JG-PP Email

Joint Group on Pollution Prevention

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Date: 04/28/2003
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JG-PP Lead-Free Solder Project
Teleconference Meeting Minutes
April 21, 2003

Govt. Project Manager: Warren Assink, WPAFB
Meeting Chairperson: Brian Greene

Comments:
Attached please find the minutes from the April 21, 2003, Lead-Free Solder teleconference. If you have questions about the minutes, please contact Warren Assink or Brian Greene. Please further distribute as necessary.

MEMORANDUM FOR RECORD

Subject: Teleconference Summary and Minutes – April 21, 2003

Material(s) Identified: Lead

Process Identified: Electronics soldering

Methodology Phase: II - Technical, III - Business

Summary:
On April 21, 2003, technical representatives from the American Competitiveness Institute, Boeing Company, ITB, Inc., Harris Corporation, Lockheed Martin, NASA Jet Propulsion Lab, NASA Marshall Space Flight Center, Northrop Grumman, Raytheon, Redstone Army Arsenal, Robins Air Force Base, Rockwell Collins, Sandia Labs, Texas Instruments and Wright Patterson Air Force Base participated in a meeting with representatives from the Joint Council on Aging Aircraft and the Joint Group on Pollution Prevention Working Group and their contractors. One objective of the teleconference was to introduce the new members from the Joint Council on Aging Aircraft and to announce that the JCAA will be acting as the project overseer as of May 1, 2003, not JG-PP. However, the present intention is that the project managers and coordinators will remain the same. In addition, the teleconference was used to review the test flow sequence and timetable for 2003-2004, and review the latest testing cost estimate and cost share figures. Other issues discussed included the comparison of the Lead-Free Solder Joint Test Protocol (JTP) with industry standards IPC-785 and IPC-9701, to review the latest test vehicle design drawings and the review of the documentation requirements for laboratories that will perform the required testing procedures.

Prior Decisions:

- 5/9/01 – Lead as used is tin-lead (Sn/Pb) solder was chosen as the target HazMat.
- 6/20/01 – A Joint Test Protocol (JTP) will be developed for qualifying lead-free solder alloy used in the manufacture of lead-free printed wiring assemblies (PWAs)
- 11/1/01 – A second JTP will be developed for qualifying lead-free solder alloy used in the rework of lead-containing PWAs.
- 3/7/02 – By consensus, the solder alloys currently recommended for testing are:

Wave Solder:	Sn/0.7Cu
	Sn/3.9Ag/0.6Cu
	Sn/3.4Ag/1.0Cu/3.3Bi
Reflow/Manual Solder:	Sn/3.9Ag/0.6Cu
	Sn/3.4Ag/1.0Cu/3.3Bi
Baseline:	Sn/37Pb

- 10/1/02 – Because of numerous similarities in the testing procedures, all the PWA manufacturing and rework requirements will be folded into just one JTP.
- 02/27/03 – JTP distributed for endorsement

Next Teleconference: Tentatively June 17, 2003, 11:00 AM

Next Meeting: TBD

Minutes:
Mr. Brian Greene (ITB, Inc.) opened the teleconference by explaining the objective of the teleconference was to discuss business and technical issues still remaining to be resolve for the lead-free solder project. A roll call was taken.

1. **Topic:** The Joint Council on Aging Aircraft (JCAA) is now involved in our project. Review of JCAA role in the lead-free solder project (Warren Assink).

   a) Mr. Warren Assink (Lead-Free Solder Government Project Manager, Wright-Patterson AFB) announced to the lead-free solder team members that the JCAA would be taking over the role of project manager from the JG-PP. Mr. Don Streeter and Master Sargeant Rich Hricko were representing the JCAA on the teleconference. The reason for this project leadership change was that the JG-PP Working Group lead-free solder project encompasses much more than the pollution prevention goals established by the JG-PP. Alternatively, the JCAA saw the value of the lead-free solder project with regard to the numerous logistical and repair issues currently ongoing through out the aircraft and assets owned and maintained by the DoD and NASA. The JCAA at the director level have agreed to take over managing the lead-free solder project. Currently, transfer of the lead-free solder project to the JCAA is targeted on May 1, 2003.
   b) Mr. Sheldon Toepke (Boeing) asked, "What will happen to lead-free solder project schedule [in light of the JCAA taking over]?" Mr. Assink responded that the discussion between JG-PP and JCAA are on-going. At this time, changes in the project schedule are an issue that is unknown.

