

# **AIA-AMC-GEIA Lead-free Electronics in Aerospace Project**

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Many slides written by other document leaders:

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# Impact on Aerospace

## Legal Situation

- Exemption status is unclear, but it is likely that military electronics will be exempt
- Most recent information is that military and transportation (aircraft, boats, autos, etc.) are not included in RoHS, but that is not “final.”
- There are “gray areas,” such as IFE, etc.
- Specific exemption requests made by some companies
- Aerospace and Defence Industries Association of Europe (ASD) has requested an exemption – supported by Aerospace Industries Association and AMC

## Practical Situation

- Aerospace industry situation is “unsettled”
- At least one US aerospace organization forbids the use of pure tin
- The global electronics industry is making the transition, and it is approximately 50% complete
- Aerospace will be “swept along” by a supply chain that is beyond our control

***It is unrealistic to think that we have a choice as to whether or not we will use lead-free materials. Our choice is between doing so in a manner that is controlled or uncontrolled.***

# Problem to be Addressed

**“The worst real life resolution of the lead-free solder issue is the direction in which we are now headed – multi-track electronics manufacturing leading to a logistic/supply chain/manufacturing nightmare.”**

**- Association Connecting Electronics Industries (IPC), 2001**

# Denial

**1456: Halley's comet can be seen at night. Pope Calixtus III issues a papal bull (official decree) against the comet. Christendom is to pray the comet, a symbol of the "anger of God," be fended off.**

***We can't make the comet (or the transition to lead-free electronics) go away, but we can manage the risk, and that is what the LEAP WG is all about. -Procarione***

# **AIA-AMC-GEIA Lead-free Electronics in Aerospace Project Working Group (LEAP WG)**

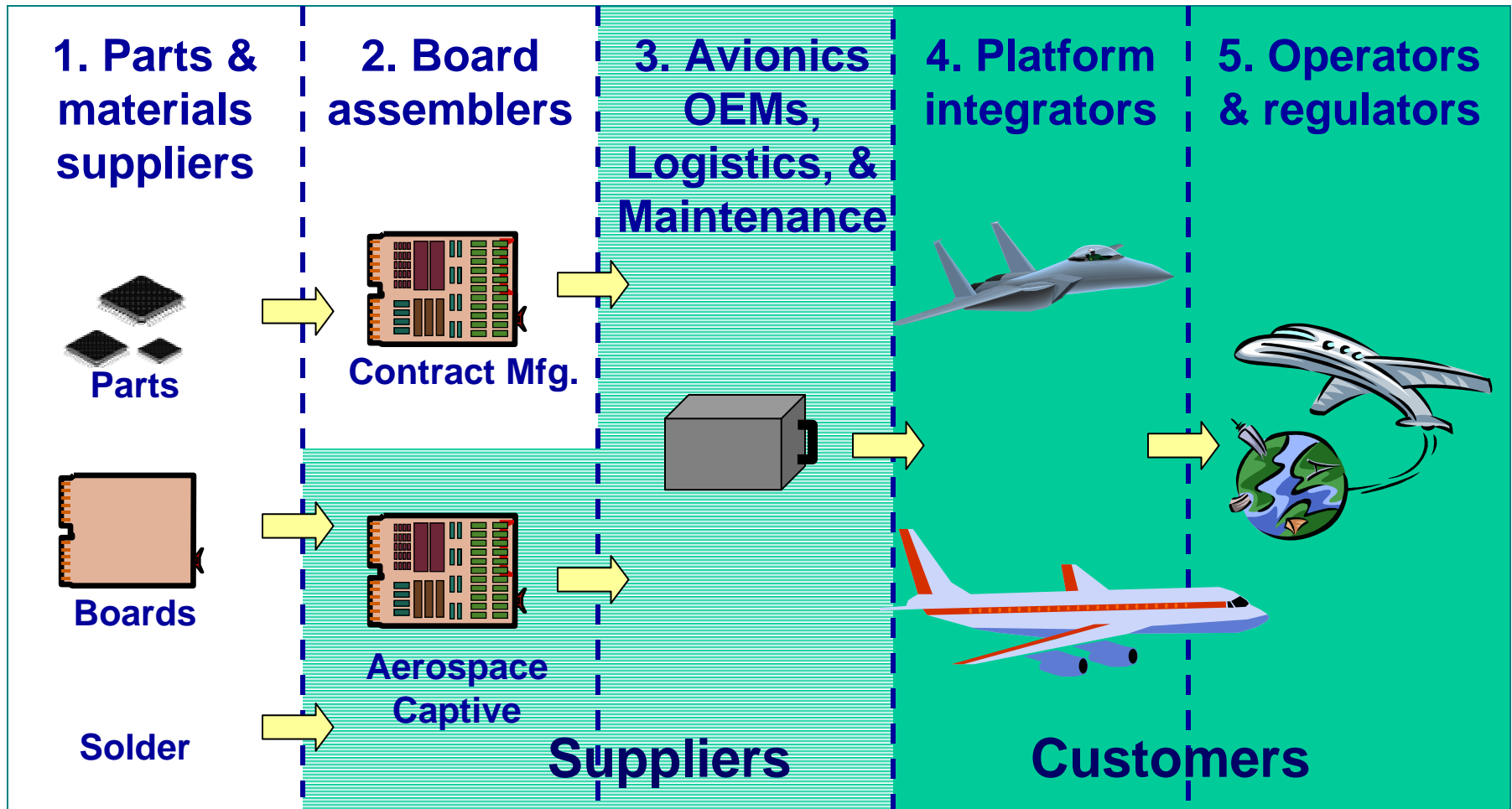
- **Formed in 2004 as AIA Lead-free Aerospace Electronics Working Group**
- **Includes all stakeholders (market segments, supply chain, geographic regions)**
- **Addresses issues that are:**
  - Unique to aerospace and military
  - Within control of aerospace and military

