

# Cadmium and Hexavalent Chromium Free Electrical Connectors (Task N.0745)

## Statement of Need

Executive Orders (EOs) 13423 and 13514, as well as recent memos from the Office of the Under Secretary of Defense (OSD) for Acquisition, Technology and Logistics (AT&L), require that the Department of Defense (DoD) reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of by the agency. Additionally, the OSD AT&L Hexavalent Chromium Policy Memo, dated April 8, 2009, requires that hexavalent chromium shall not be used without a waiver.

Based on the requirements of these EOs and OSD AT&L memos, the United States (U.S.) Army Tank-automotive and Armaments Command (TACOM) has been working to eliminate/reduce the use of cadmium and hexavalent chromium in ground systems. Electrical connector shells currently used in most ground systems are cadmium plated and then sealed with hexavalent chromium. Several alternative coating technologies were evaluated under the NDCEE Task 0470; however, there were several gaps that still needed to be evaluated. This activity focused on further evaluation of alternative coatings for electrical connectors to comply with the requirements of EO 13423, EO 13514, and the OSD AT&L Hexavalent Chromium Policy Memo, as well as reduce total life cycle cost of the system.

## Technical Approach

The primary objective of this task was to continue testing efforts of alternative coatings for use on ground equipment electrical connectors, initiated under NDCEE Task 0470. In order to complete this work, a test plan and quality assurance plan, outlining the intended testing, were completed prior to the commencement of testing. The tests that were performed include:

- Electromagnetic compatibility (EMC)/electromagnetic interference (EMI) testing
- Static and cyclic corrosion testing, in accordance with ASTM International standard B117 and GMW 14782
- Dynamic testing (salt spray testing in accordance with ASTM B117 with electrical connectors being mated and unmated before and after testing) in accordance with MIL-DTL-38999 Section 4.5.13.2
- Outdoor exposure testing
  - Both electrical connectors and test panels, each coated with the control and candidate coating systems, were evaluated.
  - Each month, each mated pair of connectors were disconnected and reconnected after 24 hours.
  - Connectors were evaluated with and without lubricant on threads.
  - Scribed and unscribed panels were evaluated.

Mixed mode connector testing was conducted. Each type of specimen was mated with one of the two baseline types.

Control panels were used to ensure quality results.

All testing, with the exception of EMC/EMI testing and outdoor exposure testing, was performed at the Concurrent Technologies Corporation (CTC) facilities in Largo, Florida, and Johnstown, Pennsylvania.

All test results were provided to the Technical Monitor (TM) and other TACOM stakeholders.

## Results and Benefits

The cadmium/hexavalent chromium coating system performed best in the series of tests conducted under this activity. The most significant result of this testing, however, was that Durmalon-coated connectors and panels performed very similarly to cadmium in many tests and even outperformed cadmium in several evaluations. Furthermore, Durmalon-coated connectors mated to cadmium did not experience significant failures in Performance Rating, Appearance Rating, or functionality (shell-to-shell conductivity). AlumiPlate was the worst performer of the two controls, while zinc-nickel was the worst performer of the two alternative candidates. If a successful alternative is found, the evaluations could result in eliminating the need to use hexavalent chromium and cadmium for coating electrical connectors used in ground vehicles. Based on the results of this study, it is suggested that Durmalon shows potential to be an adequate replacement for cadmium for use on military electrical connectors.

## Technology Transfer and Outreach

This technology could be adopted by TACOM as well as various other manufacturers. The Durmalon coating would also fulfill the EO which requires the reduction of cadmium and hexavalent chromium usage in electrical connectors.

**Government POC**  
James Heading,  
U.S. Army TACOM

**Status**  
Complete

