

# LEAD-FREE

Using Lead-free (Pb-free) in Military Electronics is a Risky Business!



## LEAD-FREE IN DOD

**Because there are inherent risks with Pb-free, risk management processes are paramount to ensure that reliability is maintained and is not adversely impacted from the unwitting introduction of Pb-free in Military Electronics.**

For over fifty years, the electronics industry has relied on Tin-Lead (SnPb) solder as the primary means of interconnection between electronic devices. The reliability of SnPb interconnections is well known, well studied, and well documented. The European Union's (EU) Restriction of Hazardous Substances (RoHS) directive and other international and domestic mandates to eliminate materials deemed hazardous has forced the electronics industry to adopt solders free of Lead (Pb).

While military electronics are considered "out of scope" for these Pb-free imperatives, the reality is that the consumer market drives the electronics industry, not the military. To remain competitive electronics companies and their suppliers worldwide must change to solders and materials compatible with Pb-free assembly.

Electronics for high reliability applications, such as the military, rely heavily on commercial piece parts, and, in some cases, circuit boards, assemblies, and equipment, the majority of which have been or will transition to Pb-free.

### Increased Reliability Risks

Based on the scientific information available today, there are increased reliability risks by using Pb-free in military electronics. These risks include the spontaneous formation of tin whiskers from pure tin (Sn) finishes, reduced Pb-free solder joint integrity, reduced reliability by cross-contamination between the different alloys, and the potential damage from higher Pb-free processing temperature.

This conversion of the commercial supply chain to Pb-free requires DoD to be diligent to



**Lead-Free Control Plan (LFCP)** addresses the inherent risks with Pb-free and provides risk management processes relating to Military Electronic Systems.

# LEAD-FREE IN DOD

## There is no drop-in replacement for Tin-Lead solder!

ensure that the reliability of military electronics is maintained and not adversely impacted from the unwitting introduction of Pb-free.

### Risk Management

Employment of risk management principles is required to deal with the identified Pb-free risk factors to eliminate or at least minimize any potential negative impact on the performance and reliability of electronics performing in military environments. Currently, there is little scientifically sound and statistically rigorous data with respect of Pb-free performing in military environments from which to conduct a quantitative analysis.

As described previously, the increased risk factors resulting from using Pb-free in military high-reliability electronics are tin whiskers, solder joint integrity, cross-contamination, and increased processing temperatures.

Management of these risk factors will be accomplished through the risk response strategies employed. Every effort should be made first to avoid the risk factor by eliminating it or its impact, followed by mitigating the probability of occurrence or reducing the impact of the risk factor, and finally, transferring the risk to another party. When there is no other viable or practical alternative, the risk factor will have to be accepted.

The use of Commercial-Off-The-Shelf (COTS) equipment is being mandated as part of acquisition reform and is becoming increasingly

prevalent in military electronic equipment and systems. In some cases, this equipment may be in mission critical systems and/or in safety of flight situations. COTS is more than likely to be Pb-free, as the commercial manufacturers are being forced to Pb-free to comply with RoHS and other legislative mandates. Special care must be taken to understand and address the reliability concerns that Pb-free presents for COTS equipment as Pb-free is yet unproven in military environments. The same reliability concerns addressed herein apply to COTS used in military equipment. The use of COTS in mission critical and/or in safety of flight circumstances requires special consideration to address the inclusion of Pb-free.

### DoD Lead-Free Control Plan

The DoD LFCP identifies DoD's intentions with respect to Pb-free and provides a standardized approach to Pb-free should inclusion become unavoidable. The DoD LFCP describes the policies to limit, control, and/or manage the inclusion of Pb-free to ensure that military electronic products will continue to satisfy the applicable requirements for performance, reliability, and safety, throughout the lifecycle as the commercial electronics industry transitions to this technology.



**Pb-free is NOT free!**

### DoD Soldering Technologies WG

The DoD Soldering Technologies Working Group (STWG) provides DoD with technical expertise with respect to Pb-free and is chartered under the Defense Standardization Program by the Lead Standardization Activity for soldering. The STWG has developed a number of documents on Pb-free:

- The DoD LFCP
- Templates for developing LFCPs
- Technical Guidance for Pb-free Electronics
- Technical Guidance for Rework/Repair of Pb-free Electronics
- Risk Management for Pb-free Electronics
- "Understanding Lead-Free" [an introductory training course]

See the DAU website for Pb-free <https://acc.dau.mil/leadfree> or the POC below for additional information and copies of the above documents.

## LEAD STANDARDIZATION ACTIVITY

Crane Division  
Naval Surface Warfare Center  
Crane IN

### Point of Contact

- Contact the DoD Soldering Technologies Working Group at [DoD\\_Lead-free@navy.mil](mailto:DoD_Lead-free@navy.mil) for additional information.

## DoD Soldering Technologies WG

Supports the LSA for Soldering Technologies, by providing technical expertise and senior level visibility for standardization, supportability, and interoperability initiatives relative to soldering technologies.