JG-PP Email

Joint Group on Pollution Prevention

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JG-PP Lead-Free Solder Project
Technical Meeting Minutes
December 17, 2001

JG-PP Project Integrator: Brian Greene, NASA KSC/ITB

Comments:

Attached please find the minutes from the December 17, 2001, Lead-Free Solder Technical Teleconference. If you have questions about the minutes please contact Brian Greene or Tess Flynn. Please further distribute as necessary.

MEMORANDUM FOR RECORD **January 3, 2002**

Subject: Meeting Summary and Minutes – December 17, 2001

Material(s) Identified: Lead

Process Identified: Electronics soldering

Methodology Phase: I-Identification, II - Technical

Summary:

On December 17, 2001, technical representatives from American Competitiveness Institute, the Boeing Company, British Aerospace Systems (United Kingdom), F-15 Program, Lockheed Martin, Mitsui Comtek/Senju Metals Co., National Aeronautics and Space Administration (NASA)-Goddard Space Flight Center, NASA-Jet Propulsion Lab, NASA-Kennedy Space Center, NASA-Marshall Space Flight Center, National Center for Manufacturing Sciences, Naval Air Systems Command, Raytheon, Research Development & Engineering Center-Redstone Army Arsenal, Robins Air Force Base, TRW/Marine Corp., U.S. Army Communications Electronic Command, U.S. Army Tank-Automotive and Armaments Command, University of Tennessee, and Wright Patterson Air Force Base participated in a teleconference with representatives from the Joint Group on Pollution Prevention Working Group. The objective of the teleconference was to further discuss the latest changes made to the Manufacturing Joint Test Protocol, test board design, and short list of lead-free solder alloys, and to review the newly drafted Repair JTP.

Prior Decisions:

- 5/9/01 - Lead as used is tin-lead (Sn/Pb) solder was chosen as the target HazMat.

JG-PP Email

Joint Group on Pollution Prevention

- 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.

Next Teleconference: TBD

Next Meeting: TBD

Minutes

1. The teleconference began with a roll call by the teleconference operator. Mr. Brian Greene, National Aeronautics and Space Administration/International Trade Bridge, Inc. (NASA/ITB) and Project Integrator for the Lead-Free Solder JG-PP project, alerted the group to the recent project emails that had been distributed to everyone. Due to technical problems with sending attachments with emails to the group, power point presentations and other material will be posted on the JG-PP (http://www.jgpp.com) web site.

2. Mr. Greene stated that the objective of the teleconference was to further discuss the latest changes made to the Manufacturing Joint Test Protocol (JTP), test board design, and short list of lead-free solder alloys, to review the newly drafted Repair JTP, and discuss the status of the Cost Benefit Analysis. The most recent discussions on these topics occurred during the face-to-face meeting held in Dallas in November.

3. Lead-Free Solders: Mr. Greene asked whether anyone had any comments on the minutes from that November meeting. Mr. Amitav Pattnaik, Warner Robins AFB, stated that it appeared that there was a lot of discussion during the meeting about solder alloys for manufacturing, but that selection of alloys for repair was not addressed. Because the lead-free solder on lead interaction is so complex and very little published literature exists to guide us, is there any way that we can predict the performance of a lead-free solder for repair? Mr. Pattnaik proposed the use of some simple coupon testing (versus board level tests) to screen a large number of lead-free solder alloys for repair.
   a. Mr. Tom Woodrow, Boeing, suggested the use of thermal cycling on a simple board using some solder joints that could be intentionally contaminated with a known amount of lead. This would help determine long-term reliability of the solder joint for repair processes. Mr. Duane Napp, NCMS, agreed with Mr. Woodrow, and specifically suggested the use of a 20 leaded LCC.
   b. Mr. Joe Felty, Raytheon, reminded the group that, at the November meeting, we discussed assembling a set of baseline boards using tin-lead solder and running them through some of the same tests as the lead-free candidates. Once that testing is completed, we could then conduct a repair operation on the lead soldered boards using lead-free solder, run them through the same tests again, and compare the failure rates.

