



IMPACT OF LEAD FREE SOLDERS (LFSs) ON STANDARD ELECTRONIC PARTS IN THE DoD STANDARDIZATION PROGRAM

LEAD FREE SOLDERING SUMMIT

July 14, 2005

DEFENSE SUPPLY CENTER COLUMBUS (DSCC)

David E. Moore

Chief, Document Standardization Unit

(614) 692-0675 or DSN 850-0675

David.E.Moore@dla.mil



DEFENSE SUPPLY CENTER COLUMBUS (DSCC)



- **MISSION:**

- Under the Defense Logistics Agency
- Supports the military warfighter with spare parts
- Manages the DoD Standardization Program for assigned specifications and standards
- Over 900,000 electronic parts in the inventory system



(DSCC-VA) DOCUMENT STANDARDIZATION UNIT



- **Specification Preparing Activity (SPA)**
- **Responsible for over 8,000 engineering specs and drawings on electronic parts**
- **Coordinates technical requirements with industry and the military services/NASA**
- **Over 1000 organizations (military, industry, NASA) involved**



HAZARDOUS MATERIAL MINIMIZATION (HMMIN) PROGRAM



- **Monitors use of hazardous materials in the DoD standardization program**
- **Provides recommendations to various SPAs on hazardous materials issues**
 - Possible alternatives
 - Minimization of use
 - Industry initiatives/trends
- **Program Manager**
 - **Dr. Simon Chang (DSCC-VSS)**
 - **(614) 692-1398 or DSN 850-1398**
 - **likow.chang@dla.mil**



Current Situation



- **Existing specifications on low voltage, small geometry parts primarily tin lead solder formulations**
 - Resistors, capacitors, semiconductors, microcircuits, electronic relays/switches, etc.
 - Current specs require a tin lead alloy (2 to 3% minimum)
- **Pure tin prohibitions date to mid 1990s based on mandate from the military departments/NASA/NSA**



HISTORY OF PURE TIN PROHIBITION



- **NSA, Air Force Space & Missile Center, & others petitioned DESC (Defense Electronics Supply Center) in early 1990s to prohibit the use of pure tin plating**
 - Tin whisker phenomenon
 - High risk nature of these applications
 - Cost of failure too high
- **DESC and the military departments successful prohibited the use of pure tin platings in hundreds of defense specifications on electronic parts and require lead alloys if tin was used (2 to 3% min lead)**



Current Situation



- **Current suppliers of standard military parts will continue to supply tin lead solders for the foreseeable future (barring future legislative mandates)**
- **Commercial grade parts are switching to pure tin solders as a quick, inexpensive drop in replacement to comply with restrictions in Europe and Japan**



RoHS, WEEE Driving Lead Free Solders



- **In Europe and Japan the move to LFSs is driving the movement away from tin lead solders**
- **One outcome is the expanded use of pure tin platings since they are viewed as an easy, inexpensive drop-in replacement for tin lead solders**
- **However, the tin whisker problem still exists**
- **No current directives in US, but commercial electronic device suppliers are reacting to European and Japanese efforts**



SAC Alloys



- **Work also continues on evaluation of SAC alloys (tin silver copper alloys)**
- **Joint Group on Pollution Prevention JG-PP is currently evaluating reliability of one SAC alloy for military/aerospace applications:**

95.5Sn-3.9Ag-0.6Cu

- **Many others are evaluating proprietary SAC alloys**



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Pure tin will remain prohibited unless root cause of tin whisker growth can be defined and mitigation methods developed**
- **SAC alloys if determined effective for high reliability military & aerospace applications, will drive a new set of standard parts with new part numbers**
- **Many specs that previously prohibited pure tin and left the solder alloy to the manufacturer will have to redefine existing part numbers as tin lead formulations**



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Configuration control of new LFSs is essential**
 - **Must be part number differentiated**
 - **Must avoid mixing existing stock of tin lead finishes with new LFSs in inventory**
- **Configuration control can be achieved in the existing defense specs for electronic parts**