2. **Topic:** Review test flow sequence and timetable for 2003-2004.
   The present schedule proposes procuring the components first and the boards second (vs. at the same time). The reason is that if the components are not correct, we can quickly and easily change the design of the test board and order it accordingly. This flexibility could not be achieved if the test vehicles are ordered at the same time as the components.

   a) Mr. Greene reviewed the PowerPoint presentation (April 21 2003 PowerPointTeleconFile.ppt), slide #1, and the overall lead-free solder schedule. He pointed out the duration of the thermal cycle test, which is scheduled for duration of 310 days. Mr. Greene stated that by the early part of summer 2003, the lead-free solder project should be in a position to start ordering components. The test vehicles should be built late in 2003, with testing to begin in the first quarter of 2004.
   b) One issue that is not allowing the testing to start sooner is that the procurement of testing articles which includes components, solders and boards, cannot be done in parallel and must be done in succession. Persons responsible for procuring the test articles must ensure that the proper items and components are received prior to procuring the boards and solders. Procuring the test articles in succession allows for changes in process and reduces the risk of placing damaged or inoperable components on the test vehicle.
   c) Mr. Jim Blanche (NASA MSFC) asked about the tasks labeled 15 minutes pre and post prep for thermal cycling on the lead-free solder schedule. Mr. Tom Woodrow (Boeing) explained that the tasks should be denoted as dwell times for each temperature, not "pre-prep" and "post-prep". Mr. Woodrow also stated that the lead-free solder consortium should be sure that all procured parts are checked for proper solder finish and daisy chain configuration.

d) Reza Ghaffarian (NASA JPL) stated that trial test vehicles should be built and qualified prior to the testing procedures being performed on the bulk of the test vehicles. This will ensure that any flaws or defects that may have occurred in the building process can be fixed and will not be translated to all the test vehicles rendering the testing program a failure. Dr. Ghaffarian asked if the lead-free solder consortium would consider qualifying the completed test vehicles to the groups require standards. In response, Mr. Dave Hillman (Rockwell Collins) stated that all board and component characterization would be preformed prior to the building of the test vehicles. Extra test boards and components will also be procured so that additional test vehicles can be built and qualified prior to undergoing testing procedures. Mr. Hillman stated that the group would have to decide if the test vehicles must be qualified to a set of standards to be determined later.
e) Mr. Greene asked the group the following question, "Should we subject the PWAs to burn-in? Burn-in would allow testing for bad components beforehand, but would likely increase the cost and schedule." Dr. Ghaffarian stated that coupons could be used to do some of the external testing needed to ensure that the test vehicles are built properly. Mr. Woodrow stated that it would not be necessary to perform burn-in because we are working with dummy components and wire bonds only. Mr. Hillman stated that all necessary characterization has been accounted for in the planning of test article procurement and test vehicle build procedures so anything that is amiss will be caught prior to the final build.
f) Mr. Greene then asked, "Should we purchase and analyze multiple lots of solder alloy (vs. just one lot)?" Jim Blanche stated that that the lead-free consortium would need to verify the composition of the solder alloys that we procure prior to applying them on the test vehicle to ensure that we are testing the proper alloys. Mr. Hillman stated that we should only use vendors in which we have confidence in to supply the proper solder alloys.
g) It was agreed without comment that, during procurement of solder, we should request both a certification of compliance (CofC) and a chemical analysis from the solder vendors.
h) Mr. Greene gave a brief overview of the comments that technical representatives have offered on the JTP. All the comments have been editorial, i.e., grammar and office designation changes, etc. No changes have been received with regard to testing procedures and test vehicle set up.