JG-PP Email
Joint Group on Pollution Prevention

c. Mr. Lee Whiteman, American Competitiveness Institute, concurred that there is not a lot of good data to answer the question of how repair will affect the reliability solder joints. He agreed with Mr. Felty's proposed approach.

d. Mr. Napp suggested one modification to Mr. Felty's proposal: to shorten the time frame, build a second set of boards with tin-lead solder, repair those, and test them at the same time as the lead-free solder alloys (versus waiting to repair the tin-lead boards after testing is complete).

e. Mr. Felty suggested that a sub-group get together to develop the repair procedure to remove the residual lead solder. Mr. Napp suggested that this may include having a military depot perform the rework.

f. Mr. John Myer, U.S. Army Communications Electronic Command (CECOM), reminded everyone that it would be undesirable to have different solders at each repair station depending on what is being worked on. One solder suitable for both manufacturing and repair is desired, unless the joint failure rates are too high. Therefore, it would be advantageous to test a solder for manufacturing that would hopefully perform well on the repair side, too. Mr. Mark Stibitz, Robins AFB, agreed with Mr. Myer.

g. Mr. Whiteman stated that the following solder-component-board combinations should be tested for repair reliability:

- tin-lead solder/tin-lead component/tin-lead board (baseline)
- lead-free solder/tin-lead component/tin-lead board
- tin-lead solder/lead-free component/lead-free board.

The reason for the testing matrix is because the lead contamination can come from more than one source.

4. The group then discussed the problems and issues with implementing lead-free solder alloys in the field.

a. Mr. Clive Simmonds, BAE Systems, United Kingdom, asked how the repairers will know what solder is being used on a particular board to eliminate potential intermixing. Mr. Whiteman replied that, for this project's testing, the documentation would have to be clear. For actual field use, the configuration management systems would have to find a way of notating which solders and materials were used on the assembly. Mr. Robert Hill indicated that, unless implementation is transparent to the repairers, the operational units will still need to track all the lead parts vs. lead-free parts. It is unlikely that such tracking could be afforded by the services or imposed on the commercial sector. Therefore, he agreed that, ideally, the project needs to strive for validating a lead-free solder that can be used in both manufacturing and repair processes.

b. Mr. Myer stated that, if part tracking is necessary, one option is to stamp or otherwise mark the boards with a symbol indicating whether it is lead or lead-free. In trying to use lead-free solder on legacy equipment, there would be no way to obtain a new part number for spare boards. The only option is to have the boards marked lead-free so that when they arrived at the depot, the repairers would recognize the boards as lead-free. Mr. Simmonds seconded that there needs to be a clear identifier between lead and lead-free parts in the field.

JG-PP Email
Joint Group on Pollution Prevention

c. Mr. Dave Locker, Army Aviation & Missile Command, proposed that the mission of this group be to provide the test data that will help system program managers in deciding what kinds of markings, if any, are required of lead vs. lead-free parts. He recommended conducting a matrix test of the different repair and manufacturing combinations. Mr. Stibitz added that if we are lucky enough to find a lead-free solder that works in both manufacturing and repair, then marking the board becomes a moot point.

