



JG-PP Email

Joint Group on Pollution
Prevention

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***JG-PP Lead-Free Solder Project
Teleconference Meeting Minutes
December 12, 2002***

Govt. Project Manager: Warren Assink, WPAFB

Comments:

Attached please find the minutes from the December 12, 2002, Lead-Free Solder teleconference. If you have questions about the minutes, please contact Warren Assink or Brian Greene. Please further distribute as necessary.



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MEMORANDUM FOR RECORD

Subject: Teleconference Summary and Minutes – December 12, 2002

Material(s) Identified: Lead

Process Identified: Electronics soldering

Methodology Phase: II - Technical, III - Business

Summary:

On December 12, 2002, technical representatives from the Boeing Company, Concurrent Technologies Corporation, Florida Cirtech, Harris Corporation, Headquarters Air Force Materiel Command, Lockheed Martin, ITB, Inc., NASA Marshall Space Flight Center, Northrop Grumman, Raytheon, Robins Air Force Base, Rockwell Collins, U.S. Army Missile Command (AMCOM), and U.S. Air Force F-15 Engineering participated in a meeting with representatives from the Joint Group on Pollution Prevention Working Group and their contractors. The objective of the teleconference was to further develop the Joint Test Protocol for Manufacturing and Repair, review the latest test board design, and discuss business issues. After addition of the revised mechanical shock test procedure, the JTP will be distributed to the technical representatives, probably for the final time. Then the JTP will be ready for stakeholder endorsement.

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.

Next Meeting: Teleconference, January 23, 2002, 11:00 AM



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Minutes

1. Mr. Brian Greene, NASA Acquisition Pollution Prevention Office/ITB, opened the teleconference with a roll call. Technical representatives from the Joint Group on Pollution Prevention, Air Force, Army, NASA, defense contractors, and electronics materials suppliers were present. The primary purpose of the teleconference was to discuss remaining issues on the Joint Test Protocol and the test board design, and discuss project funding status.

2. **Review of Last Meeting Minutes**

Mr. Greene started by presenting a summary of the major discussion points and recommendations made at the November 12 meeting in Dallas, TX.

 - a. Recommendation to modify the test board design to incorporate (a) tracing of certain components in lieu of vias, (b) 10 additional resistors, and (c) the possible need for more clearance between components.
 - b. Request for OEMs to report to Mr. Greene and Mr. Warren Assink, HQ AFMC, the nature and extent of the intended contributions, either direct cash or in-kind, to the testing effort over 2003-04 (LFS.02.11.04).
 - c. Request for technical representatives to review and comment on the facilities proposed for conducting the JTP testing.

3. **Mechanical Shock Testing Procedure**

The teleconference participants reviewed the revised Mechanical Shock Testing Procedure that Mr. Kurt Kessel had rewritten based on input from Mr. Mark Stibitz, F-15 Program (Raytheon) and Mr. Tom Woodrow, Boeing. Mr. Greene asked the group if the revised text met their needs and asked for comment from the group.

 - a. Mr. Stibitz stated that the revised text would accommodate his requirements. Mr. Stibitz stated that extended testing would provide additional data on the alternative solder alloys that could be used to further validate them as possible replacements for current tin-lead eutectic solder.
 - b. Mr. Woodrow took a few minutes to verbally review and explain what he envisions as the new mechanical shock testing procedure. Mr. Woodrow stated that the test should be performed using two separate sets of test vehicles. Test vehicle set number one would be tested in accordance with MIL-STD-810F, Method 516.5, (Shock.). The second set of test vehicles would be subjected to mechanical shock testing in each direction along one axis parallel to the plane of the board. Apply shocks until all parts fail or until the maximum number of shocks is reached (500). Mr. Woodrow also stated that an extra "pathfinder" board would be subjected to both test conditions in order to identify potential problems with the test setup before testing Test Set One and Test Set Two.
 - c. Mr. Dave Locker, AMCOM, stated that he agrees with Mr. Woodrow with regard to designing the mechanical shock testing procedure in order to obtain as many failures as possible. Mr. Dave Hillman (Rockwell Collins) stated that he agrees



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with Mr. Woodrow on the mechanical shock rewrite and expressed his satisfaction with the test vehicle pretest.