3. **Topic:** Review latest testing cost estimate and cost share figures.

   Mr. Greene's latest budget excludes any funds requested from the Environmental Security, Technology Certification Program (ESTCP) in FY 04. To accommodate this, he has removed the implementation and life cycle line expense items shown in earlier versions of his budget to accommodate the reduced funds and focus strictly on core lab tests and support. The revised estimated cost for lab testing (2003-2004) is approximately $1.6M, down from $1.9M

4. **Topic:** Compare the Lead-Free Solder Joint Test Protocol (JTP) with industry standards IPC-785 and IPC-9701.

   This matter is the subject of project action item LFS.03.01.04. IPC-9701 is the newer of the two standards and therefore generally preferred. Dave Hillman, Rockwell Collins, has provided a comparison table. Note that in almost all cases, our JTP meets the requirements of both IPC-785 and IPC-9701. In some areas, such as test duration, the JTP actually exceed the requirements of IPC-9701 (a good thing). There are two instances, however, where our JTP purposely (at the agreement of the stakeholders) differs from at least one of the IPC standards:

   - Sample size -- While our JTP fully meets the statistical validity requirements of IPC-785, we technically do not meet the 32-sample size requirement of IPC-9701. Our sample size is 25.
   - Surface finish -- IPC-9701 recommends organic solderability preservatives (OSP) as the surface finish. However, for our test vehicle we are using silver. This was a conscious decision, made because silver is the industry norm, lots of OEMs are now using it, and it is very robust (no problems like tin has).

   On the subject of failure definition, the JTP states a 300-ohm "window" as the basis for detecting disruptions in electrical circuits. Dr. Ghaffarian corrected Mr. Greene's statement in the agenda that the 300-ohm window is in violation of IPC-9701, which requires a 1,000-ohm window. Rather, the 300-ohm window actually *exceeds* IPC-9701, and therefore is not an issue. Mr. Woodrow did state, however, that certain tests such as vibration and mechanical shock might require the use of 1000-ohm due to electromagnetic interference.

5. **Topic:** Review latest test vehicle design drawings.

   Mr. Hillman reviewed his latest drawings for the test vehicle. He stated that the test vehicle design and drafting is complete and attempts are being made to obtain final quotes from vendors. He is also trying to obtain the x-outs from the vendors. The x-outs can be used for dummy tests and cross cuttings. Mr. Hillman said that the Gerber files are available for anyone that wants to review them. Anyone who wants to review the Gerber file should send his or her ftp address to Mr. Greene who will forward the site to Mr. Hillman.

6. **Topic:** Proposed facilities for performing testing activities.

   a) Mr. Greene reviewed and explained the proposed testing facilities slides (slides 11 and 12 form the April 21 2003 PowerPointTeleconFile.ppt). Mr. Greene further explained that the chart was agreed upon at the small group lead-free solder meeting held at the APEX Conference in Anaheim, CA on March 30, 2003. Facilities providing in-kind contributions were considered as primary locations due to a limited project budget. Another major limiting factor is the availability to handle the test vehicles, which have a very large I/O count. If your facility wishes to be included on Excel spreadsheet please send an email to Mr. Warren Assink or Mr. Brian Greene.
   b) Mr. Assink explained that the lead-free solder project is still in need of funding, and any in-kind or monetary contributions would be appreciated.

c) Mr. Ed Drouet (Boeing) stated that Boeing Anaheim could perform the SIR testing as an in-kind contribution to the lead-free solder project. Mr. Drouet stated that he would be sending his capabilities for the SIR test to Mr. Greene so that the information can be forwarded on to the group for approval.

