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Joint Group on Pollution
Prevention

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***JG-PP Lead-Free Solder Project
Technical Teleconference Minutes
November 8, 2002***

Govt. Project Manager: Warren Assink, WPAFB

MEMORANDUM FOR RECORD

Subject: Meeting Summary and Minutes – November 8, 2002

Material(s) Identified: Lead

Process Identified: Electronics soldering

Methodology Phase: II - Technical, III - Business

Summary:

On November 8, 2002, technical representatives from the Boeing Company, Air Force Research Laboratory, Hill Air Force Base, HQ Air Force Materiel Command, Ensil International Corporation, NASA- Marshall Space Flight Center, Naval Air Systems Command, Naval Surface Warfare Center- Crane Div., NAVSEA, Raytheon, Redstone Army Arsenal, Rockwell-Collins, and U.S. Army Communications Command participated in a meeting with representatives from the Joint Group on Pollution Prevention Working Group. The objective of the meeting was to discuss specific JTP Sections including; JTP Section 2.1.2 Test Vehicle For Reworked PWBs, JTP Section 3.1.2 Coefficient Of Thermal Expansion (CTE) Testing, JTP Section 3.2.1 Vibration, JTP Section 3.2.2 Mechanical Shock, Extended Test Criteria; Salt Fog and Humidity Testing, and Test Vehicle Design. Outstanding issues and questions were resolved for all agenda subjects listed and two new action items were taken.

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 repair of lead-containing PWAs.
- 3/7/02 – By consensus, the solder alloys currently recommended for testing are:



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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

Next Teleconference: December 12, 2002

Next Meeting: TBD



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Minutes

1. Mr. Brian Greene, NASA Acquisition Pollution Prevention Office/ITB, opened the teleconference by reviewing the teleconference agenda. A roll call was taken. The focus of the teleconference was to discuss the no lead solder JTP and answer specific questions, Mr. Greene went through the JTP section by section.
2. **JTP Section 2.1.2 Test Vehicle For Reworked PWBs.**

Mr. Brian Greene (NASA AP2/ITB, Inc.) addressed the group with the following question from Mr. Mark Stibitz (F-15); For Repair Procedures, should only one solder iron be used to melt the solder and tweezers used to remove the lead vs. using two irons to heat and push the lead through the barrel?

 - Ms. Lety Campuzano-Contreras (Boeing) stated the following; “the best method to use for rework procedures is to use one iron to melt the solder and tweezers to remove the lead”. Mr. Stibitz stated that he agreed with Ms. Campuzano-Contreras’ and the rework procedure would be acceptable for F-15 specifications.
3. **JTP Section 3.1.2 Coefficient Of Thermal Expansion (CTE) Testing.**

Mr. Greene posed the following question to the group; should we add to this section that for BGAs, multiple CTE measurements should be taken at various locations (under the die, at the outer edge, etc.)?

 - Mr. Tom Woodrow (Boeing) stated that the above comments come from the commercial section of Boeing and feels that the comments make sense, but he does not need the information himself.
 - Mr. Dave Hillman (Rockwell Collins) stated that CTE analysis is done in association with the assembly characterization. Mr. Hillman pointed out that it is very difficult to perform CTE on our test vehicle because of the various part types that are on the board. The current test vehicle would produce a composite CTE measurement.
 - Mr. Hillman took an action to develop a paragraph for section 3.1.1 taking into consideration the IPC specifications that spell out the composite versus uniform CTE measurement. Performing the CTE will increase both cost and time.
4. **JTP Section 3.2.1 Vibration.**

Mr. Greene brought up for discussion the test procedures and specifications for Vibration (*JTP Section 3.2.1*) that were added to the JTP.

 - Mr. Woodrow suggested that since the group does not have a good idea of what will happen to the test vehicles during vibration testing, the vibration test should be run using a signal test vehicle prior to performing the vibration test on the bulk of the test vehicles. This will allow the group to see what is going to happen to the test vehicles. The remaining test vehicles will be run in batches.



