

Topic: AF071-320

## Engineering and Software System Solutions (ES3), Inc.

Development of Cad Plating Replacement with Zinc Nickel on High Strength Steel Components

As the US Navy's seeks Cadmium plating alternatives, Engineering & Software System Solution (ES3), a high-end engineering firm providing an array of services and products to commercial and government entities has developed Low Hydrogen Embrittlement (LHE) alkaline Zinc-Nickel plating and non-hex chrome conversion coating as a drop-in replacement for Cadmium plating. The plating has been extensively tested since 2007 and meets or exceeds Cadmium performance in numerous tests: Corrosion, Hydrogen Embrittlement, Mechanical, Installation, and Appearance, Thickness, and Uniformity. It's successfully proceeded through testing of both barrel and rack plating on low and high strength steel fasteners and components for other DoD agencies. ES3 is currently performing additional certification testing for NAVAIR that includes extensive evaluations of structural-mechanical properties, sea based aviation corrosion performance and electroplate durability.

### Technology Category Alignment:

None

None

None

### Contact:

Jay Randolph

[jay.randolph@es3inc.com](mailto:jay.randolph@es3inc.com)

(478) 922-1460

<http://es3inc.com>

**SYSCOM:** NAVAIR

**Contract:** N68335-16-C-0037

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-16-C-0037](https://navystp.com/vtm/open_file?type=brochure&id=N68335-16-C-0037)

# Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2016-913

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Development of Cad Plating Replacement with Zinc Nickel on High Strength Steel Components Engineering & Software System Solutions (ES3), Inc.

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** COMFRC

**Transition Target:** Low and High strength steel aerospace components currently Cadmium plated

**TPOC:**  
(904)790-6405

**Other transition opportunities:** LHE alkaline Zn-Ni may be used as a drop-in replacement for Cadmium in many non-aerospace military applications, including use as a Cadmium replacement on ships, land vehicles, and support equipment.

**Notes:** ES3 has already led the transition to LHE alkaline Zn-Ni for landing gear components and will leverage experience from Phase II.5 and Phase III LHE alkaline Zn-Ni SBIR projects into the Navy Cadmium replacement effort.



Courtesy of US Navy 120902-N-SF704-016 SEPT 2012,  
<http://www.navy.mil/management/photodb/photos/120902-N-SF704-016.jpg>

## WHAT

**Operational Need and Improvement:** Steel aerospace components are frequently cadmium plated for corrosion protection. In addition to the environmental and health issues associated with Cadmium, Hexavalent Chrome and Cyanide are both highly toxic and used in the plating process. Cadmium plating's EPA emission requirements are scheduled to be further restricted to a level that requires the cadmium plating process to be replaced or its use drastically reduced over the next few years. LHE alkaline Zn-Ni plating was developed as an environmentally friendly and cost effective replacement for Cadmium that eliminates the Cyanide and Hexavalent Chrome used in production.

**Specifications Required:** A new Zinc-Nickel plating is an environmentally friendly process that has excellent corrosion resistance that may meet and/or exceeds that of cadmium plating.

**Technology Developed:** ES3 developed LHE alkaline Zn-Ni plating to replace Cadmium on both high and low strength steels. As with Cadmium, LHE alkaline Zn-Ni may be used with both the rack and barrel plating processes making it a drop-in replacement for Cadmium/Hexavalent Chrome. ES3 has been testing the plating since 2007 and it has repeatedly met or exceeded Cadmium performance in numerous tests, including: Corrosion, Hydrogen Embrittlement, Mechanical, Installation, Plating Properties, Fluid Resistance, and Appearance, Thickness, and Uniformity. It has successfully proceeded through testing of both barrel and rack plating techniques on low and high strength steel components and fasteners.

**Warfighter Value:** Aerospace components manufactured from high and low strength steel alloys require sacrificial protective coatings to perform safely in service. Cadmium has been the standard coating for such components for decades, but is a known carcinogen and has been targeted for elimination. A solution will allow steel components to be plated with LHE alkaline Zn-Ni and comply with Navy/DoD environmental objectives as well as meet all performance requirements of the original part designs. Implementation of LHE alkaline Zn-Ni will also reduce warfighter exposure to toxic cadmium/hexavalent chrome and reduce handling/maintenance costs, freeing up resources for use in more critical areas.

## WHEN

**Contract Number:** N68335-16-C-0037 **Ending on:** November 15, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Literature Review of Historical Testing (DoD & Industry)	N/A	Approved by TPOCs	N/A	March 2016
Develop NAVAIR Joint Test Protocol	N/A	JTP Completes Technical Review and Approved by TPOCs	N/A	September 2016
Anodes, Racking, & Fixture Design and Prototyping	Med	Plating designed confirmed to meeting thickness & uniformity requirements	7	November 2017
Execute Test Protocol	Med	LHE alkaline Zn-Ni meets or exceeds all performance standards for Cadmium	8	September 2018

## HOW

**Projected Business Model:** After installation and qualification of the LHE alkaline Zn-Ni plating line at FRC-SE, ES3 will execute the Joint Test Protocol as defined by FRC-SE in coordination with NAVAIR and the other FRCs to qualify LHE alkaline Zn-Ni as a replacement for Cadmium on low and high strength steel components. ES3 will also provide site surveys and expertise in the evaluation and conversion of the other FRCs from Cadmium to LHE alkaline Zn-Ni to aid in removal of Cadmium/Hexchrome fleet-wide.

**Company Objectives:** ES3 provides technical expertise in all aspects of landing gear systems research, test and evaluation, design and analysis, repair and maintenance. The primary focus of this effort is to install LHE alkaline Zn-Ni plating line and support equipment in FRC-SE facility for rack plating of high and low strength steel components, provide a complete system and coating qualification testing plan, demonstration/validation of the system, training, and written recommendations for modification of existing Cd and Zn-Ni equipment at the other FRCs to LHE alkaline Zn-Ni plating process for low and high steel fasteners and components.

**Potential Commercial Applications:** LHE alkaline Zn-Ni will effectively replace Cadmium on commercial aircraft landing gear, fasteners, structural components, and other high and low strength steel parts that currently use Cadmium as an anti-corrosion coating.

**Contact:** Jay Randolph, ES3 - Director, Southeast Operations  
[jay.randolph@es3inc.com](mailto:jay.randolph@es3inc.com) (478) 922-1460