Air Force SBIR STTR TRANSITION
EQUIPPING THE WARFIGHTER

REPLACING A HIGHLY TOXIC CHEMICAL THAT IS COSTLY TO REMEDIATE

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AF071-320

TOPIC TITLE:
Cadmium Elimination: Implementation of Low Hydrogen Embrittlement Zinc Nickel (LHE ZnNi)

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SBIR COMPANY NAME:
ES3
Clearfield, UT

TECHNICAL PROJECT OFFICE:
Air Force Sustainment Center
Hill AFB, UT

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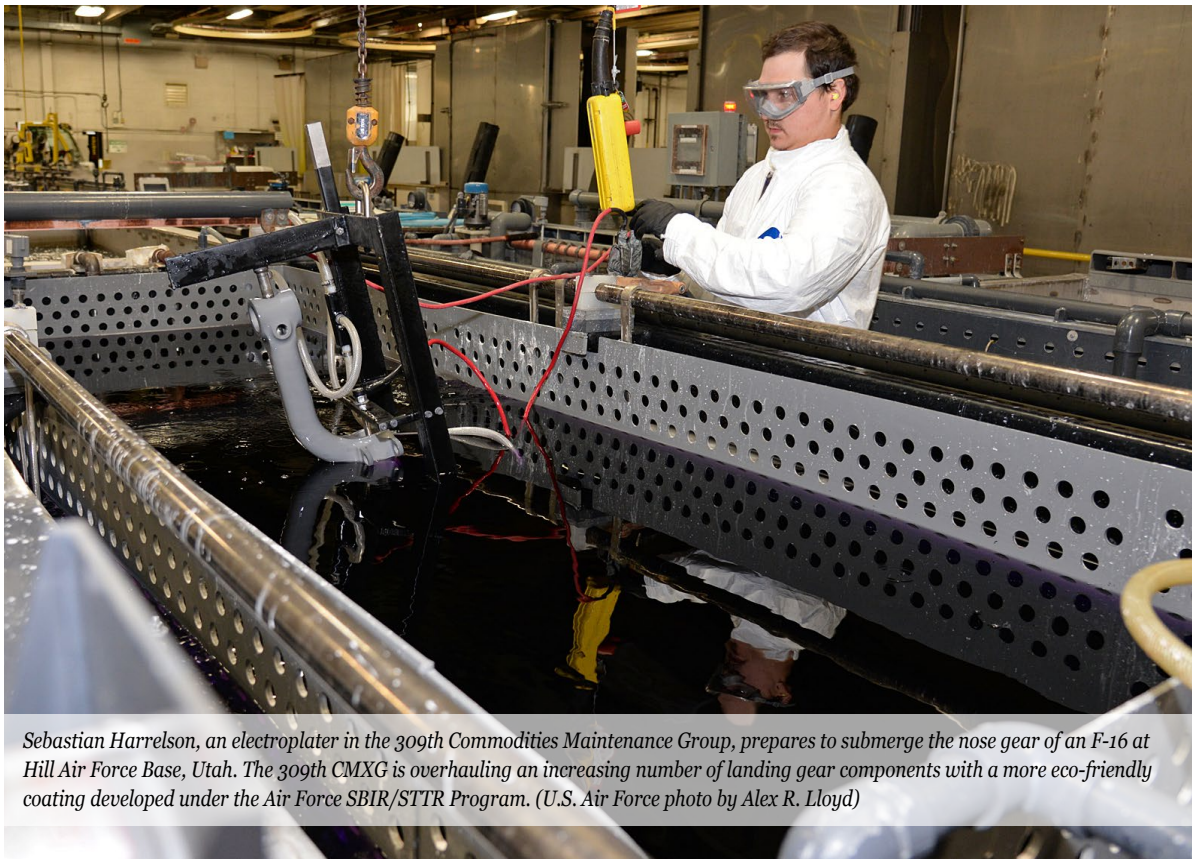

Sebastian Harrelson, an electroplater in the 309th Commodities Maintenance Group, prepares to submerge the nose gear of an F-16 at Hill Air Force Base, Utah. The 309th CMXG is overhauling an increasing number of landing gear components with a more eco-friendly coating developed under the Air Force SBIR/STTR Program. (U.S. Air Force photo by Alex R. Lloyd)

IMPROVED AIRCRAFT LANDING GEAR

PROTECTION TAKES TO THE SKIES

Spawned by a small business collaboration, the Air Force and aerospace industry now have a more environmentally-friendly and lower-cost option to protect a key aircraft system.

