



# JG-PP Email

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Joint Group on Pollution  
Prevention

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## *Lead-Free Solder Early Customer Interface Meeting Minutes*

**Comments:**

Attached please find the minutes from the May 9, 2001, Lead-Free Solder early customer interface meeting. Please further distribute as necessary.



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**MEMORANDUM FOR RECORD**

**May 21, 2001**

**Subject: Meeting Summary and Minutes – May 9, 2001**

**Material(s) Identified:** Lead

**Process Identified:** Electronic soldering

**Methodology Phase:** I-Identification

**Summary:**

On May 9, 2001, technical representatives from Headquarters Air Force Material Command, Air Force Research Laboratory, Alliant Techsystems, American Competitiveness Institute, Boeing Company, Army Aviation and Missile Command, Bradley Fighting Vehicle, INEGI - Portugal, Lockheed Martin, National Aeronautics and Space Administration-Kennedy Space Center, National Center for Manufacturing Sciences, National Institute of Standards and Technology, Naval Air Warfare Center Weapons Division, Raytheon, Rockwell-Collins, Potomac-Hudson Engineering representing HQs USMC/IL, Sandia Laboratories, TRW, U.S. Army Communications & Electronics Command, U.S. Army Tank-Automotive and Armaments Command, and Warner Robins Air Logistics Center participated in a meeting with representatives from the Joint Acquisition Sustainment Pollution Prevention Activity and National Defense Center for Environmental Excellence/ Concurrent Technologies Corporation. The objective of the one-day meeting was to introduce the potential for a Lead-Free Solder JG-PP project and begin defining overall goals and requirements for potential acquisition and sustainment organizations that may wish to become involved in the project. Presentations were given by JASPPA as well as various OEMs and technical organizations that have been researching lead-free solders. Two action items taken. See Attachment 1.

**To access the minutes and slide presentations from the May 9, 2001 Lead-Free Electronics Soldering Early Customer Interface meeting, follow these steps.**

1. Using your Web browser, go to the JG-PP home page at <http://www.jgpp.com>
2. On the home page, click on the "What's New" tab on the top menu bar to go to the What's New Web page ([http://www.jgpp.com/whats\\_new/whatsnew\\_index.html](http://www.jgpp.com/whats_new/whatsnew_index.html))
3. On the What's New page, click on the underlined 'click here' hypertext immediately following the announcement of the new Lead-Free Electronics Soldering project in the middle of the page. This will take you to the Solder project's Web page.
4. On the Solder project's Web page, note the "Related Topics" task bar on the right side. Click on the appropriate labeled item (either "Meeting and Teleconference Summaries" or "Presentations") to view the May 9, 2001 early customer interface meeting minutes and presentations. For the minutes, you have the option to view just the meeting summary paragraph as it appears on the screen, or view the entire minutes by clicking on the 'click here' link where



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indicated. For the presentations, you will automatically be shown a listing of the eight presentations by title and presenter. You can click on each presentation individually to view it, then hit your browser's 'BACK' button to go back and view the next presentation.

5. Just hit your Web browser's "BACK" button to return to a previous screen.

**Next Teleconference:** TBD

**Next Meeting:** Subcommittee meeting tentatively scheduled for June 2001 in Dallas, Texas to begin setting performance boundaries in which lead free alternatives would need to be qualified.



