

Lead-Free Manufacturing For Defense

Setting the Standard for Defense Lead Free Manufacturing

Environmental legislation passed in Europe and Asia requires commercial electronics manufacturers to convert their Tin Lead (SnPb) soldering processes to Lead Free Soldering processes by July, 2006. The European Union (EU) passed legislation prohibiting the use of lead in any electrical and electronic equipment put on the market starting July 1, 2006. Japan and China have initiated similar voluntary and legislative action. These regulations concentrate on commercial electronics.



Due to the small size of the military and aerospace electronics manufacturing market – less than 1% - it is inevitable that military and aerospace hardware will be forced by sheer commercial availability to manufacture with Lead Free solders and materials. Some large avionics and military programs are indicative of this. Airbus Industries has recently announced that avionics for the A-380 will be lead-free, as have several key NATO and U.S. military programs (e.g. AEGIS naval system). These trends indicate that Lead Free soldering is the next major technology driver in high reliability electronics manufacturing for the military and aerospace as well as the commercial industry.

The Electronics Manufacturing Productivity Facility (EMPF) has initiated several projects to determine what affect Lead Free soldering technologies will have on aerospace and military applications. In the first completed project, the EMPF performed a manufacturing infrastructure audit of the manufacturing facilities at Lockheed Martin Naval Electronics and Surveillance Systems (NE&SS) Surface Systems in Moorestown, New Jersey. The second project will have the EMPF and its Industrial Advisory Board (IAB) members build and test functional deliverable hardware manufactured with Lead Free solders.

Lead Free Soldering For Navy Systems Project Description

Background : The Electronics Manufacturing Productivity Facility (EMPF), and its Industrial Advisory Board (IAB) members, Boeing, Rockwell Collins, ITT, Raytheon, and Lockheed Martin, have individually and collectively performed research and development tasks on Lead Free solders. Together, it is proposed that a new Lead Free Program be initiated. This program, called the Lead Free Manufacturing For Navy Systems Program, will require each member will build and test functional deliverable hardware with Lead Free solders. The target programs, whose hardware will serve as Demonstration Vehicles, are the F-18 Avionics Program and the AEGIS Integrated Warfare Systems Program . The project's prime deliverable will be a manufacturing process guideline to implement Lead Free soldering processes for high reliability applications. The manufacturing process guideline will take into account the transition from SnPb solders and finishes to Lead Free solders and finishes.

These activities will benefit the Navy, and the aerospace and military electronics manufacturing community, in several ways. First, a documented Lead Free soldering process will serve as an industry standard for those who have to convert their hardware from Tin Lead to Lead Free solders. Second, these activities will augment research and development activities being performed by industrial consortiums, focusing on the special requirements by the aerospace and military electronics manufacturing community. Finally, these activities will demonstrate the viability of Lead Free soldered hardware for naval applications requiring high reliability.

Project Description : The Lead Free Manufacturing for Naval Systems Project has two (2) prime goals:

Lead Free Manufacturing Processes : To develop and certify a Lead Free Soldering Implementation Guideline for aerospace and military applications. This standard will document the electronics manufacturing processes requirements needed to produce hardware which meets IPC J-STD-001C Class 3 and IPC-A-610 Class 3 specifications. Functional Naval electronics hardware will be manufactured with Lead Free solders, so that the Lead Free hardware response can be compared with the Tin Lead (SnPb) hardware response for



the same test environments. These test environments will be defined by the program the hardware originated from. The emphasis will be to acquire test articles that the Navy will accept as being representative of their equipment.

Lead Free Demonstration Vehicle : To document the methodology used to convert electronics manufactured with Tin Lead (SnPb) solders to Lead Free solders.

Building functional deliverable Lead Free soldered hardware, as a technical Demonstration Vehicle, was identified by the Joint Group of Pollution Prevention (JG-PP) Lead Free Soldering Program as the next logical step in developing Lead Free Soldering processes for implementation and process certification. The proposed activity represents the first time where functional deliverable aerospace electrical hardware will be manufactured with Lead Free solders.

Project Deliverables : The first deliverable will be publishing a Lead Free Soldering Implementation Guideline for aerospace and military applications. This standard will document the electronics manufacturing processes requirements needed to produce hardware which meets IPC J-STD-001C Class 3 and IPC-A-610 Class 3 specifications.

The second deliverable will be completing a series of supporting activities to various industry consortiums, solder manufacturers, and the IAB members regarding the analysis, process development, material tracking, and implementation of Lead Free soldering process for high reliability aerospace applications.

Additional Lead Free Soldering Investigations

The EMPF will continue to initiate Lead Free manufacturing process investigations, and to communicate its findings to the electronics manufacturing community. These activities include:

Industry Consortium Support : The EMPF proposed that the EMPF provide technical and project management support to these organizations. These activities will augment the tasks performed the IAB membership and the EMPF. This will assure that activities performed by the various Lead Free Soldering consortiums and by the EMPF and the IAB will compliment each other.

Lead Free Solder Analysis : The EMPF proposes to perform a series of analysis of selected Lead Free solders, in concert with the solder manufacturers. The goal is to assist solder manufacturers with the development of Lead Free soldering materials for commercial and aerospace requirements.

2005 Core Competency Projects : The EMPF will perform a series of investigations. These investigations are consistent with previous Lead Free Soldering activities performed within the EMPF. These investigations include:

Lead (Pb) Contamination Investigation : To determine the maximum quantity of Lead (Pb) which can cause a Lead Free solder joint to become unreliable.

Intermetallic Growth Investigation : To determine intermetallic growth within a Lead Free solder joint, which will be utilized in failure analysis.

Lead (Pb) Contamination Analysis : To develop an industry standard procedure for Lead (Pb) contamination analysis.

Wave Solder Analysis : To develop an industry standard procedure for Lead Free Wave Solder pot contamination analysis.

Logistics and Material Tracking : The EMPF proposed that a standard be presented to the aerospace community, to track the solders, board finishes, and component finished used on deliverable hardware. This standard should be compatible with the various manufacturing systems used in industry.