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Part numbers in defense specs fall into two categories**
 - **Part number systems in which the lead finish is already coded in the existing part number**
 - **Part number systems in which the lead finish is not coded in the existing part number**



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Examples of the specs in which the lead finish is part number coded:**
 - MIL-PRF-38534 & MIL-PRF-38535 and associated Standard Microcircuit Drawings (SMDs)
 - 5962-9951001Q2**A**
 - MIL-PRF-55342 chip resistors
 - M55342H01**B**1E00M
- **Adding LFSs will be straightforward and require a new code in the existing part number system**



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Examples of the specs in which the finish is not part number coded:**
 - MIL-PRF-19500 Semiconductors
 - JANTXV2N2222A
 - MIL-PRF-39016 Relays
 - M39016/10-001L
- **Adding LFSs will present a greater challenge**
 - Existing part number will be redefined to be a tin lead alloy (no change in the part number itself)
 - Code for LFS will be added to the end of existing part number to differentiate



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Some are using proprietary LFS alloys**
 - Typically information is only available from suppliers
 - Customer may have to sign a nondisclosure statement
- **For defense specs use of proprietary alloys not feasible**
 - Need to know alloy for wide use among defense OEMs
 - Not practical for spares sustainment for military customers



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **Limited inquiries to date on providing standard electronic parts with LFSs**
 - One request to develop standard microcircuit in Vendor Item Drawing (VID) with a SAC alloy
 - On hold, SAC alloy is proprietary
- **At some point we anticipate requests from both the device manufacturers and equipment contractors**
 - Expect first requests for surface mount components



CHALLENGES FOR THE STANDARD PARTS PROGRAM



- **LFSs will also drive changes to solderability and resistance to soldering heat tests**
 - J-STD-002 already being modified to address LFSs
 - SAC alloys typically solder at higher temperatures
 - Resistance to soldering heat tests will have to be reviewed/modified
- **Due to higher temperatures some level of requalification of part designs using LFSs will be required to verify capability**
- **As noted earlier, LFSs must have definitive part number**



Other Concerns



- Acquisition reform has given contractors the flexibility to use commercial and modified commercial parts in military applications
- Many commercial part suppliers are now shifting in a big way from tin lead solders to pure tin
- Unfortunately some of these same commercial parts may have found their way into military and aerospace applications in the last few years



Other Concerns



2 Scenarios:

- (1) Device supplier changes part number to reflect switch to pure tin**
 - Still an issue (i.e., tin whiskers) but at least there is visibility
- (2) Device supplier does not change the part number**
 - May not even know that you are now getting pure tin in lieu of tin lead
 - Many buys are through distribution system



Other Concerns



- **Possible mitigation efforts for commercial parts:**
 - **Contract clauses requiring pure tin identification/prohibition**
 - **Incoming inspection**
 - **Review by engineering support activities in the military services on risks**
 - **Retin pure tin leads with a tin lead alloy**
- **Unfortunately none are ideal solutions and will drive costs**



SUMMARY



- **Defense specs on electronic components protect against use of pure tin lead finishes**
- **Pure tin prohibitions in the defense specs will remain**
- **Defense specs can react to the inevitable introduction of LFSs and will part number differentiate**
- **Defense specs will verify ability of LFS parts to meet demanding military environments and higher soldering temperatures**
- **Commercial parts present significant problems**
 - **Visibility issues**
 - **Part number differentiation can not be assumed**
 - **Switch to pure tin for commercial applications**



DSCC RECOMMENDATIONS



- **Continue ban on pure tin lead finishes until means to mitigate tin whiskers are developed**
- **Monitor activities of JG-PP and others on viability of SACs for military/aerospace applications**
- **Participate in revision of J-STD-002 and changes to resistance to soldering heat methods**
- **Monitor QPL/QML suppliers and add SAC alloys to defense specification along with appropriate testing and requalification to support DoD needs**