

Topic 5: Demonstration/Validation of Alternatives to Cadmium Plating in Manufacturing and Maintenance of Weapons Systems

Objective

Projects are sought to demonstrate and validate alternative materials and processes to cadmium plating that is currently used on a variety of weapons systems. Proposals should address one of the following three areas:

- Electrical and optical connectors and backshells
- Fasteners (threaded and unthreaded)
- Components (for example, items such as wheels and landing gear)

The materials and processes to be demonstrated/validated should already be developed to at least a Technology Readiness Level (TRL) of 4, and the proposed project should bring it to TRL 7 or higher. The primary concern is coatings that provide corrosion protection rather than only galvanic compatibility. Proposals should provide information on previous laboratory testing and field testing, if available, showing performance of the alternative material, as well as information on existing use, if any. Additional materials testing can be proposed (and will be required in the absence of publicly-available, high-quality performance data). In addition, projects must develop a Joint Test Protocol and Demonstration Plan involving stakeholder input and approval from OEM and/or DoD organizations.

Projects must demonstrate producibility, which is defined as the ability to be used in production for the application specified under relevant production conditions. This includes the ability to scale-up the process to accommodate high-volume production of small items (e.g. by barrel coating) or, for components, to accommodate large items such as landing gear. Field testing of coated items must be included in the proposed project.

Proposed materials and processes should take into account compatibility of the alternative material with mating or adjacent surfaces (i.e., the avoidance of large galvanic couples) in common military systems.

Current cadmium plating specifications require chromate conversion subsequent to plating. Proposed alternative materials should either require no post-coating surface treatment or should utilize a post-coating surface treatment that does not involve hexavalent chromium.

Proposed projects involving connectors or fasteners must involve an OEM, and all projects must involve at least one DoD organization as a funded co-performer that is considered a stakeholder for the intended application. Proposals should also indicate the involvement of other DoD stakeholders at least at the consultant level.

Unless the technology is already included in existing specifications, proposed projects must include support for the development of a new specification, or modification of an existing specification, to include the alternative material.

Background

Cadmium plating, usually with chromate conversion of its surface, has been used by DoD for many years to provide corrosion protection to steel components, and galvanic compatibility and lubricity to electrical connectors and fasteners. Almost all high strength steel components (except functional surfaces) are cadmium plated for sacrificial corrosion resistance. Most threaded and many non-threaded fasteners, as well as electrical and optical connectors, are cadmium plated to provide corrosion protection or galvanic compatibility with aluminum airframes and skins.

Cadmium plating is usually chromate converted to improve corrosion protection. For electrical conductivity electrical connectors are used as-plated, while most other applications require primer and paint. Electrical connectors must provide good electrical conductivity and lubricity for mating and unmating, while threaded fasteners require lubricity for the correct torque-tension. Most landing gear and actuators are fabricated from high strength steel, requiring a coating process that avoids hydrogen embrittlement (low hydrogen embrittlement Cd, MIL-STD-8708).

Most connectors, backshells and fasteners are coated in large numbers by OEMs or their suppliers, while components are typically coated in small numbers by OEMs and recoated by DoD organizations during overhaul.

Some military specifications for electrical connectors permit the use of alternative coatings to chromated cadmium (e.g. MIL-DTL 38999L), including pure Al, ZnNi and electroless Ni-PTFE, but data on these alternatives is lacking for broad DoD use.

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