5. The consensus of the group was to ideally select lead-free solder alloys suitable for both manufacturing and repair. Details of which solders to select were discussed by the group.
   a. Mr. Dave Hillman, Rockwell-Collins, noted that he is reviewing a stack of literature and planned to summarize it for the group in January 2002. Of key interest will be any fatigue life data that can be used to help downselect lead-free solder alloys (**AI LFS.01.12.01**). All project representatives should review Mr. Hillman's synopsis and suggest any modifications to the short list of lead-free solder alloys for both manufacturing and repair testing (**AI LFS.01.12.02**). From what he has read so far of studies that have characterized lead contamination of solder joints, there is not as large a problem as some imagine.
   b. Alloys containing more than 3.5% to 7% bismuth are troublesome because the Bi makes a eutectic with lead that has a very low melting point. Bismuth is also a weak material.
   c. Keep tin/0.7copper for wave solder, but also consider it for reflow and manual.
   d. Keep tin/silver/copper for wave, manual, and reflow.
   e. Research tin-silver-antimony more before removing it from further consideration. Yes, antimony exhibits some toxicity, but information exists (albeit conflicting data) to suggest that antimony-containing solders perform well in thermal cycling tests. Several related action items were taken to resolve the issue of toxicity from antimony and other elements:
      i) Mr. Whiteman will provide information on antimony and tin/silver/antimony solder alloy (**AI LFS.01.12.03**).
      ii) Mr. Woodrow will provide information on leachates from toxic metals used in solder alloys to Ms. Heather Moyer at *CTC* for inclusion in the JG-PP Potential Alternatives Report (**AI LFS.01.12.04**). He recalled the paper showed that antimony leached the worst of any metal in the solder. Mr. Jack Geibig, University of Tennessee Center for Clean Technologies, reported that UT is examining the life cycle impact of lead-free solder alloys. Although this study is just beginning, he agreed to share whatever findings he has with the group.
      iii) Mr. Felty will provide information about toxic metals in solder alloys from the original NCMS lead free solder study. Mr. Felty will take an excerpt from the original study and send it to Mr. Greene for distribution (**AI LFS.01.12.05**).

      Mr. Simmonds concluded that it behooves the group to not select a solder alloy that creates some of the same environmental problems (e.g., leaching) as lead.

6. Mr. Hill notes that solder alloy selection should not adversely impact the development of the JTPs. Even then, the JTPs will probably not be completed for a few more months, which gives us time to select appropriate alloys for testing.

JG-PP Email
Joint Group on Pollution Prevention

7. Microdevices and Test Board Design: The group discussed the type of devices recommended for the test board for both manufacturing and repair.
   a. Mr. Hillman reported on his progress on action items LFS.01.11.11 (look into the possibility of having a vendor supply defective capacitors that are shorted) and LFS.01.11.14 (prepare a list of the microelectronic devices proposed for the test board and the cost and availability of each).
      i) AI LFS.01.11.11. Mr. Hillman was unable to obtain shorted components. After discussion, the consensus of those on the teleconference was to eliminate the shorted components from the board, unless other group members suggest otherwise.
      ii) AI LFS.01.11.14. Mr. Hillman stated that all components discussed at the November meeting are readily available except for one or two devices. He has made a spreadsheet to capture the information, which was distributed to everyone prior to this teleconference. Mr. Hillman stated that a challenge will be obtaining with components with the alloy selection we desire. This will require teaming with alloy suppliers, such as Senju Metals. We have done about all we can do in checking general cost and availability. The next step is to actually design the board and give the suppliers a definitive number of components and delivery time. Mr. Hillman noted that industry is moving strongly toward the use of tin/silver/copper solder sphere, but through the professional connections that members of this group has, we should be able to procure parts with about any solder alloy we desire. Tintronics (http://www.tintronics.com) could perform the tinning of the component leads.
   b. It was clarified that, to date, the test board and test protocol have been developed with the idea of testing joint integrity, but not functionality of the components. There is some concern over the higher temperature to which the new solders will be work and possible damage to the boards and components.
      i) It has been stated that both the board suppliers and component suppliers will have to meet the specifications (especially temperature requirements) put forth by the group. That is, manufactures will have to supply higher temperature components and boards.
      ii) Mr. Hillman indicated that there is new data showing that it is not necessary to go as high as 260 °C to reflow lead-free solder alloys, but more like 240-245 °C, which is only about 20 degrees higher than current temperatures. This will still cause thermal expansion of the board, however.

8. Joint Test Protocols: Two JTPs have been distributed to the group for review and comment:
   - Manufacturing JTP (revision to September 2001 document)
   - Repair JTP (new document)

   a. Mr. Steve Duncan, ARDEC, suggested adding a procedure to the repair JTP to evaluate the formation of tin whiskers in the Steady State Life Test (Sec. 3.2.6). Specifically, in addition to the conditions given in Sec. 3.2.6 (125 °C for 1000 hr.), the test boards should also be subjected to the optimum temperature for tin whisker growth (50 to 55 °C for 1000 hr.) to see which of the alloys fail and determine the failure mode.