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### Minutes

1. The meeting began at 0900 on May 9 with a welcome by Mr. Ken Payne, Director, Spaceport Engineering and Technology, NASA KSC. Mr. Payne emphasized that we are collectively facing a smaller world, one with international markets and competition, and where there is an increasing need to share knowledge, resources, and experience. He expressed confidence in JG-PP to bring these pieces of the puzzle together to solve pollution prevention problems, such as lead free solder.
2. Mr. Robert Hill, Program Manager at NASA KSC and JASPPA Chairman, provided opening remarks and thanked everyone for the coming to the meeting. He introduced Ms. Tess Flynn, NASA KSC as the meeting coordinator, Mr. Brian Greene, NDCEE/CTC and Mr. Denny Jarvi, NASA KSC, taking the minutes. The minutes were collected and distributed from the NASA KSC office. Mr. Hill stated that the objective of today's meeting was to baseline where current efforts are in the process of identifying and validating lead-free solder. Mr. Hill stated that the meeting objective was to result in meeting the participants willingness to commit to supporting the lead-free solder project's activities, engage their weapon systems managers and depot process owners, and prepare for identifying critical performance requirements for circuit card assemblies employing lead-free solders.
3. Mr. Mike Leake, Raytheon, provided an overview of the lead-free solder opportunity. Mr. Leake indicated that there are least four risks that OEMs and weapon system managers now face pertaining to continued use of tin-lead solder: compliance with current environmental regulation, concerns about potential environmental legislation banning lead-containing products, risk of trade barriers and lost sales, and risk of mission readiness.
4. Recently, U.S.EPA lowered the Toxic Chemical Release reporting threshold for lead to 100 pounds. Overseas, the WEEE directive in Europe and similar mandates in Japan have instilled concern that a legislative body will prohibit the use of lead in electronics soldering. Mr. Leake stated that if a particular country disallows lead in electronics, then a trade barrier is created between that country and anyone not capable of providing lead-free electronics solutions. Finally, any potential banning of lead compounds could adversely affect DOD mission readiness overseas.
5. In order to prepare for the inevitable switch to lead-free soldering, it makes sense for the DOD and OEMs to begin the search for suitable lead-free products and processes for their unique applications as soon as possible. Mr. Leake warned that a single lead-free alternative probably does not exist for all applications. For that reason, it is important for a consortium to begin now to define the scope of a lead-free solder project(s) and validate



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alternative(s) for the defined application so that there is enough time in the future to tackle other applications.

6. Mr. Leake presented a notional project schedule (3 years) and cost estimate (\$1.7 million) for the project, assuming close adherence to the JG-PP methodology and limited test vehicle redesign based on the current test vehicle for the JG-PP CCAMTF (Circuit Card Assembly and Materials Task Force) project. Some in the audience felt the three-year timetable was reasonable, but that the cost could exceed \$2 million. Mr. Pinckert, Boeing Company, reported that Japan has committed over \$11M to the qualification and implementation of lead free solder in three major Japanese companies.
4. Following Mr. Leake's presentation, several issues were raised. Mr. Carl Handsy, TACOM, stated that the Army would not be responsible for testing and inspecting solder joints, and that he saw that as the OEM's responsibility. Mr. Leake agreed the onus would be on industry, but that the affected Service representatives still had a responsibility to define their critical performance requirements for the circuit boards. Mr. Hill commented that this was true for performance based contracts, but in non-performance based contracts the services and weapon system program managers would need to be involved. Mr. Hill also added that the Service requirements should include any special needs of the sustainment community, such as repairability, special procedures, and training. Mr. Vic Starkovich, Boeing Phantom Works, noted that the military could help by placing a requirement in future defense system contracts for the OEM to develop a plan for reducing lead in solder. Mr. John Myer, CECOM, stated that long-term reliability of the boards would be a key concern of the military. Mr. Dave Johnson, AFRL, stated a serious concern about what kind of conclusions could be drawn from testing only a single test vehicle. In response to a question from Mr. Levern Keels, WR-ALC, about the critical need to ensure depot issues are addressed, Mr. Hill stated that a lead free solder test plan should incorporate both new and old avionics designs. Mr. Leake closed his discussion by emphasizing that today's meeting objective was to answer the questions, "Can we do this project?" and "Who will the team be?" Questions pertaining to the testing details would best be addressed at a subsequent meeting once the first two questions were addressed.
5. Mr. Lee Whiteman and Mr. Blaine Partee, ACI, reviewed their manufacturing experience and industry feedback concerning lead free solders. Mr. Whiteman echoed Mr. Hill's and Mr. Leake's earlier conclusion that lead-free soldering seems to be more an issue of "when", rather than "if." ACI has been working to determine whether any lead-free solders are equivalent or better than tin-lead solders for high reliability DOD environments. Some conclusions that ACI has arrived at in comparing lead-free solders to tin-lead solders include:
  - Lead-free solder doesn't solder as well, so worker training is required



