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Lead-Free Solder Project Teleconference Minutes 3 June, 2004

Comments:

Attached please find the minutes for the June 3, 2004 Lead-Free Solder teleconference. Please further distribute as necessary.

Attendees:

ATTENDING	AFFILIATION	EMAIL
Bill Hall	Northrop Grumman	
Brian Greene	ITB, Inc.	greeneb@itb-inc.com
Bob Vanderwiel	Lockheed-Martin	robert.w.vanderwiel@lmco.com
Carl Loden	ITB, Inc.	lodenc@itb-inc.com
Chester Berry	NASA-MSFC	chester.berry@msfc.nasa.gov
Clive Simmonds	BAE Systems	clive.simmonds@baesystems.com
Dave Hillman	Rockwell Collins	ddhillma@rockwellcollins.com
Dave Tilly	ITT	
Debora Personius	Air Force	debora.personius@robins.af.mil
Duane Napp	NCMS	duanen@ncms.org
Ed Enriquez	ITT	
Gary Latter	Crane-NSWC	
Jay Brusse	NASA-GSFC	jbrusse@pop300.gsfc.nasa.gov
Jeff O'Donnell	ITT	
Jeff Kennedy	MSL	Jeff.Kennedy@MSL.com
Jim Blanche	NASA-MSFC	Jim.F.Blanche@msfc.nasa.gov
Joe Zaccari	Corfin	jzaccari@corfin.com
John Ferman	Harris Corp.	
John Kerr	Boeing	john.a.kerr@boeing.com



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ATTENDING	AFFILIATION	EMAIL
Ken Devitt	ITT	Kenneth.devitt@itt.com
Kurt Kessel	ITB, Inc.	Kurt.Kessel-1@ksc.nasa.gov
Lety Campuzano-Contreras	Boeing	ana.l.campuzano-contreras@boeing.com
Mark Stibitz	Raytheon	Mark.Stibitz@robins.af.mil
Matt Rothgeb	ITB, Inc.	Matthew.Rothgeb-1@ksc.nasa.gov
Mike Cottrell	Texas Instruments	cotl@ti.com
Mike Green		
Mike Robinson	Honeywell	mike.robinson6@honeywell.com
Paul Vianco	Sandia Laboratory	ptvianc@sandia.gov
Peggi Blakley	Crane-NSWC	blakley_p@crane.navy.mil
Rachel Khoshbin	Boeing	simin.r.khoshbin@boeing.com
Rich Hricko	USAF	Richard.Hricko@wpafb.af.mil
Ronald Janott	Boeing	ronald.j.janott@boeing.com
Roy Booth	Lockheed-Martin	
Scott Nelson	Harris Corp.	
Stephan Meschter	BAE Systems	
Tom Woodrow	Boeing	thomas.a.woodrow@Boeing.com
Mike Grant	Lokheed-Martin Sunnyvale, CA	



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MEMORANDUM FOR RECORD

Subject: – Teleconference, Summary and Minutes – June 3, 2004

Next Large Group Teleconference: Tentative, August - 2004, 1100 EST

Next Meeting: September 21, 2004 - Florida

Minutes:

1. **Opening:** Mr. Brian Greene opened the meeting by thanking consortium members who have contributed their time to the lead-free solder project. Thanks went out to:
 - Ms. Lety Campuzano-Contreras and the Boeing-Irving staff for their tremendous efforts in assembling the test boards
 - Mr. Tom Woodrow for his oversight and input on all activities related to the lead-free solder project
 - Mr. Dave Hillman for managing the procurement, including initial characterization, of components and materials required for assembling the test boards
 - British Aerospace Systems (BAE)-U.K. for their in-kind contribution to help fund the Combined Environments Test
 - Mr. Joe Felty and Mr. Jeff Bradford for their efforts in obtaining internal Raytheon funding for the Combined Environments Test. **NOTE:** As a point of clarification, with support from BAE, Raytheon has agreed to fund the remaining cost of the CET only. This does not include data and failure analysis or writing of the report. We are still looking for funding to accomplish these tasks.
 - Mr. Lee Whiteman for his continued efforts to resolve issues pertaining to the mechanical shock test.
 - Mr. Greene also introduced Mr. Matt Rothgeb who was brought on board to help manage the numerous inquiries concerning LFS. He will focus on the international aspect of LFS.
2. **Purpose:** To review decisions and accomplishments since the last lead-free solder project meeting held March 18, 2004 hosted by the Boeing Commercial Electronics Facility, Irving Texas.
3. **Recent Decisions (March 18, 2004 to June 01, 2004)**

Many issues pertaining to the Lead-Free Solder Project were brought to resolution during the March 18, 2004 project meeting hosted by the Boeing Commercial Electronics Facility, Irving Texas. Other issues raised at the March 18 project meeting required continued discussion before the group could come to resolution. Component and material procurement continued to be a challenging process.



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Because of the relatively large number of highly technical topics, the Government Project Manager permitted the institution of regular “small-group” teleconferences typically involving the same 6 to 10 team members (1 or 2 times per month). Team members provided recommendations to the group-at-large, approximately every 3 months, for final decision.

Mr. Kurt Kessel briefed the following outline summarizing issues, discussions and resolutions for several topics for the Lead-Free Solder Project.

a. Topic: Mechanical Shock

In the month of April the Mechanical Shock Profile and testing procedure was finalized and inserted into an updated version of the JTP, dated February 14, 2003 (Revised April 2004).