JG-PP Email
Joint Group on Pollution Prevention

i) Mr. Simmonds asked Mr. Duncan whether the procedure should also include the introduction of stress (pulling) to the board, since that is what often causes tin whiskers to be a problem. Mr. Duncan agreed that it should be taken into account.

ii) Mr. Jay Brusse, NASA Goddard Space Flight Center (GSFC), reported that the National Electronics Manufacturing Initiative (NEMI) Lead Free Interconnect Project is currently working to develop accelerated test methods for evaluating tin whisker formation and identification (see http://www.nemi.org/pbfreepublic/ and http://nepp.nasa.gov/whisker/). Presently there is a lot of dispute as to what conditions promote whisker growth. Conducting Steady State Life at 50 to 55 °C MAY be a relevant test, but others report that thermal cycling, moisture or high temperature are possible inducers. He advised not settling on just one temperature or other condition.

iii) Given that there is currently no consensus on the types of solders most likely to whisker and the conditions that promote it, Mr. Mike Sampson, NASA GSFC, asked whether optical and microscopic inspection for whiskering should be performed. Mr. Greene confirmed that those procedures are in the repair JTP.

b. Mr. Woodrow noted that a number of the tests in the repair JTP appear to be for evaluating the integrity of the package. Is that something that this JTP should be addressing?

i) Mr. Stibitz replied that Robins AFB has begun repairing hybrids. Therefore, he feels that the hybrid packaging requirements from which the repair JTP is based will give us as good a test as we can get.

ii) The solvent resistance test is in the repair JTP because depots, such as Robins AFB, have parts that come into contact with chemicals such as Coolanol, hydraulic fluid, and cleaning solvents. Solvents affect both the board material and the solder joints.

iii) For the moisture test, the group discussed whether some boards should be conformal coated. Mr. Felty and Mr. Napp suggested that conformal coating was unnecessary if we are just looking at the integrity of the solder joints. In addition, the test matrix may become too unwieldy.

c. The sequencing of tests still needs to be determined for both of the JTPs. Mr. Felty will be working with the people at Raytheon to help determine the best testing set up for the HALT tests. Board layout will play an important part in the testing.

The group was asked to review the JTPs and provide comment to Mr. Greene by January 7, 2002 (**AI LFS.01.12.06**). Mr. Greene will also be adding mechanical shock requirements to the manufacturing JTP.

9. Testing Location. The facilities that will be performing the actual testing will be determined later. Specifically, once the JTP is complete, the project stakeholders will be asked who they would feel comfortable in performing the testing. The JTP will be sent to those facilities, who will then be asked to provide the JG-PP Working Group with an engineering cost estimate to perform the testing. The responses will be presented to the project stakeholders, who will then be asked to make a decision on the testing location(s).

10. Cost Benefit Analysis. *CTC* is trying to complete the CBA and submitted baseline survey forms to several individuals in industry and the services. Ms. Moyer stated that *CTC* had not received

any feedback yet, and needed everyone's responses by December 31. Industry recipients on the teleconference indicated that their forms had been forwarded to the appropriate people and were being worked on. AMCOM is completing the forms for the Army. Navy will identify the best facility and POC to Ms. Moyer. Mr. Stibitz, Robins AFB, is completing the forms for the Air Force. Mr. Chester Berry, NASA Marshall Space Flight Center, is completing the forms for NASA.

11. Potential Alternatives Report. *CTC* is preparing this document. Everyone should copy Ms. Moyer (moyer@ctc.com) on information pertaining to lead-free solder alloys and rationale for downselection.

