materials and equipment. It will also give an incite to equipment suppliers and material manufactures on what may need to be addressed for today's circuit designs.

Topics:

Cost of lead-free

Soldering theory, wetting, reliability, PCB design

Copper erosion problems

Effect of tin-lead on joint reliability

Soldering materials

Spray fluxing

Equipment settings, pre heat, fluxer, wave settings

PCB board support

Lead-free soldering parameters

Inert soldering

Solder bath erosion

Effect of bath contaminates

Quality control checks

Soldering defects, causes and cures

- Fillet lifting

- Secondary reflow

- LF solder shorts

- damaged components

***Ball Grid Array, CSP & LGA Inspection Lead-Free Defect Guide***

Master Class Instructor Bob Willis ASKbobwillis.com

Duration : One or Half Day Workshop

Area Array Technology is part of mainstream electronics but very little inspection criteria is available in the industry. The assembly process for BGAs is fairly well understood for tin/lead alloys but with the move to lead-free assembly there are critical issues to consider during inspection.

The workshop covers optical and x-ray inspection of solder joints for both tin/lead and lead-free terminations. It includes an introduction to the lead-free assembly process with specific attention to BGA and area array devices. It provided a step by step guide to the procedure of inspection for optical and x-ray showing you how to do it. Inspection criteria are included for x-ray and visual criteria on different lead-free terminations and pad surfaces. The CD provided with the workshop also includes many defect examples and causes as well as illustrating the reflow of different terminations with Bob Willis's unique micro video clips.

Modern Lead-Free Assembly Processes

Tin/Lead & Lead-free Alloys - BGA – Area Array Reflow

Inspection Techniques

Inspection Procedures - Optical Inspection - X-Ray Inspection

Plastic BGA, CSP, LGA Ceramic BGA, Column Grid Array

Moisture cracking

Effect of incorrect profiling

Dye crack testing

Common process problems

Defect Guide

Inspection Criteria

**For further information and to arrange a workshop or on-line webcast contact Bob Willis**

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**Email**    [info@leadfreesoldering.com](mailto:info@leadfreesoldering.com)

**Tel:**      (44) 1245 351502 **Fax:**      (44) 1245 496123

## ***Involvement in Lead-Free Process Development***

Bob Willis has been involved with the introduction and implementation of lead-free process technology for the last seven years. He recently received A ***SOLDERTEC/Tin Technology Global Lead-Free Award*** for his contribution to the industry to help the implementation of the technology. He was responsible for co-ordination and introduction of the first series of hands-on lead-free training workshops in Europe for ***Cookson Electronics during 1999-2001***. These events were run in France, Italy and the UK and involved lead-free theory, hands-on paste printing, reflow, wave and hand soldering exercises. Each non commercial event provided the first opportunity for engineers to get first hand experience in the use of lead-free production processes and money raised from the events was presented to local charity. More recently he co-ordinated the ***SMART Group Lead-Free Hands On Experience*** at Nepcon Electronics 2003. This gave the opportunity for over 150 engineers to process four different PCB solder finishes, with two different lead-free pastes through convection and vapour phase reflow. He also ran the ***Experience 2 & 3*** in 2004/2005. 2006 sees Nepcon back at Birmingham and Bob will again be organising the features. Bob was recently presented with awards from the **SMTA** and **IPC** for his industry support.

He has also run training workshops with research groups like ***ITTF, SINTEF, NPL & IVF*** in Europe. Bob has organised and run three lead-free production lines at international exhibitions ***Productronica, Hanover Fair*** and ***Nepcon Electronics*** in Germany and England to provide an insight to the practical use of lead-free soldering on BGA Ball Grid Array, CSP Chip Scale Package, 0210 chip and through hole intrusive reflow connectors. This has resulted in technical papers being published in Germany, USA and the United Kingdom. Bob also defined the process and assisted with the set-up and running of the first ***Simultaneous Double Sided Lead-Free Reflow*** process using tin/silver/copper for reflow of through hole and surface mount products. This year 2005, he will be running a Lead-Free Production and Seminar feature at Productronica in Munich Germany with Global SMT magazine. Bob also had the pleasure of contributing a small section to the first Lead-Free Soldering text book ***"Environment - Friendly Electronics: Lead-Free Technology"*** written by ***Jennie Hwang*** in 2001. The section provided examples of the type of lead-free defects companies may experience in production. Further illustrations of lead-free joints have been featured in here most recent publication ***"Implementing Lead-Free Electronics"*** 2005.

Mr Willis led the **SMART Group Lead-Free Mission to Japan** and with this team produced a report and organised several conference presentations on their findings.

The mission was supported by the DTI and visited many companies in Japan as well as presenting a seminar in Tokyo at the British Embassy to over 60 technologists and senior managers of many of Japans leading producers.

Bob was responsible for the **Lead-Free Assembly & Soldering "CookBook" CD-ROM** concept in 1999, the world's first interactive training resource. He implemented the concept and produced the interactive CD in partnership with the **National Physical Laboratory (NPL)**, drawing on the many resources available in the industry including valuable work from NPL and the DTI. This incorporated many interviews with leading engineers involved with lead-free research and process introduction; the CD-ROM is now in its 3<sup>rd</sup> edition. Bob has recently produced three new lead-free interactive CD-ROMs with Soldertec Global/Tin Technology covering **Hand, Wave and Reflow Soldering** each CD introduced by Kay Nimmo world leading expert on lead-free and the WEEE and RosH legislation.. These CDs complement the range of lead-free training CD-ROM offered by Bob who has just introduced a CD entitled **PCB Design, Layout, Assembly and Lead-Free Defect Guide**. Recently Bob has produced one of the first set of **Lead-Free Inspection Wall Charts** covering reflow and wave solder joints using lead-free terminations and different alloys and PCB finishes. New sets recently introduced cover **BGA X-Ray Inspection & BGA Optical Inspection**.

Although the problems associated with fillet lifting of through hole joints have been well documented by many researchers, it was Bob Willis who highlighted the same problem could exist with pin in paste/intrusive reflow and selective soldering processes. He demonstrated that the problem could occur with each of the common lead-free alternative alloys, but despite its poor appearance provided reliable joints even after 2000 thermal cycles. He has recently produced video simulations of fillet lifting to help understand the way fillet lifting occurs, similar to the work done in the US by NIST. Bob has conducted workshops on lead-free production process for **IPC, APEX & Nepcon Exhibitions** in the USA as well as SMT Nuremberg and Productronica, Germany and **Nepcon Malaysia**. In addition Bob has coordinated the annual **SMART Group Lead-Free Update Seminars** with the SMART Group PR Director, Mike Judd for the last six years. He has also assisted with the launch of two **DTI Lead-Free Reports** written by representatives of Soldertec global and NPL at two Nepcon Exhibitions. Currently Mr Willis is supporting the NPL **"Lead-Free Masterclasses"** workshops on design, manufacturing and rework which are being presented around the UK. These workshops are sponsored by EM&T magazine.



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