Issue:

At the March 18 Lead-Free Solder Project Meeting, Dr. Ghaffarian presented a mechanical shock test that would be conducted in an increasing, stepwise fashion, similar to the vibration test. The test procedure was a modification based upon Mil-Standard 810F, Method 516.5, Shock, Figure 516.5-8. The group agreed to the concept of the Mechanical Shock Test Procedure that Dr. Ghaffarian presented.

Following the March 18 meeting, Dr. Ghaffarian worked to finalize the Mechanical Shock Testing procedure based upon equipment specifications and input from the “small-group”.

Resolution:

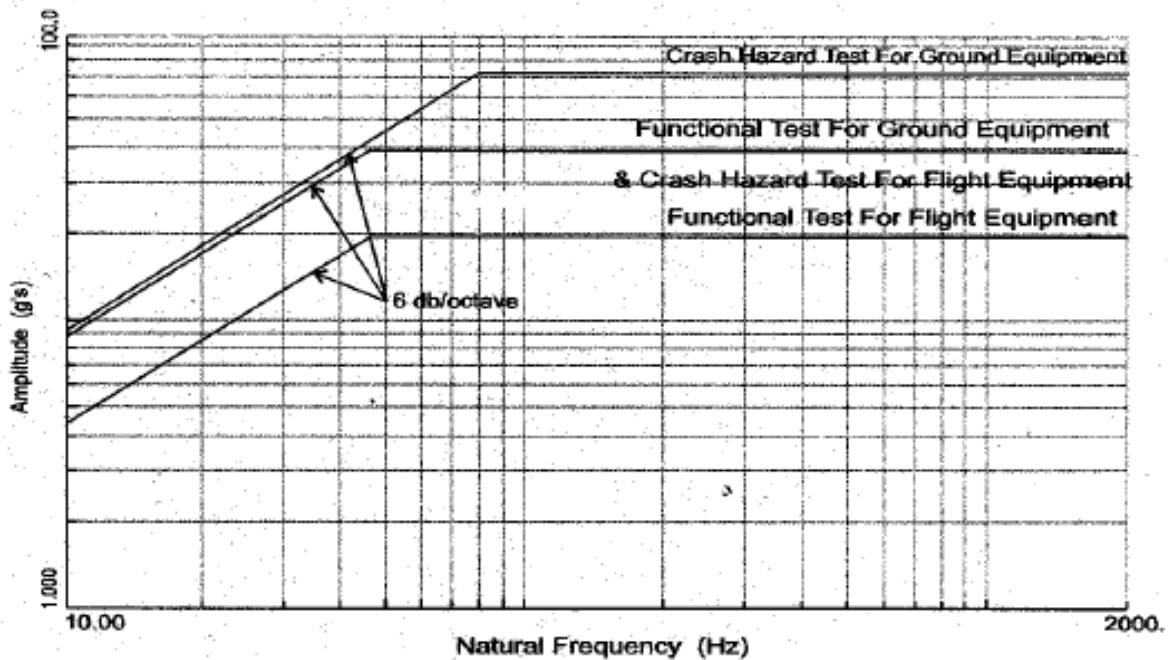
Test Set One will be used for those that want to see the boards pass the MIL-STD-810F, Method 516.5. This test includes Applying three (3) shock transients in each direction along each of the three orthogonal axes. This test will be conducted for three test shock response spectra (Functional Test for Flight Equipment, Functional Test for Ground Equipment, and Crash Hazard Test for Ground Equipment) as specified in the specification. Following completion of the three shock transients in each direction along each of the three orthogonal axes for the Crash Hazard Test for Ground Equipment, repeat the test using 100 shock transients in each direction along each of the 3 orthogonal axes for the Crash Hazard Test for Ground Equipment.



Mechanical Shock Test Methodology – Test Set #1

Parameters	<ul style="list-style-type: none"> Apply three shock transients (Figure 1) in each direction along each of the 3 orthogonal axes for three test shock response spectra 								
	Test Shock Response Spectra	Initial G	Slope	Peak G	Ts (ms)	Cross-Over Freq	Z-Axis	X-Axis	Y-Axis
	Functional Test for Flight Equipment	4.5	6	20	15-23	45	3	3	3
	Functional Test for Ground Equipment	8.5	6	40	15-23	45	3	3	3
	Crash Hazard Test for Ground Equipment	9	6	75	8-13	80	3	3	3
	Crash Hazard Test for Ground Equipment	9	6	75	8-13	80	100	100	100
Number and Type of Specimens	<ul style="list-style-type: none"> 2 PWAs per solder alloy for Test Set #1 One “pathfinder” board 								
Acceptance Criteria	<ul style="list-style-type: none"> Electrical continuity better than or equal to tin/lead controls 								