- d. Mr. Woodrow will rewrite the mechanical shock testing procedure based on the recommendations from this teleconference and provide it to ITB, Inc. for inclusion in the JTP (**LFS.02.12.01**). Mr. Warren Assink then asked Mr. Woodrow if he would be able to estimate a revised cost for the updated mechanical shock testing procedures. Mr. Woodrow stated that he would confer with the mechanical shock testing experts at Boeing and provide cost for the following procedures:
 - Test vehicle set one, testing in accordance with MIL-STD-810F, Method 516.5, (Shock.)
 - Test vehicle set two, testing until component failure
 - “Pathfinder” test in order to make sure the testing procedure is sound (**LFS.02.12.02**).

4. **Test Board Design**

Mr. Greene reminded the group that an updated version of the test vehicle design layout had been distributed the morning of December 12, 2002. Mr. Greene then invited Mr. Hillman to comment on the test vehicle design layout.

- a. Mr. Hillman stated that, as far as he was concerned, the only remaining changes to be made to the test vehicle design are to include some notations on the engineering drawings concerning board thickness and such. Mr. Hillman then explained that plated through holes and vias were no longer linked internal to the board and all components were traced on the surface of the board which will eliminate premature failure caused by vias and plated-through holes. Mr. Hillman stated that all failures on the test vehicle should be caused by the solder joints on the components and not via and plated-through-hole failure.
- b. Mr. Hillman then explained to the group that there should be enough room on the test vehicle to accommodate standard repair work operations.
- c. Mr. Hillman summarized other changes made to the test vehicle including the addition of resistor types bringing the total of each resistor type from 5 to 10. Also, resistors have been located in an area in which saw cuts can be used to remove the resistors for analysis.
- d. Mr. Hillman told the group that he will send the design for the completed test vehicles to the printed wiring board fabrication company that Rockwell Collins uses in order to obtain a cost estimate for the board build up process (**LFS.02.12.03**). The cost estimates should be ready near the end of December. Other cost estimates can be collected from other printed wiring board manufacturers as the group sees fit.

5. **Number of Test Vehicles Required**

Mr. Greene reviewed for the group table (shown below) that depicts all testing required and the number of test vehicles and I/O required to complete the test procedures.



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JTP Test	Number of Test Vehicles Needed		Total number of Anatech monitoring channels needed	COMMENTS
	Manufacturing	Rework		
Assemble PWBs	90	90	N/A	Need to re-compute. We need some extra boards to run assembly characterization.
Vibration (MIL-STD-810F, Method 514.5, Procedure I)	15	15	1920	Cannot run all 30 boards in one run
Mechanical Shock (MIL-STD-810F, Method 516.5, Procedure I)	3	3	384	
Thermal Shock (MIL-STD-810F, Method 503.3, Procedure I)	15	15	1920	
Thermal Cycling: -55°C to +125°C (IPC-SM-785)	15	15	1920	
Thermal Cycling: -20°C to +80°C (IPC-SM-785)	15	N/A	960	
Combined Environments Testing (MIL-STD-810F Method 520.2 Procedure I)	15	15	640	Cannot run all 30 boards in one run. We will probably run 10 at a time.
Salt Fog (MIL-STD-810F, Method 509.4)	9	9	N/A	Anatech is N/A
Humidity (MIL-STD-810F, Method 507.4)	9	9	N/A	Anatech is N/A
Surface Insulation Resistance (IPC-TM-650, Method 2.6.3.3)	35 IPC-B-24 boards total		N/A	
Electrochemical Migration Resistance (IPC-TM-650, Method 2.6.14.1)	35 IPC-B-25A boards total		N/A	
Rework Procedures	N/A	90	N/A	

