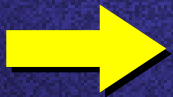




# Agenda

1. Lead Free Transition and Impacts
2. **Lead Free Failure Modes**
3. A Comprehensive Lead Free Strategy
4. **GEIA Lead Free Standards and Handbooks**
  - GEIA-STD-0005-1 Performance Standard
  - GEIA-STD-0005-2 "Tin Whisker Document"
  - GEIA-HB-0005-1 Program Management Guidelines
  - GEIA-HB-0005-2 Technical Guidelines
  - **GEIA-STD-0005-3 Performance Testing**
  - GEIA-HB-0005-3 Rework and Repair
  - GEIA-HB-0005-4 Reliability Assessment
5. **Summary**
  - Acknowledgements
  - Lead Free Links
  - Points of Contact





# Agenda

- Overview, Concerns and the Need
- The LEAP Lead-Free Test Team
- Scope and Purpose of the Document
- Recent Issues
- Recent Accomplishments
- Schedule
- Final Comments



## Overview, Concerns, and the Need

- Concerns with lead-free solder
  - Interconnection performance characteristics
    - Fatigue life, Mechanical strength
  - Effects of lead-free/mixed finishes (e.g. tin whiskers phenomenon)
    - This is a rapidly approaching threat to the long-term reliability of many military, avionics, and space programs.
  - Conversion of In-house lines to lead-free
  - Repair/Rework
  - Configuration Control

**This document focuses on the interconnection performance characteristics**



## Overview, Concerns, and the Need

# PRESENT STATE

Over the past several decades, electronics manufacturers have developed methods to conduct and interpret results from reliability tests for lead-bearing solder alloys. Since these alloys have been used almost universally in all segments of the electronics industry, and since a large body of data, knowledge, and experience has been assembled, the reliability tests for lead-bearing solder alloys are well-understood and widely accepted. When it became apparent that the use of lead-bearing alloys would decline rapidly, a large number of programs were implemented to evaluate the reliability of the lead-free interconnections.

**The lead-free alloys represent a great number of material combinations, all of which have different material properties which influence test approaches. Board and component finishes also need to be considered. Thus, focus must include the concept of a lead-free system.**



## Overview, Concerns, and the Need

### ➤ Impacts

- Global transition to lead-free electronics has significant impact on the electronics industry
  - Especially disruptive to aerospace and other industries that produce electronic equipment for high performance applications
  - Aerospace and High Performance (AHP) is characterized by rugged severe or harsh operating environments, long service lifetimes, and high consequences of failure.
  - AHP electronics also must be repairable at the soldered assembly level.
  - Typically, AHP industry production volumes are low; they can neither drive nor resist the transition to lead-free electronics
  - Reliability tests conducted by suppliers cannot be assumed to assure reliability in AHP applications

**Document provides a framework for a test methodology concerning lead-free electronic assemblies**



# Overview, Concerns, and the Need

## ➤ The Need

- What's needed is a document that provides guidance and direction which will enable designers, manufacturers, and maintainers of AHP electronics to develop and conduct performance tests of lead-free interconnections.

**This presentation will provide a status report on progress in generating the document**



## The LEAP Lead-Free Test Team

<b>Boeing</b>	<b>Curtis Wright Controls, Inc.</b>
<b>Raytheon Company</b>	<b>EADS Deutschland GmbH</b>
<b>Smiths Aerospace</b>	<b>ITB</b>
<b>DfR Solutions</b>	<b>Rockwell Collins</b>
<b>Thales Research &amp; Technologies France</b>	<b>AMCOM</b>
<b>Lockheed Martin Corporation,</b>	<b>United Technologies</b>
<b>BAE Systems Platform Solutions</b>	<b>Celestica</b>
<b>University of Maryland CALCE EPSC</b>	<b>NAVAIR</b>
<b>Goodrich Corporation</b>	<b>Medtronic</b>
<b>SAIC</b>	<b>Sun Microsystems</b>
<b>Meehan Electronics Corporation</b>	<b>Aerospace Industries Association of America, Inc.</b>
<b>Honeywell</b>	<b>Rolls-Royce North America Inc.</b>
<b>NWSC-Crane</b>	<b>SAIC</b>
<b>JCAA</b>	<b>New Mexico Tech</b>



# Scope and Purpose of the Document

- Document Outline of Contents
  - Introduction
  - Scope
  - Default Test Methods
  - Test Protocol
  - Other Information



## Scope and Purpose of the Document

### ➤ General Overview

#### ➤ Important distinctions and clarifications

- This document provides the “how to test” information
- Solder alloy refers to that material used as the electrical/mechanical interconnection
- References to platings/finishes will be specified separately but are included in the concept of a solder system
  - This document will not address whisker formation (covered in GEIA-STD-0005-2 and GEIA-HB-0005-2)

**The intent of the document is to provide a default method and to provide requirements for alternative methods so that avionics/defense suppliers can satisfy the reliability requirement of GEIA-STD-0005-1.**



## Scope and Purpose of the Document

### ➤ Objectives

- Provide a conservative default method for testing of AHP interconnections containing lead-free solder to facilitate reliability analysis, generic qualification, product-specific qualification, and similar activities
  - The default method is intended for use by electronic equipment manufacturers, repair facilities, or programs who, for a variety of reasons, may not be able to commit the resources to develop their own methods.
  
- Provide a guideline protocol, for designing and conducting one's own tests in order to facilitate interpretation of results from reliability analysis.
  - The protocol is intended for use by manufacturers or repair facilities with the necessary resources to design and conduct performance tests that are specific to their processes, products, and/or new materials

**Approach would include linking material properties  
and other failure mechanisms !**



# Scope and Purpose of the Document

- Environment (Associated Tests)
  - Thermal cycling
  - Combined Environments
  - Vibration
  - Mechanical Shock

**Document will provide guidance in selecting those tests that best represent use environments. The initially released version of this document will address only the above four tests. Other tests can be addressed if needed by individual organizations.**



## Recent Issues

- Vibration and Shock Methods
  - Deciding on referenced IPC method versus MIL-STD-810 vs program required or a combination or worst case
    - Both default and protocol cases
  - Re-look at levels; consider common sense levels to prevent overstress
- Combined Environment
  - No default approach
  - NASA/DoD LFE approach provided as information
  - Consensus is to consider a life cycle approach in designing a test program
- Acceleration Model
  - Improve comprehensibility
  - Appendix B data (presently for SAC 305)
- Considering a section on how to use the document
- Emphasize the flexibility/tailorability of the standard



# Recent Accomplishments

- Improved Introduction and Scope
- Test Vehicles
  - Working card versus coupon
- Sample Sizes
  - Flexibility provided
- Default pre-conditioning method (applicable to protocol as well)
  - Thermal aging
- Default thermal cycling method
- Failure analysis methodology
  - Three approaches with “qualifiers” for each
- Concurrence on a life-cycle approach for Combined Environment Test
  - Option of considering straight combined versus sequential-cumulative (e.g. Miner’s Law) approaches



# Schedule

- All outstanding team actions completed by 30 September 2007
- Incorporation of actions/inputs into document by 7 October 2007
- Final team review and comments by 29 October 2007
- Prepare document for GEIA ballot by 30 November 2007
- Submit for ballot January 2008



# Final Comments

- The document does not give the answers
- Provides direction/guidance in developing suitable interconnection performance tests
- “Engineers will have to be engineers” to use the document
  - Logical, sound judgment
  - Flexibility
  - Concurrence



# Thank You

- **Your inputs are welcome.....Please forward them to**
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