Mechanical Shock Response Spectrum – Test Set #1





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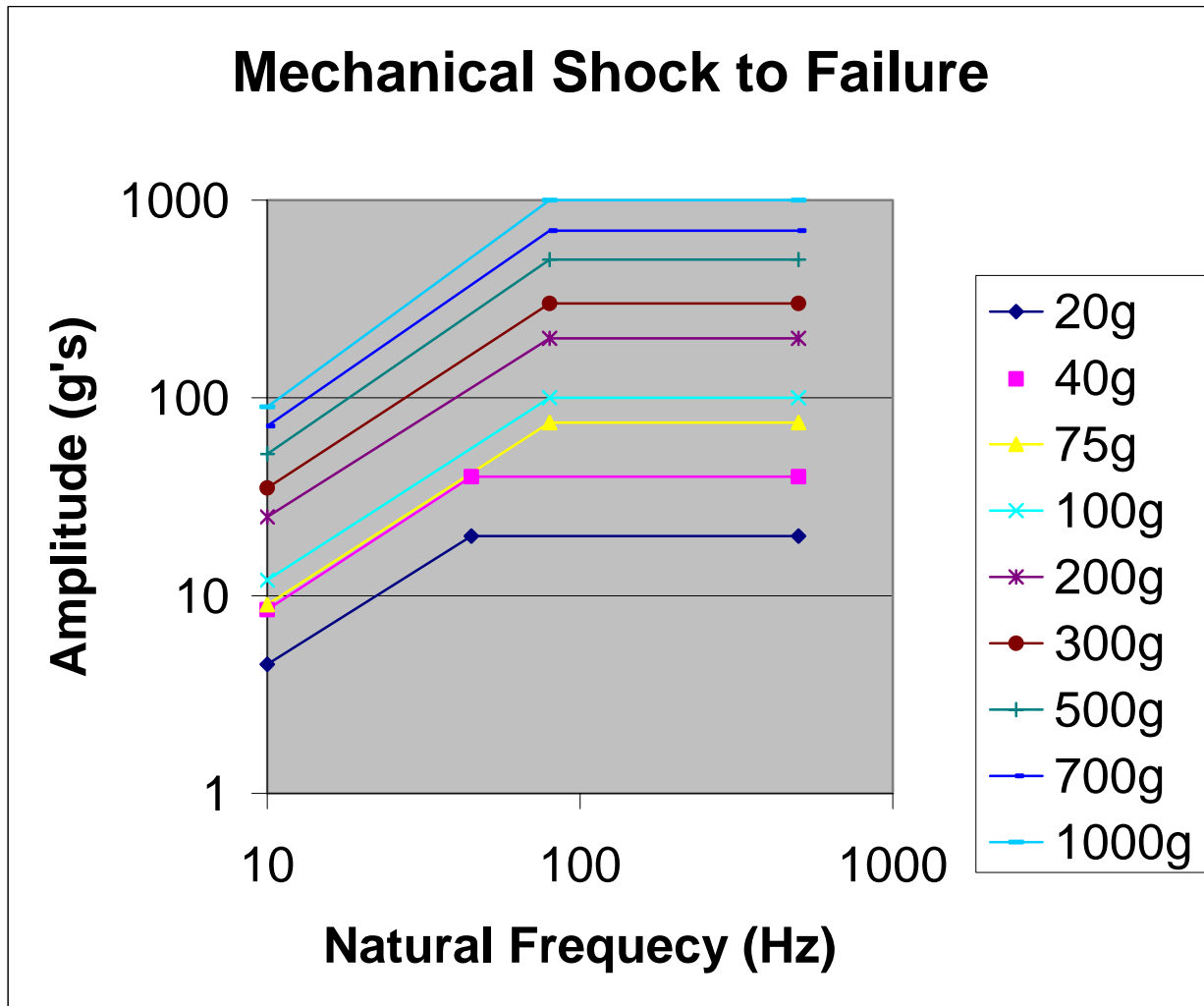
Test Set Two partially follows MIL-STD-810F, Method 516.5, but calls for higher shock amplitudes (g's). Apply the shock transients 100 times only in the Z-axis normal to the plane of the board at the MIL-STD-810F, Method 516.5 Functional Test for Flight Equipment, Functional Test for Ground Equipment, and Crash Hazard Test for Ground Equipment levels. Increase step-wise the g level and apply shock only in the Z-direction specified in Table 2. Both shock level steps and crossover frequencies may be required to be modified based on the initial "pathfinder" test sample. Continue test until failure of a majority (greater than 63 percent) of assemblies is observed.

Mechanical Shock Test Methodology – Test Set #2

Parameters	<ul style="list-style-type: none"> Apply the shock transients (Figure 2) in one axis parallel to the plane of the board, in a step-wise function, until a majority ($\geq 63\%$) of all parts fail 						
	Test Shock Response Spectra	Initial G	Slope	Peak G	Ts (ms)	Cross-Over Freq	Z-Axis
	Functional Test for Flight Equipment	4.5	6	20	15-23	45	100
	Functional Test for Ground Equipment	8.5	6	40	15-23	45	100
	Crash Hazard Test for Ground Equipment	9	6	75	8-13	80	100
	Level 1	12	6	100	15-23	80 ⁽¹⁾	100
	Level 2	25	6	200	15-23	80 ⁽¹⁾	100
	Level 3	35	6	300	15-23	80 ⁽¹⁾	100
	Level 4	52	6	500	15-23	80 ⁽¹⁾	100
	Level 5	72	6	700	15-23	80 ⁽¹⁾	100
Level 6	90	6	1000	15-23	80 ⁽¹⁾	100 ⁽²⁾	
Number and Type of Specimens	<ul style="list-style-type: none"> 2 PWAs per solder alloy for Test Set #2 One "pathfinder" board 						
Acceptance Criteria	<ul style="list-style-type: none"> Electrical continuity better than or equal to tin/lead controls 						
NOTE	<ul style="list-style-type: none"> (1) Cross-over frequency may change depending on resonant frequency (2) It may be necessary to go above 100 shocks to achieve the required failure rate (>63%) 						



Mechanical Shock Response Spectrum – Test Set #2



Discussion:

The group accepted the issue/resolution as briefed without discussion. The preceding information represents the current test protocol and has been forwarded to the JG-PP Webmaster for posting to the JG-PP web site.



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b. Topic: Components/Materials

In the months of April and May, several minor issues associated with a variety of components were addressed. These issues, including resolution, are provided below.