- a. Mr. Woodrow stated that the vibration test would need to be run in two separate 15-board sets. This will double the time needed to complete testing, each set of boards will take approximately a week, it is approximated that the total testing will take about one month to complete. Mr. Woodrow also stated that a total number of 13 test vehicles would be required to complete the mechanical shock test (6 manufactured PWAs + 6 reworked PWAs + 1 pathfinder). Mr. Bradford stated that the one extra board “pathfinder” could be a tin-lead set up board.
- b. Mr. Bradford stated that the combined environments test would be run in three 10-test vehicle sets.
- c. Mr. Hillman stated that 10 extra test vehicles should be built to allow for characteristic of assembly and other pre and post testing procedures that are required. A line should be inserted into the above table to include these 10 PWAs.
- d. Mr. Greene will update and redistribute the table of PWA numbers with the teleconference minutes.

6. Solder Alloys

Mr. Woodrow expressed some concern over the availability of the solder alloy, tin-silver-copper-bismuth in wire form. Mr. Woodrow stated that the group was able to obtain the solder from NCMS in paste form. The solder paste was let over from a NCMS solder alloy study previously completed. The concern is that the group may not be able to procure the solder alloy, tin-silver-copper-bismuth in wire form, which is required for rework procedures.

- a. Mr. Woodrow volunteered to contact Senju solder to see if they can supply the desired tin-silver-copper-bismuth solder alloy in wire form (**LFS.02.12.04**).



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- b. Mr. Bob Gilbert (Florida Cirtech) stated that he would be willing to donate solder alloy samples in any combination that they have available. Mr. Woodrow will contact Mr. Gilbert off-line to discuss the availability of solder alloys in various forms.
- c. Mr. Tom Buschor (Harris Corporation) asked the how the group had decided on using immersion silver as a board finish. Mr. Woodrow answered that the reason for immersion silver on the lead-free test vehicles is due to the fact that the OEMS like the immersion silver better than other board finish options. Currently major electronic manufacturing companies are using immersion silver and the consensus is that the silver immersion is a more promising lead-free board finish than other alternatives currently available.

7. **JTP Distribution**

Mr. Greene asked the group if they had any comments on the JTP. Mr. Assink expressed the concern that Northrop Grumman and Harris Corporation have not had enough time review the document and provide comment. Mr. Greene stated that the latest revision of the JTP would be distributed on December 18, 2002 (**LFS.02.12.05**). All group members have until January 16 to provide final technical comments (**LFS.02.12.06**).

8. **Funding**

Mr. Greene stated that there is still a need to identify final OEM contributions to the lead-free solder testing program. Mr. Assink stated that there is a need to get a good feel of what the contributions will be from each OEM. Mr. Assink expressed his interest in scheduling on site meetings with each of the OEM's business point of contact in order to discuss project funding and contributions (**LFS.02.12.07**).

SIGNED (Approved by W. Assink 12/17/02)

Warren Assink
Govt. Project Manager, WPAFB

Attachments:

- 1. Action Item

**Summary of Lead-Free Solder Action Items
As of 12/13/02**

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New Action Items

LFS.02.12.01

Date Due: 12/13/02

Responsibility: Tom Woodrow (Boeing)

Required Action: Rewrite the mechanical shock testing procedure based on the recommendations from the 12/12/02 telecon and provide to B.Greene & K.Kessel for inclusion in the JTP.

Comments:

LFS.02.12.02

Date Due: 12/31/02

Responsibility: Tom Woodrow (Boeing)

Required Action: Based on the rewrite of the mechanical shock procedure, prepare a revised cost estimate for executing the shock testing for the two different test sets and for one "pathfinder" test vehicle.

