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Document Issue	Date	Modification Number (where applicable) Brief Record of Change and Reason for Change
1	24.12.09	Initial Issue – RFC No. 110643
2	11.05.11	Up-issue to clarify – RFC112383
3	23.10.12	Up-issue to clarify – RFC113797 Approval Table simplified, some finishes removed. Paragraph 2.6, Annealed Tin now approved. Section 4 added. Paragraph 5 added, was section 3.5. Appendix C added.
4	11.06.13	Up-issue - RFC114397 Correcting errors in Table 2-1, addition of routine document refresh requirement and references to GEIA. Document revised to improve clarity.
5	10.12.15	RFC200265 – Replace wording in Sect 2.2 with “BGA’s Important” and “AgPd Important”.

NOTE: All alterations must be verified by re-authorisation and approval of the complete document.

CONTENTS

TABLES

FIGURES

1. INTRODUCTION

This Lead-Free control and Tin whisker mitigation plan (LFCP) defines Meggitt Avionics current policy on Lead free assemblies and Tin whisker mitigation. It shall be periodically updated to keep in line with subject matter developments.

1.1 Executive Summary

The processes documented in this LFCP are controlled, assuring the requirements of GEIA-STD-0005-1: Performance standard for aerospace systems containing Lead-Free solder and GEIA-STD-0005-2: Standard for mitigating the effects of Tin whiskers.

MAv are fully compliant to GEIA-STD-0005-2 Control Level 2B, with partial compliance to Control Level 2C. All instances of pure Tin are documented and have two mitigations defined per instance.

This LFCP is a baseline document that defines policies and processes that are common to all Meggitt Avionics products and programs. Some applications may exceed the scope of this baseline LFCP. Such cases will be evaluated individually.

This LFCP addresses the controlled use of Lead-Free electronics, described as follows:

Important: Currently MAv do not produce any RoHS compliant Lead-Free PCBAs. All PCBAs use Tin/Lead solder and only use components with Lead-Free termination materials or finishes when forced by marketplace conditions; these are subject to relevant mitigation practices as described in this document. The future use of Lead-Free processes combined with Lead-Free or Tin/Lead components is a topic MAv are researching.

2. STANDARD COMPONENT SELECTION STRATEGIES

The risk of Tin whiskers shall be mitigated. The method of mitigation is dependent upon the component (i.e. lead materials and construction). The options available are shown in the Approval Table that follows; this defines normally encountered configurations and is the standard mitigation policy for all MAv products. Non-standard configurations must be mitigated in consultation with MAv individually.

2.1 Approval Table

The following table shows commonly available termination finishes, over common base materials, defining if they are approved for use on MAv products. (Tin/Lead solder is always used. Standard Tin/Lead reflow temperatures are always used during board assembly.)

Solderable Finish	Base Material: Thru Hole parts (Typically Cu lead)	Base Material: SMD Devices Low expansion alloys (FeNi, Alloy 42, etc. Typical CTE ±5ppm)	Base Material: SMD Devices Ceramics, no lead frame (Resistors & Capacitors)
NiPdAu			
NiPd			
NiAu			
Sn/Pb plating (>3% Pb)			
Gold Flash over Cu			
SnAgCu (SAC Alloy)			
Ag (over Ni)			
Ag (over Cu)			
SnBi (2 to 4% Bi)	Paragraph 2.3	Paragraph 2.3	Paragraph 2.3
Matte Sn with Ni barrier layer	Paragraph 2.4	Paragraph 2.4	Paragraph 2.4
Matte Sn with Ag barrier layer	Paragraph 2.5	Paragraph 2.5	Paragraph 2.5
Sn, 150°C anneal	Paragraph 2.6	Paragraph 2.6	Paragraph 2.6
Sn, no barrier layer			
Hot dipped SnCu			
Matte SnCu 150°C anneal			
Plated SnAg (1.5 to 4% Ag)			
Sn over Brass			
Bright Sn with Ni barrier layer			
Sn over steel, Cu or Ni barrier			
Sn over steel			
AgPd (over Ni)			
Pressfit Connectors Sn finish			
SnCu alloy			

	Preferred Finish, Approved for use. Does not contain pure Tin, no whisker risk. These parts can be used with no tin whisker mitigation.
	Approved for use. Contains Tin, must be conformal coated.
	Parts may be used, but must be tin/lead dipped in accordance with note 6.4.6 and then must be conformal coated.
	Do not use.