Because of teleconference time limitations, there was no group discussion of the agenda topic of X-ray capabilities. However, the following information was previously provided to ITB.

POC	X-Ray Capabilities
Dave Hillman	The x-ray equipment we have at Collins can be used to meet the requirements of JSTD-001
Joe Felty	Our CCA shop X-ray works to J-STD-001, Class 3 requirements
Lety Campuzano-Contreras	We use a NIS 1410HB, (Nicolet Imaging Systems) through transmission, X-Ray machine with NIS/AIPPII-Advanced Image Processor. We use it to evaluate ball alignment and solder. When testing failures occur X-ray evaluation is performed to determine if there are shorts, opens, missing solder, etc. Our procedures are equivalent to 9.2.6.15 of J-STD-001C.

Next Telecon: Mr. Greene proposed that the next teleconference be no later than mid-June. He will coordinate and announce the exact date and time.

SIGNED (Approved by W. Assink 04/25/03)
Warren Assink
Govt. Project Manager, WPAFB

Attachments: Action Items

ACTION ITEMS:

Action Items Closed 04/21/2003 Teleconference

LFS.03.01.04

Date Due: **February 7, 2003**
Responsibility: Mr. Dave Hillman (Rockwell Collins); Mr. Brian Greene (NASA AP2/ITB)
Required Action: Compare IPC-9701 to IPC-SM-785 and write a proper paragraph for JTP sections 2.3 & 2.5. Mr. Hillman will find differences and spell out properly in JTP. Once Complete Mr. Greene will send out the revised write up for the group to review.
Comments: **Closed – 04/21/03:** Dave Hillman's comparison table was distributed on March 12, 2003.

LFS.03.01.05

Date Due: **February 7, 2003**
Responsibility: Dr. Ghaffarian (Jet Propulsion Lab)
Required Action: Review the sample size being used for the JG-PP lead-free solder testing program and rewrite the paragraph in JTP Section 2.5 "Quality Assurance" that addresses sample size and statistical analysis.
Comments: **Closed – 04/21/03:** Text from Dr. Ghaffarian was inserted into the version of the March 05, 2003 JTP, which has not yet been distributed.

LFS.03.01.06

Date Due: **February 7, 2003**
Responsibility: Mr. Dave Hillman (Rockwell Collins)
Required Action: Rewrite the current paragraph in JTP Section 3.1.1 "Electrical Continuity Testing" to better define event detection and the failure criteria.
Comments: **Closed – 04/21/03:** Comments were received and inserted to the March 05, 2003 JTP, which has not yet been distributed. An event detector (Anatech or equivalent conforming to IPC-SM-785) will be used to monitor the electrical continuity of each channel on the test vehicle, and thereby detect solder joint failures that occur during testing (i.e. an "event"). The failure criteria measured by the event detector will be 10 events per channel with an interruption of electrical continuity ($\geq$300 Ω up to 1000 Ω) for periods greater than 0.2 µsec per IPC-SM-785 *(Guidelines for Accelerated Reliability Testing of Surface Mount Solder Attachments).*

LFS.03.01.08

Date Due: **February 7, 2003**
Responsibility: Mr. Brian Greene (NASA AP2/ITB)
Required Action: Develop text explaining the selection of solder alloys and the immersion silver board finish that will appear in the potential alternatives report (PAR). Mr. Greene stated that he would work with Mr. Hillman and CTC to develop the proper text for the PAR.
Comments: **Closed – 04/21/03:** The following text was provided to CTC and inserted into the PAR: "The type of surface finish on the printed board is often the initial mode of solder joint failure; therefore, selection of the surface finish was critical to the test design for the JTP. Suitable board finishes for use with SnPb and lead-free solders include immersion silver, organic solderability preservative (OSP), and immersion tin and electroless nickel/immersion gold (ENIG). Each surface finish has its advantages and limitations. For example, ENIG is susceptible to "black pad" which can cause premature failure of solder joints. Immersion tin and OSP become non-solderable after several exposures to reflow conditions, and OSP exhibits poor wetting with some solders. However, several major electronic manufacturing companies are currently using immersion silver in production and the general consensus is that immersion silver has the best balance of desirable properties (good wetting by solders, good solder joint reliability, good long-term solderability upon storage, and retention of solderability after multiple reflow cycles). Therefore, project stakeholders and participants have selected immersion silver as the surface finish used for testing in the project's JTP."