# LEAP WG Purpose

**The purpose of the LEAP WG is to develop and implement actionable deliverable items that enable the aerospace industry to accommodate the global transition to lead-free electronics. The deliverable items address problems that are unique\* to, and are within the control of the aerospace industry.**

*\*Other producers of low-volume, complex electronic systems may use the deliverables of the LEAP WG.*

# The Aerospace Electronics Supply Chain



**Non-aerospace Control**

**Aerospace Control**

# LEAP WG Participants

## **AIA – Aerospace Industries Association (Sponsor)**

The Aerospace Industries Association represents the nation's major manufacturers of commercial, military and business aircraft, helicopters, aircraft engines, missiles, spacecraft, materials, and related components and equipment.

## **AMC – Avionics Maintenance Conference (Sponsor)**

The Avionics Maintenance Conference (AMC) is an air transport industry activity sponsored ARINC. The objectives of AMC are to promote reliability and reduced operating cost in air transport avionics by improving maintenance and support techniques through the exchange of technical information. AMC accomplishes its objectives through a number of activities including its premier event-the annual Avionics Maintenance Conference-known worldwide as the AMC. Attended by more than 750 avionics maintenance experts from around the world, the annual conference identifies technical solutions to maintenance issues and, as a result, the airline industry saves over \$94 million annually.

# LEAP WG Participants, cont'd.

## **GEIA – Government Engineering and Information Technology Association (Sponsor)**

The GEIA promotes the interests of the U.S. electronics, communications and information technology industries with regard to government markets, requirements, and technical standards. GEIA represents companies that create and apply innovative products, services, practices, technologies and integrated solutions to meet government needs.

## **IEC – International Electrotechnical Commission (Standards Publisher)**

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts.

# Stakeholders

## Supply Chain:

Avionics OEMs, Airframe Integrators, Operators (airlines, military services, etc.), Regulators, Repair Facilities