Table 2-1 Standard Component Selection Strategies

2.2 Avoid The Use of Pure Tin Plated Components

The best strategy to prevent Tin whisker induced failures is to avoid using pure Tin plating altogether. Finishes such as Tin Lead(SnPb), Nickel Palladium (NiPd), Nickel Palladium Gold(NiPdAu), Nickel Gold(NiAu) do not grow whiskers. Historically the predominant whisker mitigation strategy has been the addition of Lead to the Tin plating on the terminations (minimum of 3% Lead by weight). These parts can be used with no Tin whisker mitigation.

It is recognised that avoiding Tin containing finishes is not always possible; it is however, the best choice.

BGAs Important:

BGA's must always have Sn/Pb solder balls. The use of Tin Silver Copper alloy (SnAgCu or SAC) BGA balls soldered with Sn/Pb solder is prohibited.

BGAs can be re-balled. Currently, (Issue 5 of this document) Retronix, Coatbridge, Scotland are the only approved supplier for this process. BGA's must be laser re-balled only, no other process is permitted.

It is imperative that the following notes are adhered to:

a) All re-balled parts must be given their own MAv part number to differentiate them from the RoHS compliant original part. Each part should have a yellow ink dot on it's top surface to signify it has been re-balled.

b) At Retronix, each converted BGA must receive an AOI inspection to verify ball placement. All re-balled BGAs must receive an XRF analysis to confirm Sn/Pb solder balls are fitted. Each re-balled BGA must receive an electrical test, Retronix use a 'curve trace' test which is acceptable.

c) Results of the above testing must be retained at Retronix for future reference, refer to APP05 for storage duration.

d) Once these BGAs are fitted to built PCBAs they must receive a 100% X-Ray inspection, results must be retained for future reference.

AgPds Important:

Avoid the use of Silver Palladium (AgPd) over Nickel (Ni) finishes, this has separate concerns, primarily to do with solderability and shelf life. AgPd-terminated parts are designed for conductive adhesion. Reflow or wave soldering is not recommended.

(Reference Document Numbers 6, 8, 9 & 11)

2.3 Select a Component with Tin/Bismuth Coated Leads

When added to Tin in amounts of 2-4% by weight, Bismuth (Bi) will aid in suppressing whisker growth. With Lead free solder, SnBi is a viable candidate for component finishes. With eutectic Tin/Lead solder, it is necessary to control the Bismuth content of the finish between 3-5% so as to have enough bismuth to suppress whisker formation without getting into the compositional range of the ternary eutectic causing weaker solder joints. In addition, keeping the Bismuth content low is required to retain solderability of formed leads.

(Reference Document Numbers 6 & 7)

2.4 Select a Component with a Termination of Matte Tin Plating Over a Nickel Barrier

Matte Tin is a Tin film with lower internal stresses and larger grain sizes than bright Tin and is therefore less prone to whisker formation. Matte and bright Tin finishes are defined by the following:

Parameter	Matte Sn	Bright Sn
Carbon Content	0.005%-0.050%	0.2%-1.0%
Grain Size	1µm-5µm	0.5µm-0.8µm

(Reference Document Numbers 2, 6, 7 & 8)

A Nickel (Ni) underlay between the Tin plating and a Copper (Cu) base metal is thought to mitigate whisker formation. The underlying plating may alleviate the compressive stress in the Tin film, which is thought to be one of the driving forces for Tin whisker growth. A nickel barrier layer of 1.5 µm over a copper base material significantly reduces the growth of Tin whiskers on a low stress Tin finish.

(Reference Document Numbers 6, 7, 8, 11 & 12)

Important:
If the component is a leaded rather than SMD and it will have it's leads formed, then it should be tin/lead solder dipped; as the lead forming process may help induce whiskers.