LFS.02.12.06
Date Due: **12/13/02**
Responsibility: OEM Representatives
Required Action: OEM's are to identify point of contact that will officially sign and accept the JTP
Comments: **Closed – 04/21/03:** JTP was distributed for endorsement in February, with April 30, 2003 as suspense date.

LFS.03.01.07
Date Due: **February 7, 2003**
Responsibility: Mr. Dave Hillman (Rockwell Collins)
Required Action: Put together a sample plan for everyone's review on how the capacitors will be tested and sampled
Comments: **Closed – 04/21/03:** A sample set of capacitors (one complete row of capacitors) shall be removed from the test board at the following total cycle intervals:
For the -55C to +125C recipe:
250,500,1000,1500,2000,2250,2500,2750,3000,3250
For the -20C to +80C recipe:
250,500,1000,2000,3000,3500,4000,4500,5000,5500
Each sample set of capacitors shall be bagged, labeled and stored for future possible metallurgical microsectioning analysis. A visual examination of the capacitor sample sets shall be conducted upon the completion of the overall JGPP test vehicle thermal cycle program. A recommendation shall be made to the JGPP team as to which total cycle interval capacitor sample set(s) shall undergo microsectioning analysis.

Open Action Items

LFS.02.12.07
Date Due: **12/13/02**
Responsibility: OEM Representatives
Required Action: OEM's are to identify headquarters and management points of contact for a meeting to held in January.
Comments: No meetings are presently planned.
04/21/03 – Warren Assink asked to keep the action item open

LFS.02.11.04
Date Due: **12/01/02**
Responsibility: OEM Business Representatives
Required Action: Report to B. Greene and W. Assink the nature and extent of the intended contributions, either direct cash or in-kind, to the lead-free solder testing effort over 2003-04
Comments: **In Progress:** In-kind contributions were discussed at a March 30, 2003 small-group meeting in Anaheim, CA. and a following larger group telecon on April 21, 2003. The following are in-kind contributions, totally almost $400K, offered specifically for the 2003-2004 testing activities.

Test Activity	Rockwell Collins	Boeing-Irving	Boeing-Seattle	Boeing-Anaheim	Raytheon
PWA Design	X				
PWA Assembly & Rework		X			
PWA Characterization		X			
Pretest PWA		X			
Combined Environments Testing (MIL-STD-810F Method 520.2 Procedure I)					?
Thermal Cycling: Manufacturing -20°C to +80°C (IPC-SM-785)			X		
Surface Insulation Resistance (IPC-TM-650, Method 2.6.3.3)				X	

LFS.02.10.03

Date Due:	**11/01/02**
Responsibility:	All technical representatives
Required Action:	Identify to Brian Greene and Warren Assink their organizational business point of contact, if other than themselves
Comments:	

LFS.02.08.13

Date Due:	**09/30/02**
Responsibility:	ITB, Inc. (Brian Greene)
Required Action:	Distribute expected contributions from stakeholders once cost estimate is better defined
Comments:	In progress: 04/21/03 – Brian Greene reviewed latest cost estimate at this telecon. Following is the latest cost summary. 03/30/03 – OEM funding and in-kind contributions were reviewed and discussed. Testing facilities have been tentatively agreed upon. 11/12/02 - B. Greene presented a summary of the estimated cost of testing and the current amount that that Government indicated they would fund. The shortfall would need to be made up by the OEMs and/or the scope of the testing reduced. A new action items was taken for OEMs to assess the nature and extent of their contributions.