With support from the Air Force Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Program, Utah-based ES3 developed a process for plating steel aircraft landing gear components with Low Hydrogen Embrittlement Zinc-Nickel. Along the way, ES3 worked closely with a unit of prime contractor Boeing, as well as coating manufacturer Dipsol of America, to make the technology a reality.

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Low Embrittling Cadmium has traditionally been used as a sacrificial protective coating on high-strength steel aircraft landing gear to prevent corrosion, but is highly toxic so it poses a danger to the environment as well as to those workers who would handle it.

Also known as LHE (Low Hydrogen Embrittlement) Zinc-Nickel, the alternative chemical is much safer, has been shown to provide better protection and costs less when environmental factors are taken into account. LHE Zinc-Nickel has been used for other lesser-strength steel applications, such as auto manufacturing, but not successfully applied to high-strength steel aircraft landing gear until now.

“Cadmium has been an aerospace corrosion protection plating for years and years,” said Dave Frederick, a lead engineer for the Landing Gear Systems division of the 417th Supply Chain Management Squadron at Hill Air Force Base in Utah. “This development has been significant and will be relevant for a long time down the road.”

An LHE Zinc-Nickel plating line has been installed at Hill Air Force Base, where the 309th Commodities Maintenance Group is using the new method to overhaul an increasing number of landing gear components. Frederick said early financial assessments projected the new line would yield a multi-million dollar savings on hazardous waste disposal.

In addition to addressing legacy systems – a big step because it requires changes to drawings and specifications – LHE Zinc-Nickel also has the potential to be widely adopted for new aircraft manufacturing. Frederick said the specifications are available to any vendor that wants to set up a line, and an increasing number of new part acquisitions identify LHE Zinc-Nickel as a “preferred” plating method.

COLLABORATION WAS KEY

Aircraft manufacturers and overhaul facilities have been able to obtain a waiver to use cadmium on landing gear systems because there has been no feasible corrosion coating substitute. In recent decades, the industry has been trying to develop an environmentally-friendly, cost-effective, drop-in replacement.

Boeing endeavored to find a solution – through extensive laboratory testing of Dipsol’s LHE Zinc-Nickel coating – but was never able to scale-up the plating application process. When the Air Force decided to pursue a similar avenue using the SBIR program, ES3 answered the call and connected with Boeing, which provided a wealth of technical support and laboratory test data on Dipsol’s coating.

“LHE Zinc-Nickel has been the first coating developed that meets all the technical requirements of a protective sacrificial coating and ES3 elevated it to the next level, which is what the Air Force and aerospace industry needed,” said Steve Gaydos, a technical fellow for Boeing Research and Technology.

“Basically what they were doing is creating a (LHE) Zinc-Nickel (application) process that could be used in a large aerospace company, like Boeing, or by the Air Force. It was a fantastic partnership. All that knowledge was built upon the SBIR program.”

Air Force SBIR/STTR funding allowed ES3 to advance the technology through extensive qualification testing, which included adhesion, corrosion, fatigue, hydrogen embrittlement, re-embrittlement and brush plating.

The Air Force SBIR Commercialization Readiness Program, along with the Department of Defense Environmental Security Technology Certification Program, provided support for the company to scale up testing from simple laboratory LHE Zinc-Nickel plating to full-scale landing gear plating at Hill Air Force Base.

“This advancement wouldn’t have happened without the SBIR program,” said Craig Passetto, lead materials and process engineer at ES3.