2.5 Select a Component with a Termination of Matte Tin Plating over a Silver Barrier

Adding a silver (Ag) underlay between Tin plating and copper base metal is a method to mitigate whisker formation, similar to Nickel as above, but less common.

(Reference Document Numbers 6, 7, 8 & 11)

2.6 Annealed Tin

Annealing after plating has become a widely accepted whisker mitigation technique. Annealing at 150°C for 1 hour within 1 hr of plating is an acceptable mitigation technique as long as the part is also conformal coated after soldering to the board. Annealing has been proved to reduce the maximum whisker length and the growth rate by relieving plating stresses; causing grain growth increasing grain sizes and also forming a uniform intermetallic layer of Cu_6Sn_5 over Cu_3Sn which slows further intermetallic growth.

Source CALCE & iNEMi

3. STANDARD TIN WHISKER MITIGATION STRATEGIES

3.1 Tin/Lead Solder Dip Terminations

A SnPb solder dip process may be used to re-coat the component leads. Solder of 63/37 or 60/40 can be used. Precautions are required to prevent damage to the parts. Possible damage to parts can include package cracking or loss of hermeticity resulting from thermal shock, popcorning of plastic packages, solder bridging between leads on fine pitch packages, solder bridging between leads and component body and handling damage such as bent or non-coplanar leads, electrostatic discharge, etc.

The success of solder dipping as a Tin whisker risk mitigation approach depends on coating the entire exposed Tin plated surface, if portions of the Tin are left uncovered by the Tin/Lead solder they can still grow whiskers.

With the exception of robust through-hole parts, all components must be dipped in accordance with GEIA-STD-0006; a specialist sub-contractor, compliant with these requirements will perform the operation using an automated robot system.

Larger, more robust parts for e.g. axial or radial leaded parts can be dipped by hand and in house by the PCB assembler. MAv have a recommended procedure to be followed for this process, see Appendix A & B.

(Reference Document Numbers 2, 8, 11 & 13)

3.2 Apply a Conformal Coat

The application of a conformal coating may be used to retard Tin whisker growth, to contain whisker growth within the coating, and to prevent whiskers from shorting to exposed conductors. Concoat can provide some benefit by reducing the whisker growth rate, but Tin whiskers can grow through a conformal coating and, once exposed, can then short to other Tin whiskers or other exposed surfaces.

Parylene coating has been proved to be the most effective coating at reducing growth of whiskers.

Urethane coatings have been shown to be relatively effective mitigators. Use the extended cure profile recommended by the manufacturer, so the coating is hard, and ensure the coating is within the datasheet thickness limits to avoid cracking and delaminating.
Acrylic coating are the least effective of the three and do not stop the whiskers growing, but may contain the whiskers within the coating.

Using a combination of two different coatings, Parylene under either Urethane or Acrylic can be used.

Locally applying a conformal coating to a selected component or to a specific area of the PCBA is acceptable.

The concept is not to prevent whiskers from exiting the coating, rather to prevent whiskers from re-entering the coating once exited. This is due to the force required to re-enter the coating being greater than the collapse / buckling force the whisker can tolerate.

(Reference Document Numbers 2, 6, 8, 10, 11, 13 & 14)

3.3 Strip and Re-Plate Terminations

If alternatives to Tin plated parts cannot be obtained, it may be possible to remove the Tin finish. This is normally high risk when done on electronic components; the ability to remove the Tin plating from the affected surfaces and refinish these surfaces must be made based on a risk and cost analysis.

Such processes should be reviewed to determine the potential for affecting the reliability of the original product (e.g., chemical attack on component materials). This method is currently not approved and should be carefully reviewed prior to any use as it is perceived to be very high risk.

(Reference Document Numbers 2 & 8)

3.4 Reflowed Tin

Reflowed tin is a stress relieving process applied to the component before it is soldered to the board. See Appendix C at the end of this document for the MAv approved method of reflowing tin.

4. NON-STANDARD TIN WHISKER MITIGATION STRATEGIES

4.1 Mitigation Due to Conductor Spacing or Component Positioning

In certain exceptional cases it is acceptable to evaluate the tin whisker risk on an individual component basis. Perform a detailed analysis on the individual part considering the following points.

