National Electrical Manufacturers Association

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NEMA White Paper on Cadmium in Electrical Contacts

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Executive Summary

- Cadmium is used in silver-cadmium-oxide (AgCdO) electrical power switching contacts because it provides the best-known performance for switching off electrical current quickly and cleanly, and avoiding contact welding and premature failure.
- There are many other contact materials available, but they do not perform as well in power switching applications, and thus can create life-safety and property damage issues.
- Contact manufacturers have invested heavily to develop silver-tin-oxide (AgSnO) as a replacement; however, this also does not perform as well as AgCdO and is difficult and expensive to process. There is a reluctance to invest additional capital in developing other contact alloys until the AgSnO investment can be recouped.
- The EU has restricted the use of cadmium since the ratification of the 1992 Basel Convention, however, a RoHS exemption is in place to allow the use of cadmium in electrical contacts. This exemption is under consideration to be rescinded in the EU, and U.S. restrictions will certainly follow.
- A blanket ban on cadmium-bearing electrical contacts will do more harm than good.
- Safety-related products (overload relays, transfer switches, bypass contactors, fire pump controllers, etc.) built with alternative contact materials may fail more often and in more dangerous modes, resulting in increased loss of life and property.
- Power switching products (motor starters, contactors, pilot devices) built with alternative contact materials may fail more often, resulting in increased volume of product disposed into the waste stream.
- Replacement contacts built with alternative contact materials would be larger, requiring larger contactors that may not fit in the space of the original contactor; this can result in disposal and replacement of the entire end-product, also resulting in increased volume of product disposed into the waste stream.
- The NEMA Industrial Automation Control Products and Systems Section contends that, as a steward for continuous improvement, NEMA and its member companies should fund U.S. researchers to develop new contact materials with the goal of finding an “as-good-or-better” replacement for cadmium-based electrical contacts as soon as is technologically feasible.

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1 Purpose

The purpose of this white paper is to propose a course of action for NEMA that balances the importance of protecting the environment with the unintended consequences of a blanket ban on cadmium-based electrical products.

2 Background

Cadmium is a silvery-white, relatively rare, ductile metal obtained as a byproduct of the smelting of zinc. Most commercially viable zinc ore produces 4.6 pounds of cadmium per ton of zinc.

Cadmium is widely used by the electrical switching industry in the form of cadmium oxide (CdO) in metal alloys (primarily silver cadmium oxide, AgCdO) to manufacture high-quality power switching contacts.

3 Technical Details

3.1 Biology

Cadmium enters the human body two ways—inhaling cadmium vapors or consuming cadmium particles. Cadmium oxide used in electrical contacts does not dissolve in water.

Cadmium that enters the bloodstream via the stomach or lungs is immediately bound to a protein (metallothionein) and stored in the liver, where no damage occurs. Persons exposed to high doses of cadmium in industrial settings show no trace of it in their bloodstream as soon as 18 hours after exposure. However, very slowly over a period of decades, the cadmium metallothionein is released back into the bloodstream and absorbed into the cells of the kidneys, where the metallothionein is used as fuel, and the cadmium poisons the cell. The result is very slow degradation of kidney function.

There is no evidence to suggest that cadmium causes cancer.

3.2 Usage

The Cadmium Council reports that the usage of cadmium in 2005 was as follows:

- 79%: nickel-cadmium (NiCd) batteries
- 11%: pigments for paint
- 7%: coatings for metal
- 2%: stabilizers for plastics
- 1%: miscellaneous uses including solar cells, fusible links, high-temperature wire, sacrificial corrosion protectors, jewelry, and electrical contacts

3.3 Human Exposure

The vast majority of human exposure to cadmium results from the following activities:

- **The drinking of turbid, untreated water directly from rivers and streams where cadmium dust has been dumped**. Simple filtering avoids this exposure.
- **Industrial exposure to cadmium fumes and dust during smelting and processing**. In the U.S., OSHA has all but eliminated this as an issue.
- **Inhaling cadmium fumes created by incinerating garbage**. (Note: Many European countries lack the land area to bury their garbage. As a result, they incinerate it, which releases cadmium fumes that could place their citizens at risk. In the U.S., most garbage is buried in landfills, where the cadmium lies dormant.)

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