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- Lead-free solder does not have as good an appearance
- Component manufacturers are preparing for new, lead-free component finishes, so tin-lead finish component obsolescence issues must be addressed

Mr. Partee concluded the joint presentation by reviewing the observed failure mechanisms of lead-free solders that ACI tested. He stated that ACI is still trying to determine what additional reliability testing is needed to implement lead-free solder in the field, especially for aerospace avionics applications.

6. Mr. Richard Salzbrenner, Sandia Labs, briefed the group on their work in measuring and modeling thermal-mechanical fatigue deformation of lead-free solder interconnects. Sandia is responsible for all nonnuclear components and subsystems in nuclear weapons, equaling thousands of parts per weapon system. The basic question that the predictive modeling was designed to answer is, "How will lead-free solder affect long term reliability?" Accelerated testing is fast becoming impractical for long-term reliability databases, especially if changes are made to the board resulting in the frequent rerunning of the tests. Because Sandia's parts operate in a hermetic environment, the simplified model did not incorporate a term for corrosion effects or for microstructure failure. Sandia's plans are to set failure criteria and work backward using the model to predict the failure of a board, and then verify the model with actual test results.
7. Mr. Tom Woodrow, Boeing, discussed efforts to eliminate lead from printed wiring assemblies. Boeing is presently examining two lead-free solders and three lead-free boards finishes in terms of reliability, shear strength, and leachate potential. Boeing selected the 1206 chip resistor as the test board, primarily because it is cheap and fails quickly. Not all testing is complete yet, so only some preliminary results are available. Mr. Woodrow indicated that the leachate test is important because some lead-free solders contain silver, which is toxic to some marine life. Preliminary cycling failure results seem to indicate that lead-free solders fail sooner than tin-lead solders.
8. Mr. Tim Swigert, AFRL, briefly reviewed some of the lessons learned from lead-free solder testing. He stated that any lead-free solder should not be environmentally questionable. He also stated that any Joint Test Protocol should include both physical property tests (e.g., heat of vaporization, solder density, melting point, conductivity, corrosion performance, stress) as well as mechanical and tensile strength, fatigue strength, heat resistance, etc.
9. Mr. Lee Patch and Mr. Duane Napp, NCMS, reviewed his experience with lead-free solder. Mr. Patch noted that at a recent meeting that he attended, issues like rework came across strongly. Mr. Napp reviewed the results of three recent NCMS studies that have been completed and will soon be completed. In one project, whose results will soon be released, lead-free solders were subjected to thermal cycling between -55 °C and 160 °C.



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Results indicate that two bismuth-containing solders performed the best of the lead-free solders tested on plastic and other boards. Mr. Napp noted that a key requirement is that all lead must be removed from the board. A future NCMS project is to develop a lead-free solder for harsh environments (-55 °C to 205 °C.).

