Lead remains critical to the safety and reliability of space systems

Artist's view of Sentinel-6 in orbit

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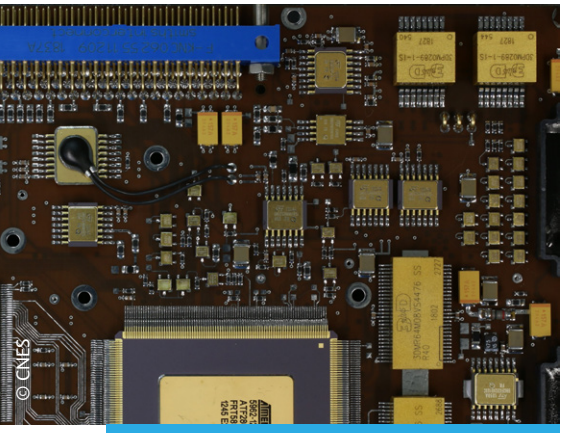

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Space flight model electronic board

The European space manufacturing industry is a strategic sector for the region, embedded in the wider aerospace and defence industrial complex.

For decades, the space sector has reached a level of maturity that allows reliable and autonomous access to space, extraordinary space and earth science, as well as fully operational programmes delivering strategic services for governments and answering citizens' needs. Satellite imagery and communications (including localisation) have become a staple for a range of major applications such as for meteorology, disasters monitoring, surveillance purposes, providing localisation, navigation and cartography software and services, emergency and/or secured communication, delivering connectivity everywhere (in-flight and to the most isolated places), just to mention a few. Many of those applications address Europe's societal challenges (such as the Maritime Strategy, the Arctic Strategy, the Digital Agenda, the Common Security and Defence Policy and the Sustainable Development Strategy for example).

With the inherent risk involved as no repair is possible after launch, new space technologies require extensive testing and a high level of maturity before they can be implemented widely. With lead's reliable properties, it has become an essential element for the sector.

Used across the industry for decades, lead plays an integral part in high reliability applications in the European space industry. The use of tin-lead solder alloys for electrical and electronic equipment constitutes the main space-related use of lead. The trend in the electronics industry towards the use of lead free solder and pure tin finished terminations poses risks for space applications such as brittleness that can promote crack formation and tin whiskers emerging from component termination that can lead to short circuits. It is for this reason also that equipment designed to be sent into space is explicitly excluded from the scope of the RoHS Directive 2011/65/EU on the restriction of lead and some other substances.

Additional critical uses of lead in the space domain include indium-lead solder on thick gold coatings for long-life systems and pyrotechnical devices, in seals for applications where the high temperatures are not suited to organic materials and as a solid lubricant for space mechanism bearings in applications which cannot use oils and greases due to contamination, viscosity or volatility problems. Further areas of use include battery terminals and radiation shielding.

In the case of leaded solder, there is vast heritage and experience under all environmental conditions, the window process is relatively large allowing a process flexibility and it presents all the needed characteristics to produce high reliability assemblies (mechanical, thermo-mechanical, physico-chemical properties).

No other material can match the safety and reliability of leaded solder. The entire satellite industry is based on 60 years of cumulated experience of tin-lead solder joints. This is more important in modern day satellites where electronics pervade all subsystems. Changing such a basic process would introduce a high degree of uncertainty and risk for the components and printed circuits. Professional use of leaded solder follows strict risk management processes, and a framework of existing legislation and industry best practice protects engineers and technicians. Without lead, the risk of mission failure for space vehicles due to inferior equipment may increase, with far greater safety implications for old and current design.

Ultimately, transitioning to lead-free alternatives for solders offers no benefits for the space industry. With strong risk prevention measures already in place, engineers and technicians are already well protected, while with the significant investment required to create a suitable replacement, pursuing a lead-free solution comes with no guarantee a suitable replacement could be found.

Nevertheless, there are already increasing pressures driving and further intensifying R&D activities for substitution. To support this long-term and complex challenge jointly in the space sector, a 'Joint Task Force on Pb-free transition'* comprising major industrial players, the European Space Agency and national space agencies has been created. This initiative was launched by the European Space Components Steering Board of the European Space Components Coordination (ESCC SCSB) in early 2019 to define long-term strategic goals. In the meantime, lead metal continues to be an indispensable component in high reliability applications in the European space industry.

Fact file

- Lead is used in a vast array of solder applications along the space supply chains, manufacturing high reliability Electrical and Electronic Equipment (EEE), Printed Circuit Boards (PCB) and solder connections designed for use in space. This use is based on 60 years of cumulated experience and fine-tuning that has resulted in a highly reliable process that underlies the broad space industry
- Critical uses of lead include advanced coating and sealing in high-temperature environments, and solid lubrication in contamination-critical environments
- Further areas of use include battery terminals and radiation shielding
- The European space industry delivered 70 spacecraft for launch in 2019, including 33 micro satellites (below 100kg in mass at launch)**
- In 2019, the European space industry posted consolidated sales worth €8.7 billion and employed a total of 48,000 workers. The six major European Space Agency member states (France, Germany, Italy, United Kingdom, Spain and Belgium) contribute around 90% of European space industry employment opportunities**

*More information on the Joint Task Force on Pb-free transition is available at: https://indico.esa.int/event/264/contributions/4516/attachments/3488/4611/Kick-off_of_the_joint_task_force_for_Pb-free_transition.pdf

**Source: Eurospace facts & figures annual survey - 2020 edition (Draft June 2020); copyright by Eurospace; reproduction by ILA authorised in the context of joint advocacy and the Lead *Matters* toolkit.

Developed in collaboration with the Lead metal REACH Space Task Force represented by Eurospace, this case study highlights just one of the many essential uses of lead that provide societal benefits and boost the EU's economy

For Europe's future, lead matters.

Lead Matters