12. News.
    a. The group was alerted to the fact that vendors have begun notifying their customers, such as Rockwell-Collins, that they are changing their solders and finishes to lead-free. When asked whether they are addressing tin whiskering, the vendor responded they are addressing it on a customer-by-customer basis.
    b. The European Union/U.S. Early Customer Interface Meeting, originally scheduled for fall 2001 in Naples, has been rescheduled for March 26-27 in or near London, England. Mr. Simmonds extended an offer to Mr. Hill to host the meeting at BAE's offices outside of London.
    c. Mr. Hill has retired from the government and will likely no longer be JG-PP Lead for the Lead-Free Solder project. He has accepted a job offer from ITB, Inc. to work in industry. For project continuity, however, Mr. Hill will still stay involved in the Lead-Free Solder project. He noted that Ms. Olga Dominguez, JG-PP Chairperson, is committed to this project and ensuring that it continues smoothly. Mr. Hill's new email is hillr@itb-inc.com.
    d. The APEX Conference is January 20-24 (Exhibition January 22-24) in San Diego (http://www.goapex.org). Mitsui Comptek & Senju Solder will have a booth there (booth #837). Mr. Hillman suggested we keep open the option of having a face-to-face group meeting in San Diego, since many industry people will be there.

13. The teleconference was adjourned at approximately 12:30 p.m.

SIGNED (Approved by B. Greene 01/03/01)

Brian E. Greene
Project Integrator, NASA KSC/ITB, Inc.

Attachments:
1. Action Items

New Action Items

LFS.01.12.01

Date Due:	**01/07/02**
Responsibility:	Rockwell-Collins (Dave Hillman)
Required Action:	Solders. Prepare a synopsis of published data on lead-free solder fatigue life testing.
Comments:	

LFS.01.12.02

Date Due:	**One week after completion of LFS.01.12.01**
Responsibility:	All technical representatives
Required Action:	Solders. Review Mr. Hillman's synopsis and suggest any modifications to the short list of lead-free solder alloys for both manufacturing and repair testing.
Comments:	

LFS.01.12.03

Date Due:	**01/07/02**
Responsibility:	ACI (Lee Whiteman)
Required Action:	Solders. Provide information on antimony and tin/silver/antimony solder alloy
Comments:	12/28/01 – Completed. Information distributed.

LFS.01.12.04

Date Due:	**01/07/02**
Responsibility:	Boeing (Tom Woodrow)
Required Action:	Solders. Provide information on leachates from toxic metals used in solder alloys to Heather Moyer at *CTC* for inclusion in the JG-PP Potential Alternatives Report.
Comments:	

LFS.01.12.05

Date Due:	**01/07/02**
Responsibility:	Raytheon (Joe Felty)
Required Action:	Solders. Provide information about toxic metals in solder alloys from the original NCMS lead free solder study to Brian Greene for distribution.
Comments:	

LFS.01.12.06

Date Due:	**01/07/02**
Responsibility:	All technical representatives
Required Action:	JTPs. Review the Manufacturing and Repair JTPs and provide comment to Brian Greene
Comments:	

Action Items Closed at this Meeting

LFS.01.06.03

Date Due:	**10/11/01 (originally 07/30/01)**
Responsibility:	NAWCWD (John Nelson), Raytheon (Joe Felty), Rockwell-Collins (Dave Hillman)
Required Action:	Identify (e.g., through a literature search) any lead-free and tin-lead solder interaction and report the findings at the next project meeting
Comments:	12/17/01 – Replaced by AI LFS.01.12.01 (Dave Hillman to prepare a synopsis of published data on lead-free solder fatigue life testing). 08/07/01 – Literature survey from John Nelson distributed to project representatives 09/20/01 – Action item amended to have CTC/NDCEE examine any interaction between Pb and Bi-containing solder alloys.

LFS.01.09.01

Date Due:	**10/11/01**
Responsibility:	All project technical representatives
Required Action:	Review and comment on the draft potential alternatives list, the draft JTP (especially details of the tests, such as vibration frequencies, dwell times, temperatures, ramp rates, etc.), and the test board design
Comments:	12/17/01 – Replaced by new AIs LFS.01.12.02 and LFS.01.12.06 and discussions on the test board at the Nov 2001 meeting. Revisions to the short list of solder alloys may occur pending Dave Hillman's data summary. The Manufacturing JTP were made and distributed in December, and a new Repair JTP was developed.

