

Cadmium Replacement Coating for Military/Aerospace Connectors

Ed Sullivan

EN-PTFE composite coating exhibits equivalent, or better, properties than cadmium and nickel-cadmium



With the last remaining loopholes closing rapidly, the opportunity for connector manufacturers to find an optimum cadmium replacement is here. Even those that produce or distribute aerospace and military-grade connectors are under mounting pressure to meet the tightening requirements of the European RoHS directives, which are pushing towards elimination of cadmium altogether.

“The first European RoHS standard came out in 1996, but excluded the military and some aerospace applications,” says John Schnepf, president, Corsair Electrical Connectors, Inc. (Irvine, CA). “Since then, however, the stance of RoHS against cadmium content in electrical and electronic equipment has continued to intensify. The EPA is not quite there as far as the requirements are concerned, but you can see the trend. It is coming.”

According to Schnepf, Corsair and other connector manufacturers are more than willing to eliminate cadmium or any other contaminants from products. The issue, however, is finding a suitable alternative to cadmium and nickel-cadmium at a reasonable price point that delivers the equivalent (or better) conductivity, corrosion protection, compatibility, wear resistance, lubricity and low coefficient of friction.

“There are any number of platings that meet the corrosion resistance requirements of cadmium,” explains Schnepf. “However, most do not meet the electrical requirements for conductivity, or meet the conductivity requirement, but not the corrosion resistance. A few of the more recent alternatives do well in both areas, but still do not meet RoHS standards due to use of Hexavalent Chrome and even Cyanide in the plating process.”

Dangers of Cadmium

Cadmium, and in particular nickel-cadmium, can be electroplated relatively thinly

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and evenly on fine and coarse threads and complex geometries, making it ideal for use on connectors. Cadmium's advantageous properties include excellent corrosion resistance even in salt atmospheres, lubricity, wear resistance, conductivity, EMI shielding, and galvanic compatibility.

However, Cadmium is particularly dangerous when airborne in dust form. It can cause lung disease, kidney failure, and even death. Any maintenance process that releases cadmium into the air exposes personnel and the environment to this hazardous material. Furthermore, the Cadmium plating process often incorporates the use of cyanide in the process and Hexavalent Chromium as a sealant.

In 1993, cadmium became one of six hazardous substances restricted by Europe through its RoHS directive and the EPA has classified cadmium as a Group B1 compound (probable human carcinogen).

Since then, legislation in Europe and the United States has increasingly focused on banning and limiting the use of cadmium, along with other harmful substances. DOD, US dept of labor, RoHS and REACH policy all intend to restrict, control exposure or ban use of cadmium.

Connector Manufacturers Seek Cad Alternative

To replace the cadmium content while maintaining conductivity and corrosion resistant properties, Corsair is working with CSL Inc. (Santa Clara, CA), a supplier that offers over 40 different plating processes. CSL is one of the few independent third party processors in the U.S. that develops proprietary custom coatings.

As a manufacturer specializing in circular connectors with crimp-removable contacts for military, commercial aircraft, and other aerospace applications, Corsair's original specifications were MIL-C-26482 and MIL-C-5015. Today, however, the company is in the process of qualifying MIL-DTL-38999, one version of which is a circular connector with a cadmium-class finish.

The solution Corsair is currently testing is a nickel Teflon (EN-PTFE) composite coating developed by CSL over a decade ago.

This EN-PTFE composite coating is not to be confused with standard nickel Teflon plating which is available from multiple sources. A simple 1-2 layer of EN-PTFE will not suffice in harsh environments.

CSL's EN-PTFE composite coating, on the other hand, forms a monolithic barrier that is self lubricating, scratch resistant, and anti-galling without galvanization. CSL's composite EN-PTFE coatings meet the conductivity and lubricity requirements of Cadmium while reportedly exceeding the wear resistance and corrosion protection attributes of Cadmium or Nickel Cadmium plating. It can cross mate with stainless steel, aluminum, PEI, and PEEK and can be applied to most metals and composites.

"We are currently investigating the composite nickel-PTFE alloy as an alternative to cadmium," says Shnepf. "CSL has developed a plating process that apparently can deliver both electrical conduction and corrosion resistance and is RoHS compliant."

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According to Shnepf, Corsair is currently entering the qualification phase of the testing with CSL.

“Given that this coating meets all the performance characteristics outlined, we expect it will have a very favorable response in the military and aerospace market as a cad alternative,” adds Shnepf.

Connector manufacturers are not the only ones testing EN-PTFE. Over the past 15 years, Lockheed, Boeing, and Sikorsky have tested it and it is already a spec for connectors for harsh environments under MIL-DTL-38999. CSL’s EN-PTFE products are use on Navy ship programs, the F35 Joint Strike Fighter, Sikorsky helicopters, and Boeing Aerospace programs.

Standardizing on a Cad Alternative

Standardization of product line features can be a major advantage for the connector industry from a manufacturing and marketing standpoint. As the military becomes more of an international collaboration, U.S. connector manufacturers will have to become more responsive to RoHS and some of the other standards adopted by the European nations other NATO Alliance partners.

By standardizing on a replacement for cadmium plating embraced by both Europe and the U.S., connector manufacturers can enjoy manufacturing economies while making life easier for global distributors by simplifying inventories.

About the Author

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