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5. **JTP Section 3.2.2 Mechanical Shock.**

Mr. Greene asked the group the following question; for Mechanical Shock Test (*JTP Section 3.2.2*), we need to consider an alternative testing procedure for practical reasons, following are four options per Mr. Tom Woodrow:

1. First choice would be to run all shock cycles along one axis (perpendicular to the plane of the board).
 2. Second choice would be to run all shock cycles along one axis (parallel to the plane of the board).
 3. Third choice would be to run 100 shock cycles along each axis with the remainder done perpendicular to the plane of the board. Each 100 cycles would be run consecutively (that is, the fixture would NOT be flipped after each shock).
 4. Fourth choice would be to run 100 shock cycles along each axis with the remainder done parallel to the plane of the board. Each 100 cycles would be run consecutively (that is, the fixture would NOT be flipped after each shock).
- Mr. Woodrow stated that the group should obtain failure information from the test vehicle during the mechanical shock so that comparisons can be made between the tin/lead and lead-free solders. Mr. Woodrow suggested that a mechanical shock expert should write the test procedure for the JTP. Mr. Woodrow will get information from Boeing representatives on the mechanical shock that is generated from various aircraft maneuvers.
 - Mr. Hillman stated that when mechanical shock is performed perpendicular to board axis, components fail due to size and mass of the components, not due to the failures of the solder joints. The mechanical shock test will provide more useful information on solder joints if the test is performed parallel to axis of the test vehicle.
 - Mr. Dave Locker (U.S. Army Research, Development and Engineering Center) will write the testing procedure for the JTP taking into account all stakeholders concerns. The test will be tailored so that design and life cycle qualification standards of existing platforms will be met. Following the initial testing the test will continue testing until parts fail allowing for the comparison of tin/lead and lead-free solder alloys.

6. **Extended Test Criteria; Salt Fog and Humidity Testing.**

Mr. Greene stated that there was some confusion as to what the pass/fail criteria should be for the extended testing procedures. Mr. Greene then asked the group for input as to what the pass/fail criteria should be.

- Mr. Woodrow stated that salt fog and humidity testing standards do not include pass/fail criteria. Surface insulation resistance testing standards contain pass-fail



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criteria based on resistance. Acceptance criteria for all testing procedures should read as follows, better than or equal to tin/lead. Mr. Stibitz stated that salt fog and humidity testing pass/fail criteria should be based on visual inspection for the formation of corrosion, including blistering, pitting, flaking, and other corrosion products. Mr. Stibitz said that he would look into what defines pass/fail for leaded solder alloys in within the F-15 platforms.

- Mr. Bradford posed the question as to whether we need five test vehicles for salt fog and humidity testing, suggesting that three test vehicles should be sufficient. Mr. Hillman brought to the group's attention that IPC specifications call for a minimum of three or five test vehicles. The group came to agreement that salt fog and humidity testing will be conducted using three test vehicles per solder alloy.
- Mr. Warren Assink suggested the possibility of measuring surface insulation resistance pre and post salt fog and humidity testing and using the difference in resistance to indicate a possible problem with the solder joints. Mr. Hillman stated that resistance measurements both pre and post salt fog and humidity testing will serve as an addition data point and would serve as a measured response of solder joint integrity.
- Mr. Hillman expressed his opinion to the group that the salt fog and humidity tests results will not provide valuable data but the tests are needed to obtain buy in from other stakeholders. Mr. Woodrow stated that the salt fog and humidity tests are easy and inexpensive to complete and the data will be essential for the stakeholders to except the no-lead solder testing program. Mr. Woodrow agrees with Mr. Hillman in that the salt fog and humidity test results will not provide valuable data. Once the data is collected, the testing consortium will explain the testing results by making comparisons between the tin/lead eutectic baseline solder alloys and the alternative no lead solder alloys.

7. **Test Vehicle Design**

Mr. Hillman announced to the group that the drawing is done for the test vehicle.

8. The two action items assigned at today's teleconference were:

- Mr. Hillman took an action to develop a paragraph for section 3.1.1 taking into consideration the IPC specifications that spell out the composite versus uniform CTE measurement. Performing the CTE will increase both cost and time (**AI LFS.02.11.01**)
- Mr. Locker will write the testing procedure for the JTP taking into account all stakeholders concerns (**AI LFS.02.11.02**).