10. Mr. Hill provided an overview of JG-PP and discussed how it works, it's accomplishments, and the kind of role JG-PP would play in a Lead-Free Solder project. Mr. Hill emphasized that the JG-PP methodology calls for the alternatives selected for testing, the tests themselves, and the test locations to be selected by the technical participants, not JG-PP. JG-PP is a technical and managerial resource to facilitate the process of sharing resources, testing alternatives, and helping implement validated alternatives through the Single Process Initiative and the services internal processes. Mr. Hill discussed the current JG-PP CCAMTF project as an example of a JG-PP project where many technical and financial resources were leveraged to share the testing burden, but where all participants stand to benefit from the testing. Information on current JG-PP activities can be found at JG-PP Web site, <http://www.jgpp.com>.
11. Mr. David James, JASPPA, Defense Contract Management Agency (DCMA), provided an overview of DCMA's role in supporting Acquisition Pollution Prevention Initiative (AP2I). AP2I links the Single Process Initiative with JG-PP to identify potential new JG-PP projects and implements JG-PP projects at contractor locations. SPI enables process improvement on current as well as future contracts. By gaining up front buy-in from stakeholders, validated alternatives can be quickly and easily implemented following testing. For OEMs, briefing their Management Council early and often is very important.
12. Mr. Hill asked all the meeting participants to individually indicate whether now was the right time to begin a lead-free solder project and state whether they would participate in a lead-free solder project at this time under the auspices of JG-PP. All of the affected participants indicated unanimously that now was the time to begin a project. Some individuals had reservations about how the testing would be conducted (e.g., Mr. Johnson, AFRL), while others (e.g., Mr. Mark Shireman, Alliant Techsystems) saw a need to definitely include component manufacturers. All but NIST and NCMS could commit at this time to participating in future JG-PP lead-free solder project meetings. Mr. Leake proposed that a subcommittee of the larger group be formed to set boundaries and develop the scope of the project, including a schedule and cost estimate proposal to the group at large. A tentative list of subcommittee members was formed (see Attachment 2).
13. Two action items were assigned to the meeting participants, each due on May 23. The first was for all the technical representatives to provide to Mr. Greene the names and organization of anyone who would like to participate in a Lead-Free Solder subcommittee



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meeting (Action item **LFS.01.05.01**). The meeting would tentatively be hosted by Raytheon in Dallas, Texas. The other action was for all technical representatives to provide the name and organization of anyone within their Service, organization, or outside organization who should be involved in the JG-PP Lead-Free Solder project (AI **LFS.01.05.02**).

14. Mr. Hill closed the meeting by again thanking everyone for attending and for agreeing to participate in the project. The meeting was adjourned.

***SIGNED (Approved by R. Hill 05/24/01)***

Robert P. Hill  
JASPPA Chairman, NASA KSC

Attachments:

1. Action Items
2. List of Lead-Free Solder Subcommittee members (draft)

## **New Action Items**

### **LFS.01.05.01**

***Date Due:*** 05/23/01

***Responsibility:*** All Technical Representatives

***Required Action:*** Provide to Brian Greene, CTC, the names and organization of anyone who would like to participate in a Lead-Free Solder subcommittee meeting to be hosted by Raytheon. Brian Greene will forward the names to Mike Leake, Raytheon.

***Comments:***

### **LFS.01.05.02**

***Date Due:*** 05/23/01

***Responsibility:*** All Technical Representatives

***Required Action:*** Provide to Brian Greene, CTC, the name and organization of anyone within their Service, organization, or outside organization who should be involved in the JG-PP Lead-Free Solder project

***Comments:***

## **JG-PP Lead-Free Solder Subcommittee Members (draft)**

1. Mike Leake, Raytheon
2. Joe Felty, Raytheon
3. Dave Johnson (AFRL)
4. Dave Hillman (Rockwell-Collins)
5. Lee Whiteman (ACI)
6. Jerry Ewing (AFMC)
7. John Myer (CECOM)
8. Tom Woodrow (Boeing)
9. Celeste Roper (NAWCAD China Lake)
10. Don Bowie (Potomac Hudson, representing Marine Corps)
11. Bill Brockett (Lockheed Martin)
12. Linda Lauer (Lockheed Martin)
13. Duane Napp (NCMS)
14. Carl Handsy (TACOM)
15. Amitav Pattnaik (WR-ALC/TIECT)
16. Chris Jurgeson (IPC) (need to personally invite)
17. Robert Hill (JASPPA, NASA KSC)
18. Denny Jarvi (NASA KSC)
19. Kurt Kessel (NASA KSC)
20. Tess Flynn (NASA KSC)
21. Brian Greene (CTC)