Cadmium and Hexavalent Chromium Free Electrical Connectors (Task N.0470)

Statement of Need

Many of the electrical connectors currently used in U.S. Army ground systems contain cadmium and/or hexavalent chromium coatings. In January 2007 the President revoked Executive Order (EO) 13148 and signed EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, which orders agencies to reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of. It is anticipated that the successful implementation of alternative coatings for electrical connectors will not only comply with the requirements of EO 13423, but will also reduce total life cycle costs of the weapon system.

Identified Alternatives

Under this task, the NDCEE conducted a search of the Army's electrical connector requirements. This involved researching U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) databases to obtain pertinent information about electrical connector coating types that are used in four weapons systems: Abrams (M1, M1A1, M1A2), Family of Heavy Tactical Vehicles (FHTV), Family of Medium Tactical Vehicles (FMTV), and Stryker. The search resulted in the identification of the most commonly used connector types by specification. In addition, the NDCEE reviewed work that has been done on alternative cadmium and hexavalent chromium processes to identify potential alternative coatings, associated post-treatments, available test data, and test data voids. The review included past evaluations conducted by the NDCEE, work completed under the Joint Cadmium Alternatives Team, and a literature search to identify work done by the electrical connector industry. The review resulted in the identification of five cadmium alternatives (electrodeposited aluminum [AlumiPlate®], electroplated zinc-nickel (Zn-Ni), electroplated tin-zinc (Sn-Zn), and two composite electroless nickel [DurmalonTM and Polymer Infused Nickel (PIN)]) and two viable alternatives to hexavalent chromium post-treatments (trivalent chromium and nonchromate processes).

Demonstration and Justification

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Status
Completed

Upon completion of the identification effort, testing was conducted to evaluate the most promising alternatives. The testing conducted was focused on addressing any test data voids for substrate/coating/post-treatment combinations as well as the functional requirements of the electrical connectors. Testing included: corrosion, salt spray; fluid resistance; high temperature resistance; mating/unmating forces; shell-to-shell conductivity; corrosion, cyclic; corrosion, scribed with primer and topcoat; corrosion, sulfur dioxide; durability in humidity; galvanic corrosion resistance; lubricity; and, wear/handling. Results demonstrated that, while no candidates demonstrated performance as good as or better than cadmium in all tests, AlumiPlate®, the two composite electroless nickel coatings, and ZnNi with a nonchromate post-treatment demonstrated performance closest to that of the baseline.

Implementation

Results of the demonstration indicated that additional testing/process optimization is required before an alternative can be implemented. TARDEC is planning to conduct additional evaluations on the most promising alternatives.

Follow-Up

If the technology is implemented, the NDCEE will provide support services as necessary, including periodic implementation review and measured progress.

Data is being gathered on electrical connectors currently used in ground systems, like the Stryker Family of Vehicles