Comments:

LFS.02.12.03

Date Due: 12/31/02

Responsibility: Dave Hillman (Rockwell Collins)

Required Action: Re-calculate the cost of the printed wiring boards (w/o components)

Comments:

LFS.02.12.04

Date Due: 01/16/03

Responsibility: Tom Woodrow (Boeing)

Required Action:

Comments: Contact Senju solder to see if they can supply the desired tin-silver-copper-bismuth solder alloy in wire form.

LFS.02.12.05

Date Due: 12/18/02

Responsibility: Kurt Kessel (ITB, Inc.)

Required Action: Submit latest version of JTP to the lead-free solder technical representatives no later than December 18, 2002.

Comments:

LFS.02.12.06

Date Due: 01/16/03

Responsibility: All technical representatives

Required Action: By January 16, 2003, submit final comments on the Joint Test Protocol, to be distributed December 18.

Comments:

**Summary of Lead-Free Solder Action Items
As of 12/13/02**

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LFS.02.12.07

Date Due: 01/09/02
Responsibility: OEM Representatives
Required Action: OEM's are to identify point of contact that will officially endorse the JTP
Comments:

LFS.02.12.07

Date Due: 12/31/02
Responsibility: OEM Representatives
Required Action: OEM's are to identify headquarters management points of contact for a meeting to held in January.
Comments:

Open Action Items

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

LFS.02.11.05

Date Due: 12/01/02
Responsibility: All Technical Representatives
Required Action: Review the 'Proposed Testing Facilities' table in B. Greene's 11/12/02 slide presentation and respond to B. Greene and W. Assink whether you agree or disagree with any of the proposed testing assignments shown in the table, the reasons for disagreement, and whether you would propose another facility for conducting a particular test.
Comments: As of 12/12/02, no comments received

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

**Summary of Lead-Free Solder Action Items
As of 12/13/02**

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LFS.02.08.09

Date Due: 10/26/02
Responsibility: OEMs
Required Action: OEMs submit concept paper
Comments:

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: In progress.
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.

**Summary of Lead-Free Solder Action Items
As of 12/13/02**

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Action Items Closed at this (12/12/02) Teleconference

LFS.02.11.02

Date Due: 11/13/02

Responsibility: ARDEC (Dave Locker)

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

Comments: Completed – Completed. New text distributed by email.

LFS.02.11.03

Date Due: 12/01/02

Responsibility: Rockwell Collins (Dave Hillman)

Required Action: Modify the test board design to incorporate (a) tracing of certain components in lieu of vias, (b) 10 additional resistors, and (c) the possible need for more clearance between components.

Comments: 12/12/02 – Completed, as reported during 12/12 telecon. D.Hillman stated that

- Plated through holes and vias were no longer linked internal to the board. All components will be traced on the surface of the board, which will eliminate premature failure caused by vias and plated-through holes.
- There should be enough room on the test vehicle to accommodate standard repair work operations.
- Resistor were added, bringing the total of each resistor type from 5 to 10. Also, resistors have been located in an area in which saw cuts can be used to remove the resistors for analysis.

LFS.02.07.02

Date Due: 08/09/02

Responsibility: Potential testing facilities

Required Action: Complete Lab Survey form

Comments: 12/12/02 – Closed, since no further survey forms have been received in months. Completed survey forms were received from; ACI, Raytheon, Sandia, Boeing Rockwell Collins and NAVAIR. A follow-up telecon resulted in the generation of a chart showing which facilities are most interested and capable of performing the various tests. This table was presented at the 11/12/02 meeting in Dallas. A subsequent action item was taken at the 11/12 telecon (AI LFS.02.11.05) for all Technical Representatives to review the 'Proposed Testing Facilities' table and respond to B.Greene and W.Assink whether they agree or disagree with any of the proposed testing assignments shown in the table, the reasons for disagreement, and whether they would propose another facility for conducting a particular test.

Summary of Lead-Free Solder Action Items
As of 12/13/02

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LFS.02.09.02

Date Due: **08/09/02**

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: 12/12/02 – Completed.