– Issues: DIP Components

The DIP components may have been shipped with a mixed lot of Tin-Lead and Pure Tin lead finishes, the DIP components were ordered with a Pure Tin finish. Only DIP components with a pure Tin finish can be used for the Wave soldering process, being conducted at Vitronics-Soltec, in-order to eliminate the risk of lead contamination being introduced into the lead-free solder processing equipment.

Resolution:

Mr. Woodrow had 495 DIP components with a pure tin finish on hand. The DIP components were shipped to Boeing Irving as overnight freight so that the components could be placed on the board, eliminating the risk of schedule delays. The DIP components that Mr. Woodrow shipped to Boeing Irving are daisy chained but do not contain dye.

Discussion:

The group accepted the issue/resolution as briefed without discussion.

– Issue TQFP-208 Components:

During post assembly inspection of assembled circuit boards, it was discovered that some of the TQFP-208 components were missing daisy chains. All of the TQFP-208 components assembled and all of the yet to be assembled components were checked for missing daisy chains and it was discovered that approximately 38 components were found to be defective/missing daisy chains.

Resolution:

There was a surplus of 83 TQFP-208 components from the original order. For the defective TQFP-208 components that were placed on the board, the components will be removed and replaced by hand. For tracking purposes, all boards with removed and replaced components will be documented by serial number. All removed and replaced components will be documented by location and some sort of identification marking will identify the components.

Discussion:

The group accepted the issue/resolution as briefed without discussion.



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– Issue: Hybrid Components

Some of the hybrid components were received with bent/ mangled leads that rendered the components unusable. The hybrid components were returned to Solitron and fixed/ had the leads straightened.

Status:

Corfin Industries processed all 615 of the hybrid components for tinning on April 29. The SnAgCuBi finished hybrid components will be marked by Boeing Irving so that they can be easily distinguished from the SnAgCu finished components. When Boeing Irving tried to place the hybrid components onto the boards it was discovered that the hybrid component is designed to be put on a circuit board with a recessed area for the hybrid, which allows the leads to meet the circuit board pads. Since the assembled circuit boards being used on the lead-free solder project are not recessed for the hybrids, the hybrid leads have to be reformed.





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Discussion:

Mr. Dave Hillman stated that he had sent two of the hybrid components to Corfin Industries and asked them if they could resolve this issue by reforming the leads. Mr. Joe Zaccari, from Corfin Industries, was participating in the telecon and stated that the factory is having trouble reforming the leads and having them properly align with the pads on the board. When the leads are reformed they do not have a proper foot, which is required for soldering the hybrid components to the boards. Current efforts to reform the hybrid leads, with a gull-wing shape, results in a butt joint at the end of the leads sticking down on the pads. Mr. Zaccari presented another option, straighten the leads then bend them at an angle down to the pads. This results in a shallow angle of the foot to the board. The concern is for the loss of mechanical stress relief. Ms. Peggi Blakely asked if the leads were reformed manually or by machine. Mr. Hillman said they would use dies to maintain consistency.

One Possible solution being explored would include milling material from the bottom of the hybrid components reducing the distance from the leads to the board pads.

– Issue: PLCC Components

The PLCC components arrived without daisy chains. New components with daisy chains were ordered from Practical.

Status:

The new PLCC components arrived at Practical on April 28. Ms. Campuzano-Contreras at Boeing Irving has the components on hand. Once the wave soldering procedures are complete, the PLCC components will be hand soldered onto the boards.

Discussion:

The group accepted the issue/resolution as briefed without discussion.

– Issue: 0402 Capacitors/ Resistors

Due to a mistake made by the component supplier, a tape & reel (1 of 5) was labeled properly (capacitors), but contained the wrong components (resistors) the following manufactured boards were assembled as follows:

- The SnPb Manufactured boards, numbers 11-31 have 0402 resistors
- The SnAgCu Rework boards, numbers 150-177 were built using the 0402 resistors
- The SnAgCuBi Rework boards, numbers 178-205 were built using the 0402 resistors

Resolution:

Since the components are so small, the stress of the testing conditions will not affect these components as adversely as the larger capacitor components on the board, possibly resulting in fewer failures. Due to the small size of the component and the difficulties associated with removal and replacement, all boards will be left as is and documented accordingly.



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Discussion:

The group accepted the issue/resolution as briefed without discussion.

– Issue: Solder Paste

Boeing Irving had difficulties working with the original SnAgCuBi solder paste. It was determined that the paste contained a flux that included beads/fillers, which created difficulties with the stencil and caused bridging problems during board assembly.

Resolution:

Heraeus formulated a new SnAgCuBi paste (CL30-8467) with a new flux to replace the original SnAgCuBi solder paste. The flux is a new formulation intended for a SnAgCu solder paste product that they are selling. Ms. Campuzano-Contreras reported that she received the new paste on April 8, 2004. The reformulated solder paste is easier to blend & mix and prints much better. Since working with the reformulated paste there have not been any processing issues directly linked to the solder.

Discussion:

Mr. Clive Simmonds asked, was the formulation of the paste for wave solder and hand solder the same. Mr. Kessel responded that the wire was procured with the same alloy make-up as the paste. Mr. Bill Hall wanted to know if the flux was just a RMA flux. Is it used on all these applications? Was there any testing done with no clean flux? Lety Campuzano-Contreras explained that they used various fluxes for hand solder, wave solder, and reflow. She also explained that it was decided earlier to use the manufacture recommended fluxes so no other fluxes were used or tested.