Consider the risks of component lead pitch and component positioning. Fine pitch components present a higher risk as the spacing between conductors is small, whiskers infrequently grow longer then 3mm so add a margin and consider a radius of 5mm around the conductor as the danger area.

Analyse the circuit around the component, consider the voltages present. Tin Whiskers are coated with an oxide layer, which has an average breakdown voltage of approximately 5 volts. If the circuitry around the part operates below this voltage, the risk of shorting is mitigated.

Consider locally mitigating against whiskers by locally brush applying concoat over the affected areas.

All of the following can increase the propensity of a finish to grow whiskers; compressive stresses induced in the Tin coating caused by trimming and forming the leads and scratches or nicks in the Tin plating as a result of handling or test probe contact.

If it can be justified that if whiskers do grow, the risk of shorting is absolutely minimal, it is possible to approve the use of individual components with non-compliant finishes.

This is a non-standard mitigation and intentionally does not align to Table 2-1.

5. MECHANICAL PIECE PARTS WHISKER MITIGATION STRATEGIES

Consider mechanical piece parts e.g. solder tags, brackets, frames, shields, housings, etc. These parts should not have any pure Tin finishes, all parts should be finished in a material that does not whisker, for e.g. nickel plated, anodised etc.

6. REPAIR, REWORK, MAINTENANCE, AND SUPPORT

All data and information required to conduct repair and rework shall be made available to those responsible for repair, rework, maintenance and support. All repair, rework must conform to the requirements of the drawing, Items List and any referenced manufacturing documents. At the time of writing there are no PCBAs containing Lead free solder, the approved repair/rework process is to use a Tin/Lead solder to solder all components, irrespective of whether the components contain Lead or not. Refer to the PCBA assembly drawing or appropriate control data to determine whether to apply conformal coating.

7. TECHNICAL REQUIREMENTS

7.1 Reliability

All equipment supplied by MAv shall meet the reliability and product life requirements of the program specification/contract. Implementations of Lead-free materials for which durability and reliability data are not sufficient to perform required analyses are prohibited.

Use of Lead-free solder materials with known incompatibility with other solder alloys used in the design is prohibited. Use of Lead-free Tin as a surface finish is permitted as long as it is supported with test data indicating that the propensity for Tin-whisker formation has been mitigated, and protection has been incorporated into the design to prevent failure in the event that Tin-whiskers occur.

7.1.1 Reliability Tests and Analyses

Reliability tests and/or analyses shall be conducted on all assemblies and sub-assemblies that employ the use of Lead-free solder in part terminations, assembly materials, and/or printed wiring board finishes.

As a minimum, reliability testing shall include temperature cycling, mechanical shock, and mechanical vibrations.

Prior to MAv converting over to Lead free assembly, these reliability tests will be defined in detail. Representative sample boards will be manufactured and then subjected to testing as necessary to validate reliability of the product in its intended environment.

Consideration should be given to published reliability data available from whatever sources are deemed suitable.

7.1.2 Environmental and Operating Conditions

The life cycle environmental and operating conditions of a given article of equipment shall be described in the MAv EPD for that individual item of equipment.

7.1.3 Sources of Reliability Data

Reliability analyses and Tin whisker mitigation strategy shall be based on the data contained in:

- BOEING published data
- CALCE published data
- GEIA-STD-0005-2
- GEIA-STD-0005-1
- iNEMI published data
- IPC published data
- JEDEC published data
- NASA published data
- NPL published research

(Copies of all the above are available from MAv PED and MAv Technical Library.)

7.1.4 Conversion of Results From Available Data to Applicable Conditions

Should MAv decide to convert a result from one set of environmental or operating conditions to another, MAv shall define and publish methods, processes, and models to be used. It is likely that GEIA-STD-0005-3, supported by appropriate acceleration models will be candidates. Examples of these acceleration models are the inverse power law (cyclic strain), the Arrhenius model (thermal-activated processes), or the Eyring model (combined stresses).