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SIGNED (Approved by W. Assink 11/22/02)

Warren Assink
Govt. Project Manager, WPAFB

Attachments:

1. Action Items



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New Action Items

LFS.02.11.01

Date Due: 11/13/02

Responsibility: Mr. Dave Hillman (Rockwell Collins)

Required Action: Develop a paragraph for section 3.1.1 taking into consideration the IPC specifications that spell out the composite versus uniform CTE measurement. Performing the CTE will increase both cost and time.

Comments:

LFS.02.11.02

Date Due: 11/13/02

Responsibility: Mr. Dave Locker (U.S. Army Research, Development and Engineering Center)

Required Action: Will write the testing procedure, JTP Section 3.2.2 Mechanical Shock, for the JTP taking into account all stakeholders concerns.

Comments:

Open Action Items

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.02.10.04

Date Due: 11/01/02

Responsibility: OEMs

Required Action: Identify the frequency of their use of hybrids

Comments: Raytheon uses 13% hybrids

LFS.02.08.09

Date Due: 10/26/02

Responsibility: OEMs

Required Action: OEMs submit concept paper

Comments:



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LFS.02.08.10

Date Due: 09/16/02
Responsibility: ITB, Inc. (Brian Greene)
Required Action: Distribute guideline and examples of DCMA concept paper
Comments: In progress by JG-PP

LFS.02.08.12

Date Due: 09/16/02
Responsibility: OEMs
Required Action: OEMs identify their past and forecasted in-kind contributions, including labor and other expenses for meetings, JTP development, etc.
Comments: Past contributions: Tom Woodrow of Boeing has provided information on past in-kind contributions
Future contributions: At least the following OEMs have indicated that they will provide testing as an in-kind contribution, Boeing, Raytheon and Rockwell Collins.
As of 10/11/2002 the following has provided past LFS contributions; hours per month, travel costs, and materials cost; LM Aero Fort Worth, Boeing Seattle, Rockwell Collins, Naval Air Warfare Center, Weapons Division, Boeing Texas, Raytheon-Dallas, and CTC

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: To be presented at the 11/12/02 lead-free solder meeting in Dallas.

LFS.02.07.02

Date Due: 08/09/02
Responsibility: Potential testing facilities
Required Action: Complete Lab Survey form
Comments: In progress, as of 11/08/2002 survey forms have been received from; ACI, Raytheon, Sandia, Boeing Rockwell Collins and NAVAIR



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Action Items Closed at this (11/8/02) Teleconference

LFS.02.10.01

Date Due: 10/10/02

Responsibility: HQ AFMC (Warren Assink)

Required Action: Collect AFRLs recommendations on lead-free solder alloys for testing and send to Brian Greene for distribution

Comments: 11/08/02 - Closed. AFRL indicated to Warren Assink that they had no further lead-free solder alloys to recommend for the testing.

LFS.02.10.02

Date Due: 10/10/02

Responsibility: HQ AFMC (Warren Assink)

Required Action: Collect AFRLs recommendations on additional Air Force requirements

Comments: 11/08/02 - Closed. AFRL indicated to Warren Assink that they had no testing requirements to add to the JTP.

LFS.02.09.02

Date Due: 10/01/02

Responsibility: Rockwell Collins (Dave Hillman) and Raytheon (Jeff Bradford)

Required Action: Determine what effects reducing part count will have on statistical analysis and failure criteria, provide findings to Brian Greene

Comments: To be discussed at Nov 12 meeting.

LFS.02.08.07

Date Due: 09/16/02

Responsibility: Army (Dave Locker)

Required Action: Provide reasonable number for mechanical shock. Mr. Greene will also try to identify original diagrams

Comments: 11/08/02 - Replaced by new action item LFS.02.11.02 (Dave Locker to write the testing procedure, JTP Section 3.2.2 Mechanical Shock, for the JTP taking into account all stakeholders concerns.)