Mr. Tom Woodrow asked if Ms. Campuzano-Contreras could describe how things went with the wave soldering. Ms. Campuzano-Contreras stated things went pretty well. They were aiming at 245°C reflow in the pre-heat. They began with a tin-copper and profiled it to where they were comfortable. Two different fluxes were used because the first flux was not working properly. After an evaluation of the first flux, it was decided to go to a NR310B Alpha flux. Once the flux was changed and some parameters adjusted they got better flow. The same thermal profile and flux used for the tin-copper alloy was used for the tin-silver-copper-bismuth solder alloy. A few of the wave parameters were adjusted to account for the fact that the tin-copper solder alloy is more dense than the tin-silver-copper-bismuth solder alloy. Ms. Campuzano-Contreras reported that all boards are complete.

Once the boards were complete they were sent to Kaizen for cleaning. The cleaning chemicals and parameters used by Kaizen, matched those used by the Boeing Commercial Electronics Facility, Irving Texas. An omega-meter was used for every fourth board and no ionic contamination was found. The lead-free solder joints look good, but different from the tin-lead joints. Mr. Woodrow asked if the SIR boards wave soldered okay. Ms. Campuzano-



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Contreras stated that there was some difficulty with bridging and a lot of coupons were used, but they were able to solder the SIR coupons okay.

Ms. Campuzano-Contreras was asked to describe the wetting capabilities of lead-free solder alloys. Ms. Campuzano-Contreras explained that for the solder joints on the bottom-side of the board, the tin-copper solder alloy flowed perfectly and looked shiny, similar to tin/lead. For the top side fillet almost all of the tin-copper solder joints had more than 100 percent fill, the tin-copper solder alloy did not wet the whole pad. For the solder joints that were not 100 percent filled, the solder joints were convex with an angle not exceeding 90 degrees. The tin-silver-copper solder alloy performed similarly to the tin-copper solder alloy. It was pointed out that the flux was applied to the boards with a spray fluxer. Ms. Campuzano-Contreras stated that photos are being taken and will be provided in the future.



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Board Assembly Status Continued

Extended Tests															
Test	Performed By	Manufactured Boards (Controls)			Manufactured Boards			Rework Boards (Controls)			Rework Boards				
		Sn37Pb Reflow Paste Sn37Pb Wave Solder			Sn3.8Ag0.8Cu Reflow Paste Sn3.8Ag0.8Cu Wave Solder			Sn3.4Ag1.0Cu3.3Bi Reflow Paste Sn0.7Cu + Ni(-0.09Ni) Wave Solder			Sn37Pb Reflow Paste Sn37Pb Wave Solder Sn37Pb Wire			Sn37Pb Reflow Paste Sn37Pb Wave Solder Sn3.4Ag1.8Cu3.3Bi Wire Sn0.7Cu + Ni(-0.05Ni) Wire	
Board ID Numbers		35	36	37	104	105	106	143	144	145					
Salt Fog	ACI														
Board ID Numbers		38	39	40	107	108	109	146	147	148					
Humidity	ACI														

Boards for Microsection	Manufactured Boards (Controls)			Manufactured Boards			Rework Boards (Controls)			Rework Boards									
	Sn37Pb Reflow Paste Sn37Pb Wave Solder			Sn3.8Ag0.8Cu Reflow Paste Sn3.8Ag0.8Cu Wave Solder			Sn3.4Ag1.0Cu3.3Bi Reflow Paste Sn0.7Cu + Ni(-0.09Ni) Wave Solder			Sn37Pb Reflow Paste Sn37Pb Wave Solder Sn37Pb Wire			Sn37Pb Reflow Paste Sn37Pb Wave Solder Sn3.4Ag1.8Cu3.3Bi Wire Sn0.7Cu + Ni(-0.05Ni) Wire						
Board ID Numbers		41			110			111			42			177			205		
Boards for Microsection												RW							

Boards Being Used and Removed from the Matrix

149 (replaced by 111) was put together with SnPb paste during the March 18 LFS Meeting in order to show that higher reflow temperatures would not damage the board. 149 is now in Boeing Seattle being used for test fixture design.

71 (replaced by 42) is at ACI being used for test set up and fixture design

13 (replaced by 1) Boeing Irving found exposed copper in the BGA pads so the board was pulled from the assembled boards and shipped to Rockwell Collins for characterization and test fixture set-up

48 (replaced by 43) Some of the pads were lifted while removing a BGA for rework purposes



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Rework Procedure Status

KEY		Blank= Waiting to Assemble									
Rework Boards	Serial Numbers	Solder Alloy used for Initial Board Assembly	Solder Wire Used for Rework by Component Type with Board Location								
			TSOP-50 U25	TSOP-50 U12	TQFP-208 U57	TQFP-208 U3	PBGA-225 U18	PBGA-225 U4	PDIP-20 U59	PDIP-20 U23	
Controls	42 - 71	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb	SnPb	SnPb	SnPb	SnPb	SnPb	SnPb	SnPb	SnPb
Set A	150 - 177	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnAgCu	SnAgCu	SnAgCu	SnAgCu	SnAgCu	SnAgCu	SnAgCu	SnAgCu	SnAgCu
Set B	178 - 205	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnAgCuBi	SnAgCuBi	SnAgCuBi	SnAgCuBi	SnAgCuBi	SnAgCuBi	SnAgCuBi	SnCu+Ni	SnCu+Ni