7.1.5 Reliability by Similarity

For assemblies and sub-assemblies that are similar to those for which reliability has been demonstrated through testing, analysis, or in-service performance, the existing data may be used to demonstrate the reliability of the assembly or sub-assembly through similarity. The reliability tests performed in 7.1.1 above should allow boards to be grouped into boards of similar types; therefore reliability results from one type of board can be read across to others within the same group. For e.g., group all 3'' system boards, they all use the same bare board and very similar components.

7.1.6 Assembly Processes and Materials

The assembly processes shall be conducted in accordance with MAv document numbers PS0392, and any documents called up in the Items List, Assembly drawings or any other separate contract documents.

7.1.7 Cleaning Processes and Materials

The cleaning processes and cleaning materials used shall be in accordance with IPC-M-108, as described in PS0392, or any other documents referenced in the assembly drawings or Items List.

7.1.8 Handling and Storage

Handling and storage of solder materials, and of assemblies and sub-assemblies containing Lead-free solder, shall be done in accordance with the following:

1. The PCBA sub-contractor shall ensure that Lead bearing solder and Lead free solder are stored and processed in a way that prevents the possibility of cross contamination. MAv recognize that a PCBA sub-contractor may have to process Lead-free and Lead containing assemblies through their shop floor at the same time. They must implement robust procedures that will prevent any Lead-free solder from contaminating any MAv product.

2. Sub-contractor Production Documentation and shop floor processes must make it impossible to use the wrong solder on a MAv PCBA. This may be subject to verification and approval by MAv.

7.1.9 System Reliability

The impact of totally Lead-free, fully RoHS compliant, PCBAs on MAv systems reliability must be fully determined prior to any conversion away from Lead bearing solder to Lead free solder. This reliability determination method is not currently defined, but must take into account processes for estimating failure rates, expected lifetimes, or other measures of reliability. This method must be based on the best available internal and external research, and should also include methods to assess the impact on the system, such as failure modes effects and criticality analyses. The defining of this reliability determination method should be done by MAv PED and MAv Engineering departments.

7.2 Configuration Control and Product Identification

If MAv change an existing, Lead containing PCBA to a Lead free RoHS compliant PCBA, this new board will have new MAv part numbers, new drawings and new Items Lists. For all Lead free boards, the assembly drawings must include a PB-free symbol within the drawing. The boards must be labeled with a Lead free label. This process will ensure that Lead bearing and Lead free boards are not interchangeable and will be processed differently.

7.2.1 Termination Material and Finish Alloy Compositions of Piece Parts

MAv PED shall verify the termination material and finish alloy composition of all electronic components prior to them becoming approved parts. This process should occur during the RFC sign off process when a new part is introduced. The component should conform to the approved terminations described in this procedure.

This approval must occur for all parts, including new parts on new boards, or replacement parts on current production boards. For Information: Many component manufacturers use J-STD-609 to classify their termination finishes. This standard uses codes e0 to e9 to classify termination finishes.

See Figure below for an explanation of the codes.

e0 – contains intentionally added lead (Pb)

e1 – tin-silver-copper (SnAgCu)
e2 – tin (Sn) alloys with no bismuth (Bi) nor zinc (Zn), excluding tin-silver-copper (SnAgCu)
e3 – tin (Sn)
e4 – precious metal [e.g., silver (Ag), gold (Au), nickel-palladium (NiPd), nickel-palladium-gold (NiPdAu) (no tin (Sn)]
e5 – tin-zinc (SnZn), tin-zinc-other (SnZnX) [all other alloys containing tin (Sn) and zinc (Zn) and not containing bismuth (Bi)]
e6 – contains bismuth (Bi)
e7 – low temperature solder (≤150°C) containing indium (In) [no bismuth (Bi)]
e8 and e9 symbols – unassigned

Figure 7.2-1 J-STD-609 Standard Codes explained

7.2.2 Solder Alloys Used in the PCBA Assembly Process

MAv shall identify the assembly alloy compositions in such a manner that users, maintainers, and repairers of the equipment have sufficient information to perform their functions reliably. The processes for alloy identification are documented either on the Items List for the particular PCBA, in PS0392, or in other manufacturing documents, e.g. ISxxxx specs. Solder alloys will always be Tin/Lead, in 63/37, 60/40 or Tin/Lead/Silver alloy combinations.