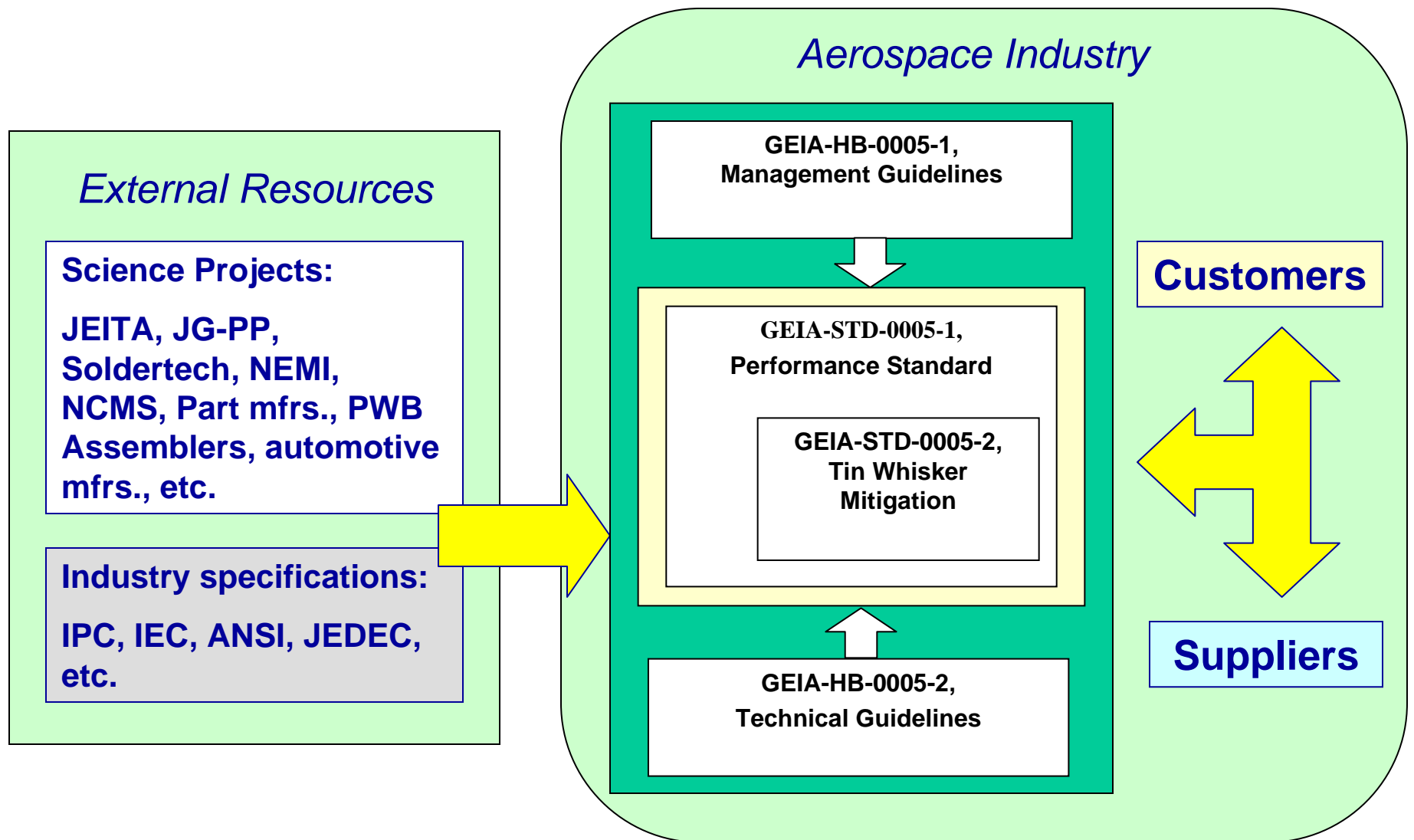
## Market Segments:

Air Transport, General Aviation, Military, Space

## Priorities:

- Assure reliable products
- Minimize all stakeholders' costs
- Meet all stakeholders' needs

# LEAP WG Deliverables: What We're Going to Do



# Actionable Deliverables

- ❑ **GEIA-STD-0005-1, Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder**

Used by “customers” to communicate requirements to aerospace / high performance electronic system “suppliers”

Examples: Reliability, configuration control, repair, maintenance, and support

- ❑ **GEIA-STD-0005-2, Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems**

Used by “customers” and “suppliers” to determine how much whisker mitigation is needed in a particular application. For each level of mitigation there are requirements regarding material monitoring, mitigating actions, and analyses.

- ❑ **GEIA-HB-0005-1, Program Manager’s Handbook**

Used by program managers to address all issues related to lead-free electronics, e.g., logistics, warranty, design, production, contracts, procurement, etc.

- ❑ **GEIA-HB-0005-2, Technical Guidelines for Using Lead-free Solder in Aerospace Applications**

Used by “suppliers” to select and use lead-free solder alloys, other materials, and processes. It may include analytical methods, technical data, specific solutions, lessons learned, test results, etc.

# Task Teams

**GEIA-STD-0005-1**: Boeing, Rockwell Collins, Honeywell, AIA, Bombardier, Matsushita, Lockheed Martin, EADS, BAE Systems

**GEIA-STD-0005-2**: Boeing, Raytheon, NASA, Curtiss Wright, BAE Systems, Honeywell, Bombardier, Rockwell Collins, AIA, Harris, Smiths, ACI, Northrop Grumman, General Dynamics, Hamilton Sundstrand, Navy, Vishay, Intersil, Rolls Royce, EADS