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PLCC Placement Status

KEY		Blank= Waiting to Assemble	
			Rework Complete
PLCC COMPONENTS			
Manufactured Boards	Serial Numbers	Solder Alloy used for Initial Board Assembly	Solder Wire Used to Place PLCCs
Controls	1 - 41	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb
Set A	72 - 110	Sn/3.9Ag/0.6Cu Reflow Paste Sn/3.9Ag/0.6Cu Wave Solder	SnAgCu
Set B	111 - 149	Sn/3.4Ag/1.0Cu/3.3Bi Reflow Paste Sn/0.7Cu + Ni(~ 0.05Ni) Wave Solder	SnAgCuBi
PLCC COMPONENTS			
Rework Boards	Serial Numbers	Solder Alloy used for Initial Board Assembly	Solder Wire Used to Place PLCCs
Controls	42 - 71	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb
Set A	150 - 177	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb
Set B	178 - 205	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb

Hybrid Placement

HYBRID COMPONENTS				
Manufactured Boards	Serial Numbers	Solder Alloy used for Initial Board Assembly	Component Finish	Solder Wire Used to Place Hybrids
Controls	1 - 41	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb	SnPb
Set A	72 - 110	Sn/3.9Ag/0.6Cu Reflow Paste Sn/3.9Ag/0.6Cu Wave Solder	SnAgCu	SnAgCu
Set B	111 - 149	Sn/3.4Ag/1.0Cu/3.3Bi Reflow Paste Sn/0.7Cu + Ni(~ 0.05Ni) Wave Solder	SnAgCuBi	SnAgCuBi
HYBRID COMPONENTS				
Rework Boards	Serial Numbers	Solder Alloy used for Initial Board Assembly	Component Finish	Solder Wire Used to Place Hybrids
Controls	42 - 71	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnPb	SnPb
Set A	150 - 177	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnAgCu	SnAgCu
Set B	178 - 205	Sn/37Pb Reflow Paste Sn/37Pb Wave Solder	SnAgCuBi	SnAgCuBi

*Circuit boards will be wicked prior to placing the hybrid components on the board.
Solder joints are expected to be contaminated with lead.*



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SIR and EMR Processing Tracker

KEY		<input checked="" type="checkbox"/> Assembly Completed				
		<input type="checkbox"/> No Boards to be Assembled				
SIR						
SnAgCu Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnAgCu Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnAgCuBi Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnCu Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnPb Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnPb Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Control, No-Heat						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Control, Heated						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
EMR						
SnAgCu Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnAgCu Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnAgCuBi Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnCu Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnPb Reflow						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
SnPb Wave						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Control, No-Heat						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Control, Heated						
1	2	3	4	5	6	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