7.2.3 Solder Alloys on Printed Wiring Boards (Bare Boards)

MAv shall identify the solder alloys used on printed wiring boards in such a manner that users, maintainers, and repairers of the equipment have sufficient information to perform their functions reliably. The alloy identification is documented in the drawing of the bare board. PCB finishes will always be either ENIG or SnPb HASL. Do not use OSP, Immersion Silver or Immersion Tin.

7.2.4 Labelling

Where required by contract, all Pb-free sub-assemblies, assemblies, and equipment shall be labeled as such by affixing industry-approved Pb-free labels appropriately. This requirement will be defined on the assembly drawing for the particular PCBA. At the time of writing this document this label is not required on any MAv PCBA's, as they all contain Lead.

7.2.5 Part Number Changes

Part number changes will be determined by the requirements of the specific program. Examples of changes to be considered are re-designs of assemblies from Lead-based to Pb-free and changes in assembly solder alloys. Changes to basic parts on soldered assemblies and soldered assemblies within equipment will also be considered.

7.3 Risks and Limitations of Use

All restrictions, risks, and limitations of use of MAv's products, assemblies, and sub-assemblies shall be recorded in the MAv DDP for the individual item of equipment.

Any risks or limitations of use will be agreed on a case-by-case basis with specific customers. The documented restrictions, risks, and limitations shall be communicated to the customer using agreed-upon methods of communication.

8. REFERENCES

Reference Document No.	Description
1	GEIA-STD-0005-1: Performance Standard for Aerospace Systems containing Lead free solder
2	GEIA-STD-0005-2: Standard for Mitigating the effects of Tin Whiskers
3	JESD22A121: Test Method for Measuring Whisker Growth
4	JESD201: Environmental Acceptance Requirements
5	IEC 60068-2-82: Whisker Test Methods for electronic and electronic components.
6	JP002: JEDEC/IPC Current Tin Whisker Theory and Mitigation Practices Guideline
7	TT Electronics(Welwyn components) Study published by M. Birkett 2006
8	Mitigation Strategies for Tin Whiskers, prepared by M. Osterman CALCE-EPSC 2002
9	Whisker Evaluation of Tin-Plated Logic Component Leads, Texas Instruments, Feb 2003
10	The Continuing Dangers of Tin Whiskers and Attempts to Control them with Conformal Coating, Jong S. Kadesch, NASA
11	iNEMI Recommendations on Lead-free finishes for Components used in High Reliability Products, as presented to IPC/APEX, Feb 2006
12	Examination of Nickel Underlayer as a Tin Whisker Mitigator, CALCE, as presented to IEEE ECTC Conference May 2009
13	Metal Whiskers; Failure modes and Mitigation Strategies, NASA, DEC 2007
14	Evaluation of Conformal Coatings as a Tin Whisker Mitigation Strategy, Boeing, April 2005
15	PS0392: Sub Contract PCB assembly specification
16	S363: Rigid PCB Manufacturing Specification
17	PS366: Flex-Rigid PCB Manufacturing Specification
18	PS0569: Flex-Rigid PCB Manufacturing Specification
19	PS0577: Requirements for conformal coating
20	PS0422: Conformal coating with 1B31

Reference Document No.	Description
21	PS0563: De-golding and Tinning of Electronic components and wires
22	IS2000: Manufacturing Standard Electrical
23	IPC/JEDEC J-STD-609; Marking and Labeling of Components, PCBs and PCBAs to identify Lead (Pb), Pb free and other Attributes
24	JEDEC JESD22-B102E; Solderability

9. TERMS AND ABREVIATIONS

BGA	Ball Grid Array
CALCE	Centre for Advanced Life Cycle Engineering
CTE	Coefficient of Thermal Expansion
DDP	Design Certification
ENIG	Electroless Nickel/Immersion Gold
EPD	Engineering Product Description
GEIA	Government Electronics and Information Technology Association
iNEMI	International Electronics Manufacturing Initiative
IPC	Association Connecting Electronics Industries
JEDEC	Solid State Technology Association
LFCP	Lead Free Control Plan
MAv	Meggitt Avionics
MSL	Moisture Sensitivity Level (see Jedec J-STD-020)
NPL	National Physical Laboratory
OSP	Organic Surface Preservative
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PED	Production Engineering Department
QA	Quality Assurance
SnPb HASL	Tin Lead hot air solder levelled
SMD	Surface Mount Device