**GEIA-HB-0005-1**: Boeing, Parker, AIA, FAA, Boeing, Raytheon, NAVAIR

**GEIA-HB-0005-2**: BAE Systems, CALCE, Honeywell, Parker, AMC, Bombardier, Rockwell Collins, AIA, Harris, Matsushita, Raytheon, ACI, Kidde Aerospace, Rolls Royce, Teldix, Northrop Grumman, Tyco Electronics

**Repair Group**: AMC, Parker, Boeing, FedEx, Delta, Bombardier, Hamilton Sundstrand, AIA, BAE Systems, Raytheon, Matsushita, ACI, Air Canada, NAVAIR

# Elements of GEIA-STD-0005-1

## **1 Plan objectives**

### **1.1 Reliability of materials and processes**

All solder materials and processes used in the Plan owner's products are reliable.

### **1.2 Configuration control and product identification**

The configurations of all systems, equipment, assemblies, sub-assemblies, and piece parts are identified and controlled.

### **1.3 Risks and limitations of use**

All risks and limitation of use of the Plan owner's products, due to the use of lead-free solders, are identified, and information is provided to mitigate them.

### **1.4 Deleterious effects of pure tin**

The deleterious effects of pure tin are mitigated

### **1.5 Repair, maintenance, and support**

Repair, maintenance, and support activities are controlled in a manner that mitigate effects of lead-free solder materials and processes.

# Elements of GEIA-STD-0005-2

- **Level I. No restrictions on tin-finish use.**
- **Level II. Tin-finish is allowed under some circumstances.**
  - *Level IIA.* Use of tin-finish without explicit controls is acceptable under most circumstances but the likelihood of whiskers and methods used to estimate their impact or circumstances of the application that mitigate the whisker risk shall be documented.
  - *Level IIB.* Tin-finishes may be used but only with customer approved and with control measures. These tin-finish approvals may be blanket approvals for multiple components and applications within the system.
  - *Level IIC.* Restricted use of tin-finish. Tin-finish is prohibited unless an exception is made. Specific instruction on use of tin-finish and required control measures to be provided and reviewed on a case-by-case basis.
- **Level III. Use of tin-finish is prohibited and measures must be taken to verify compliance.**

# Elements of GEIA-HB-0005-1

## **4.1 Elements of the Plan, in accordance with GEIA-STD-0005-1**

- 4.1.1 Reliability
- 4.1.2 Configuration Control
- 4.1.3 Risk Management
- 4.1.4 Deleterious Effects of Tin
- 4.1.5 Rework/Repair and Maintenance

## **4.2 Additional Program Management / System Engineering Concerns**

- 4.2.1 Cost
- 4.2.2 Parts Obsolescence / COTS
- 4.2.3 Existing Program Constraints
- 4.2.4 System Engineering Management Plan

# Elements of GEIA-HB-0005-2

- **Aerospace System Level Service Environment and Requirements** (Thermal Environments, Vibration and Shock, Humidity, etc.)
- **Solder Joint Reliability Considerations** (Alloys, mixing, impact of geometry, process variability, rework)
- **Impact of and on Components** (Materials, thermal ratings, assembly stresses, terminal finishes)
- **PWB Issues** (Materials, assembly stresses, finishes)
- **Module Assembly Considerations** (Connectors, heat sinks, conformal coat, etc.)
- **Manufacturing** (Solder process, fluxes, inspection, etc.)
- **Wiring Issues** (Finishes, stress relief, splices, etc.)
- **Rework and Repair** (Profiles, mixed alloys, etc.)
- **Modeling and Analysis** (Intermetallic growth, Kirkendall voids, fatigue, mixed materials, similarity analysis, recommended qual tests, etc.)

# Document Publication Schedule

Document Number	Title	Task Leader	GEIA Document	IEC Document
GEIA-HB-0005-1	Program Management/ Systems Engineering Management Guidelines for Managing the Transition to Lead-free Electronics	Pat Amick (Boeing)	30 June 2006	30 June 2007
GEIA-HB-0005-2	Technical Guidelines for Aerospace Electronic Systems Containing Lead-free Solder	Stephan Meschter (BAE)	30 June 2006	30 June 2007
GEIA-STD-0005-1	Performance Standard for Aerospace and Military Electronic Systems Containing Lead-free Solder	Lloyd Condra (Boeing)	30 June 2006	31 Dec. 2006
GEIA-STD-0005-2	Standard for Mitigating the Deleterious Effects of Tin in High-Reliability Electronic Systems	Anduin Touw (Boeing)	31 Dec. 2005	31 Dec. 2006

# Implementation – Impact the Design, Production, and Support of Aerospace Vehicles