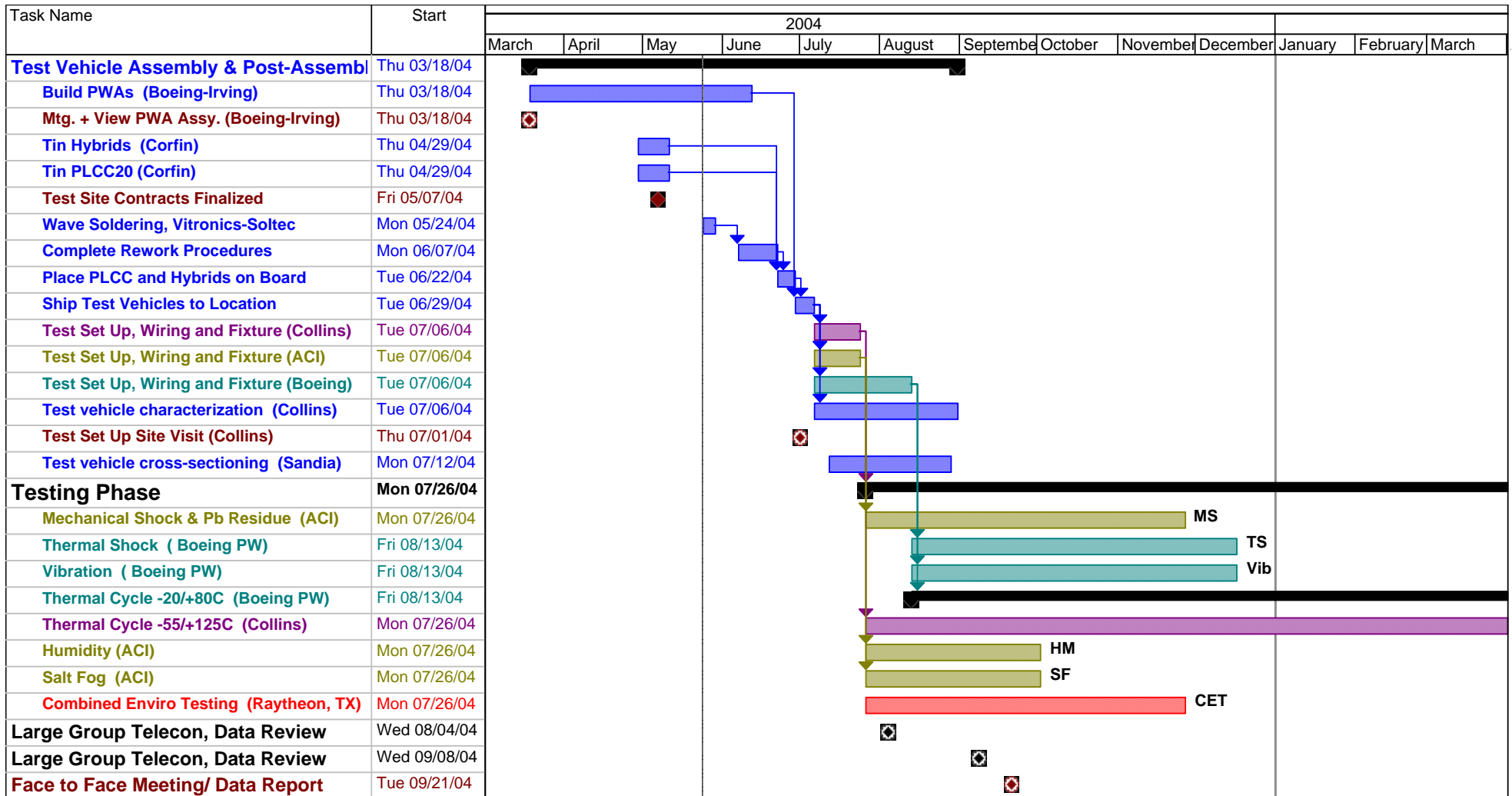


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3. LFS Schedule





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4. Next Meetings

- **Tentatively Scheduled Telecons**
 - **August**
 - **September**
- **Next Face-to-Face Meetings**
 - **September 21, 2004, Harris Facility, Melbourne Fl (closed door, LFS members only)**
 - **Proposed Agenda**

Opening/ Overview	K. Kessel/ B. Greene
Pb-Free Test Vehicle Assembly, Insight Gained/ Lessons Learned	Lety Campuzano Contreras
Test Set-Up Over view/ In-Progress Review	
Mechanical Shock	Lee Whiteman
Thermal Cycle Test -55/+125C	Dave Hillman
Thermal Cycle Test -20/+80C	Tom Woodrow
Vibration Test	Tom Woodrow
Thermal Shock Test	Tom Woodrow
Combined Environments Test	Joe Felty
Salt Fog/ Humidity Tests	Lee Whiteman
EMR/ SIR Test	John Kerr

5. International Pollution Prevention workshop

In conjunction with the September 21 lead-free solder project meeting, the NASA AP2 Office is hosting an international pollution prevention workshop. The NASA AP2 Office would like to invite the presenters from the September 21 lead-free solder project meeting to present at the 2-day workshop. The purpose of the workshop is to provide up to date information on solutions and lessons learned on joint P2 projects. The project categories currently being developed include:

- Coatings depainting
- Plating (Cadmium, chrome)
- Industrial Cleaning

Please see the following link for the P2 Workshop web site for more information and registration: <http://acqp2.nasa.gov/workshop.htm>



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6. Test Equipment Setup Meetings

The NASA AP2 Office will be traveling to the test facilities to document the setup of the testing equipment including fixtures, wiring, data loggers and testing chambers. Photographs will be taken. Anyone interested in visiting the testing facilities should contact Mr. Kurt Kessel. (321) 867-8480; kurt.kessel-1@ksc.nasa.gov

7. European Lead Free Network (ELFNET)

Mr. Clive Simmonds briefed the lead-free solder consortium on a new European Union (EU) lead-free initiative entitled European Lead Free Network (ELFNET). The purpose of ELFNET is to bring together all lead-free activities across the EU. It will be a coordinating activity across 19 countries. It will be looking at four industrial networks:

- Consumer Electronics
- IT and Telecoms
- Automotive
- Aerospace and defense (Mr. Simmonds is the lead for this particular network)

ELFNET will try to coordinate the activities within research associations, industry, and academia to get focused research. A formal web site will be launched in September. The lead-free solder project consortium will be provided some access to the website. There will be three levels of access for the website:

1. Core Members – EU contributors to the lead-free activities.
2. Affiliates – EU members that are active participants but not core members, any industries and/or companies within the EU can join.
3. General Users – Intended to be a network/ sign posting activity where individuals can get information on what is being done with regards to lead-free solder around the various industries, individual countries, and technical areas.

ELFNET will not do any research rather it will try to network together all the different activities across the EU. It will also help companies get ready for 2006.

8. New Action Items

- **Nothing Recorded**



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9. Lead-Free News

For Lead, No Blue Sky

MIKE BUETOW

Printed Circuit Design & Manufacture – April 2004

THE sky was the limit for lead-free, literally. Declarations from Europe and elsewhere led us to believe that electronics for military and aerospace applications would be exempt from bans on lead. Suppliers to companies in those sectors were flying high, believing that under the EU directives (WEEE and RoHS) they were off the radar. None of that is stopping Airbus from taking a closer look, querying its suppliers on their use of lead and other materials on the EU hit list. In a Jan. 9 letter, a copy of which was obtained by PCD&M, Airbus France director of procurement quality and supply chain equipment Jean-Philippe Bedos explained: “For Airbus, both directives and the associated planning are applicable.”

By contract, the European airplane consortium prohibits its equipment suppliers from using materials “forbidden by national and international regulations, or likely to be....” The statement clearly implies WEEE and RoHS. With that in mind, Airbus submitted to its suppliers a 46-question form asking about lead use. Responses, wrote Bedos, will be analyzed by Airbus and “will initiate an exchange and a follow up of your process and the possible corrective actions to mitigate the risks.”

That’s not all. The consortium is also putting the onus for end-of-life disposal squarely on its suppliers. In an October presentation by Airbus UK’s environmental affairs coordinator, a slide listing environmental requirements for Airbus’ suppliers included this statement: “In particular for electrical and electronic equipment, supplier responsibility for the elimination of the corresponding waste at the end of life of the delivered product including packaging, unless otherwise agreed with Airbus.” (Ever tried to throw out a plane? It’s not as easy as it looks.)