LFS.01.11.01

Date Due:	**12/09/01 (originally due 11/09/01)**
Responsibility:	NASA/ITB (Brian Greene)
Required Action:	Each service and agency indicate to Brian Greene who will help in building a strawman depot level rework JTP. Build a skeletal framework of a Repair JTP for the November 14-15 meeting.
Comments:	12/08/01 – Strawman JTP was distributed, based on requirements matrix developed by Mark Stibitz, Robins AFB.

LFS.01.11.07

Date Due:	**12/04/01**
Responsibility:	NASA/ITB (Brian Greene)
Required Action:	Manufacturing JTP. Contact John Nelson, China Lake, to obtain details of the shock profile provided earlier by Mr. Nelson and determine its suitability for inclusion in the Manufacturing JTP Mechanical Shock Test
Comments:	

LFS.01.11.09

Date Due: **12/11/01**
Responsibility: Rockwell-Collins (Dave Hillman)
Required Action: Provide data to everyone showing the method by which tin whiskers form. This could be used to eventually develop a means of controlling tin whiskers.
Comments:

LFS.01.11.10

Date Due: **12/11/01**
Responsibility: NASA/ITB (Brian Greene)
Required Action: Repair JTP. Incorporate comments received at the Nov 14-15 meeting into a strawman Repair JTP, and distribute it for review and comment.
Comments:

LFS.01.11.11

Date Due: **12/11/01**
Responsibility: Rockwell-Collins (Dave Hillman)
Required Action: Test Board Design. Look into the possibility of having a vendor supply defective capacitors that are shorted.
Comments:

LFS.01.11.13

Date Due: **12/11/01**
Responsibility: Army (Martha Schuster)
Required Action: Test Board Design. Check the extent to which components are being soldered to flex boards in Army missiles and aviation
Comments:

LFS.01.11.14

Date Due: **12/11/01**
Responsibility: Raytheon (Joe Felty, Jeff Bradford), Rockwell-Collins (Dave Hillman)
Required Action: Test Board Design. Prepare a list of the microelectronic devices proposed for the test board and the cost and availability of each.
Comments:

LFS.01.11.15

Date Due: **12/11/01**
Responsibility: Air Force (Mark Stibitz)
Required Action: Repair JTP. Survey within Robins AFB to ascertain the percentage of solders that are high-temperature vs. low-temperature.
Comments:

LFS.01.11.16

Date Due:	**11/26/01**
Responsibility:	All technical representatives
Required Action:	CBA. Provide comments on suggested improvements to *CTC*'s Cost Benefit Analysis data collection forms to *CTC* (Ron Patun).
Comments:	12/4/01 – Completed with CTC's emailing of the CBA data collection forms.

LFS.01.11.17

Date Due:	**12/03/01**
Responsibility:	All technical representatives
Required Action:	CBA. Anyone who might be interested in completing a Cost Benefit Analysis survey form should provide a point of contact to *CTC* (Ron Patun).
Comments:	12/4/01 – Completed with CTC's emailing of the CBA data collection forms.

LFS.01.11.18

Date Due:	**12/11/01**
Responsibility:	Senju Metals (Derik Daily)
Required Action:	PAR. Confirm with Senju's customers whether Sn/Ag/Cu and Sn/Ag/Cu/Bi solder alloys had been applied using wave solder.
Comments:	

LFS.01.11.19

Date Due:	**12/04/01**
Responsibility:	NASA/ITB (Brian Greene)
Required Action:	Schedule a mid-December teleconference to discuss lead-free solder alternatives, the two JTPs, and the continuing work on test board design.
Comments:	