10. SYMBOLS

Sn	Tin	**Au**	Gold
Ag	Silver	**Bi**	Bismuth
Cu	Copper	**Pb**	Lead
Ni	Nickel	**Fe**	Iron
Pd	Palladium		

APPENDIX A

1. HAND SOLDER DIPPING PROCEDURE

These guidelines are for the hand dipping of axial or radial leaded components only. All other types of parts must be dipped in accordance with GEIA-STD-0006.

1. Observe ESD precautions throughout this process.
2. Check the MSL for the parts to be dipped, and if required they should be pre-baked i.a.w. J-STD-033 prior to solder dipping.
3. Pre-heat the components to 125°C, dwell for 30 minutes. Ensure the oven is switched on only after the components are placed inside to ensure a gentle ramp rate up to temperature.
4. Apply a small amount of liquid flux to the lead.
    a. The flux used must be compatible with the cleaning method used after dipping.
5. Dip the full length of the lead into a solder pot containing either 63/37 or 60/40 solder. The dwell time should be between 2 to 5 seconds.
    a. The solder pot temperature must be above the reflow point of pure Tin 232°C but below 255°C, so ideally use a solder pot temperature of 245 to 250°C. The pot must be able to maintain the set temperature to within ±3°C.
    b. Components must move from pre-heat to dip quickly enough to prevent them cooling before dipping.
    c. Solder pot contamination must be monitored in accordance with J-STD-001.
6. Use solder wick to remove any excess solder.
7. Allow the component to cool to ambient and only then clean off all flux residue. This can be done in a bath of IPA for example.

8. Visually inspect each part using 7X magnification.
9. MAv prefer to use a two part number system, the first part number for the Tin coated part, then the same part number with a –PB suffix for the Tin/Lead dipped part. The –PB part is the one called up on the PCB BOM. We feel that by using this method there is less chance of forgetting to dip the part prior to fitting.
10. Then, once these parts are fitted to the PCB, brush coat Humiseal 1B31 or 1A33 conformal coating over the leads covering their full length. Cure the coating as normal.

APPENDIX B

1. SOLDERABILITY TESTING

1. When it is necessary to assess the solderability of a device, Jedec Standard JESD22-B102E Document should be used (October 2007).

2. The purpose of this standard test method is to provide a means of determining the solderability of device package terminations that are intended to be joined to another surface using lead- (Pb-) containing or Pb-free solder for the attachment.

3. The standard provides optional conditions for preconditioning and soldering. It provides procedures for dip & look solderability testing of through hole, axial and surface mount devices and a surface mount process simulation test for surface mount packages.

4. Pass and fail criteria are well defined in this standard, with examples.

(Reference Document Number 24)

APPENDIX C

1. REFLOWED TIN THERMAL STRESS RELIEF PROCESS

1. Open the component packaging and inspect the desiccant. If the desiccant shows no moisture exposure, proceed to the next step. If descant shows a moisture content then determine the MSL level of the components and bake them in accordance with J-STD-033.

2. Prior to fitting the components to the PCB, they must be thermally treated. Create the flowing reflow profile on a convection reflow oven. Place the parts on a heatproof base material and pass them once through the oven. Allow to cool.

Profile:

   a. Preheat: Raise temperature of leads to 100°C, in a period of 50 seconds.

   b. Temperature soak: Raise the temperature from 100°C to 185°C over a period of 180 seconds. Max ramp rate 1.5°C/sec.

   c. Reflow: Minimum lead temperature to be reached is 235–245°C, do not exceed 260°C.

   d. Desirable dwell time above 232°C is greater than 50 seconds and less than 80 seconds. Do not exceed three minutes above the tin melt temperature of 232°C.

3. The conditioned parts can now be soldered to the board using convention tin/lead solder and a tin/lead solder reflow profile. If the parts are not going to be fitted immediately they must be protected against moisture ingress.