For products delivered after July 1, 2006, Airbus is mandating its suppliers attest in writing that their products contain no lead, cadmium or other substances (including polybrominated biphenyls, or PBBs; and polybrominated diphenyl ethers, or PBDEs) banned per the RoHS Directive. And if Airbus succumbs, it says here it’s only a matter of time until Boeing, Lockheed Martin, Northrop Grumman and the other primes follow.

There may be a loophole. As reported by *Electronics Weekly*, last-minute language inserted in the RoHS Directive may permit the use of tin-lead-plated components under certain circumstances (see story, page 9). Circuit boards might squeeze through, too.

Separately, the U.S. Congress last month held hearings on why elevated lead levels were found in some water flowing through Washington D.C. taps. Residents of the nation’s capital were advised to let water run for at least 10 minutes before using it for drinking or cooking. Worse, the problem, it was learned, dates at least to early 2001. Such revelations could be the proverbial straw to break lead’s back. Thankfully, it’s an election year, which means Congress will be out to lunch until at least 2005.

We’ve used up quite a bit of oxygen arguing the principles behind lead and its alternatives. Surely, the chaos and concern unleashed by incidents such as these will only serve to further embolden those whose kneejerk response was to succumb to the “inevitability” of a



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lead-free world. So be it. An even bigger drain is the time and expense involved just to keep track of the vast number of rules and regulations to monitor, which seems to be growing by the month. And it ticks me off that while everything is going to hell in a handbasket neither the EU nor those whom our tax dollars and association dues help support are making it their top priority to protect and prepare their constituents. With pending regulations limiting the use of not only lead but various flame-retardants as well, one would think we'd all have a better handle on what's in store.

For now, confusion reigns. Will it end before airplane parts rain, too?

JEDEC Lead Free Statement

The **JEDEC** Solid State Technology Association (Once known as the **J**oint **E**lectron **D**evice **E**ngineering **C**ouncil), is the semiconductor engineering standardization body of the Electronic Industries Alliance (EIA), a trade association that represents all areas of the electronics industry.

"JEDEC supports environmentally responsible semiconductor design, manufacturing, and use. JEDEC and its member companies will continue to participate in industry efforts to minimize the use of lead. Our various standards committees will support and drive the creation of the applicable standards needed to ensure a smooth industry transition to reduce lead in semiconductor products."



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Action Item Status

Open Action Items

LFS.04.05.02

Date Due: Continuous

Responsibility: All

Required Action: Review the LFS data on the JG-PP web site at www.jgpp.com and recommend any changes/improvements to ITB

Comments:

LFS.04.05.01

Date Due: 06/03/04

Responsibility: Kurt Kessel

Required Action: Create calendar to document upcoming events to include scheduled star dates of testing

Comments:

LFS.04.03.29

Date Due: 04/13/04

Responsibility: Lee Whiteman

Required Action: Gather cost data for the new mechanical shock test. Determine the impact on cost.

Comments: Assigned at 03/30/04 telecon. *Cost cannot be developed until the test plan is finalized on 6 Apr 04. Will not go to BAE until we have our ducks in a row.*

LFS.04.03.19

Date Due: 04/01/04

Responsibility: Dave Hillman

Required Action: Obtain specifics on the board laminate, send to ITB who will distribute to group and place in the appropriate documents

Comments: Assigned at 03/18/04 meeting.

LFS.04.03.24

Date Due: 04/01/04

Responsibility: Kurt Kessel, ITB, Inc

Required Action: Notify project stakeholders of all JTP changes initiated at the March 18 meeting

Comments: Assigned at 03/18/04 meeting.



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LFS.04.03.25

Date Due: 04/01/04

Responsibility: Dave Hillman

Required Action: Create a standard data-reporting sheet, build upon previous submittals

Comments: Assigned at 03/18/04 meeting. *Waiting for completion of Action Item*
LFS.04.03.27

LFS.04.03.26

Date Due: 04/08/04

Responsibility: Kurt Kessel, ITB, Inc

Required Action: Distribute Dave Hillman's standardized data collection sheet to the group for review

Comments: Assigned at 03/18/04 meeting. *Waiting for completion of Action Item*
LFS.04.03.27

LFS.04.03.27

Date Due: 04/01/04

Responsibility: Dave Hillman

Required Action: Send out board schematics to potential testing sites

Comments: Assigned at 03/18/04 meeting.

LFS.04.03.28

Date Due: 04/01/04

Responsibility: Lety Campuzano-Contreras

Required Action: Send to Dave Hillman one board each (5 total) for High Tg PWB, low Tg PWB, (as delivered Tg & thicknesses) SAC/SAC PWA, SACB/SnCu PWA, SnPb/SnPb PWA for characterization (for Tg [changes] and cutting up)

Comments: Assigned at 03/18/04 meeting.

LFS.04.03.15

Date Due: 3/26/04

Responsibility: Kurt Kessel, Brian Greene

Required Action: Follow-up with Lee Whiteman to determine if the boards are instrumented to measure strain and the costs associated with strain measurement.

Comments: Assigned at 03/15/04 telecon.

LFS.04.03.14

Date Due: 3/18/04

Responsibility: Brian Greene

Required Action: Contact Lee Whiteman to discuss the group's interaction with ACI and BAE Systems during testing to ensure proper data is obtained.

Comments: Assigned at 03/15/04 telecon.



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LFS.04.03.02

***Date Due:* 3/16/04**

***Responsibility:* Lee Whiteman**

***Required Action:* Confirm BAE's ability to measure board deflection and possibility of obtaining strain gage measurements. Pass information directly to Brian Greene.**

***Comments:* ITB, Inc. will follow with Mr. Whiteman in order to confirm BAE's capabilities**