Open Action Items

LFS.01.11.04

Date Due:	**12/11/01**
Responsibility:	Raytheon (Joe Felty)
Required Action:	JTPs. Ask a statistician whether five PWAs was a statistically sufficient number of samples.
Comments:	

LFS.01.11.05

Date Due:	**12/11/01**
Responsibility:	Raytheon (Joe Felty)
Required Action:	JTPs. Ask a statistician what should be the general criteria for test failure (e.g., 2 out of 5; 3 out of 5)
Comments:	

LFS.01.11.06

Date Due:	**12/11/01**
Responsibility:	Army (Keith DeGroot), Raytheon (Joe Felty)
Required Action:	Manufacturing JTP. Contact their respective organizations to obtain worst-case vibration spectra for inclusion in the Manufacturing JTP Vibration Test.
Comments:	

LFS.01.11.08

Date Due:	**12/11/01**
Responsibility:	All technical representatives
Required Action:	Manufacturing JTP. Check with respective organizations to make sure that 200 cycles is a sufficient maximum number of cycles to run Thermal Shock for the Manufacturing JTP Thermal Shock Test.
Comments:	12/17/01 –M. Stibitz responded that 200 thermal shock cycles are sufficient for WR-ALC as long as the level of shock being used is per the MIL-STD-883 requirements.

LFS.01.11.12

Date Due:	**12/11/01**
Responsibility:	Boeing (Tom Woodrow)
Required Action:	Test Board Design. Provide data from Lucent on the performance of immersion silver surface finish.
Comments:	

LFS.01.08.01

Date Due:	**11/1/01 (originally 08/22/01)**
Responsibility:	All Services and NASA [e.g., AFRL (Dave Johnson), TACOM (Carl Handsy), NAWCWD (John Nelson), USMC (Don Bowie), NASA (Bob Hill)]
Required Action:	Itemize and describe any technical concerns your Service/organization has with use of lead-free solders. Distinguish concerns by new systems (manufacturing) versus old systems (depot repair).
Comments:	11/15/01 – Progress was made at the Nov 14-15 meeting. Awaiting input from more of the stakeholders.

LFS.01.08.02

Date Due:	**11/1/01 (originally 08/22/01)**
Responsibility:	All Services and NASA [e.g., AFRL (Dave Johnson), TACOM (Carl Handsy), NAWCWD (John Nelson), USMC (Don Bowie), NASA (Bob Hill)]
Required Action:	Identify the range of currently used lead-containing solder formulations and applications that the Services and NASA would be trying to replace (e.g., are they all eutectic [63% Sn/ 37% Pb]?).
Comments:	09/18/01 – WR-ALC indicates that 95% of their solders are 63Sn/37Pb. Awaiting more service input.

LFS.01.08.03

Date Due:	**11/1/01 (originally 08/22/01)**
Responsibility:	All project technical representatives
Required Action:	Review and comment on the suitability of the candidate lead-free solders that were emailed to the technical representatives on Tuesday, August 7. The information is contained in the four attached files. Brian Greene will consolidate all responses and provide them to all via e-mail within 2 weeks of final receipt (no later than 09/05/01).
Comments:	11/15/01 – Progress was made at the Nov 14-15 meeting. Awaiting input from more of the stakeholders.

LFS.01.06.06

Date Due:	**10/11/01 (originally 07/30/01)**
Responsibility:	All Technical Representatives
Required Action:	Identify their top lead-free solder candidates to Joe Felty, Raytheon
Comments:	09/19/01 – Raytheon provided their recommendations; posted to the JG-PP Web site 11/15/01 – Progress was made at the Nov 14-15 meeting. Awaiting input from more of the stakeholders.

LFS.01.06.07

Date Due:	**11/1/01 (originally 08/03/01)**
Responsibility:	All Technical Representatives
Required Action:	Consolidate the candidate lead-free solders and provide them to CTC for inclusion in a draft JG-PP Potential Alternatives Report (PAR)
Comments:	11/15/01 – Progress was made at the Nov 14-15 meeting. At that meeting, a more refined list of alternatives was identified. Awaiting input from more of the stakeholders.