

Charting the Way Forward to Cadmium and Hexavalent Chromium Free Connectors: NAVSEA Usage and Testing

ASETSDefense 2012: Workshop on Sustainable Surface Engineering for Aerospace and Defense

27 August 2012

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Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 27 AUG 2012		2. REPORT TYPE		3. DATES COVERED 00-00-2012 to 00-00-2012	
4. TITLE AND SUBTITLE Charting the Way Forward to Cadmium and Hexavalent Chromium Free Connectors: NAVSEA Usage and Testing				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Surface Warfare Center,Dahlgren,VA, 22448				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the ASETSDefense 2012: Workshop on Sustainable Surface Engineering for Aerospace and Defense August 27-30, 2012, San Diego, CA					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 11	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Agenda

- **Overview**
- **Navy Connectors**
- **Specification Work**
- **Collecting the Data**
- **Understanding the Data**
- **NSWCDD—Test Efforts for M28876 Fiber Optic Connectors**
- **Wrap Up**

Overview

- **Going cadmium and hexavalent chromium “free”**
 - Many alternatives exist but few qualified connectors without cadmium and/or hexavalent chromium exist
 - < 0.1 percent by weight of hexavalent chromium is allowed
- **Without qualified cadmium and hexavalent chromium free connectors available to existing and future programs:**
 - Waivers for qualified cadmium connectors will not continue
 - Waivers for non-qualified connectors increase risk to performance requirements

Meeting performance and regulation at the same time.

Navy Connectors

	Allowed non-cadmium platings or finishes*							Status
	Cadmium	Electroplated Aluminum	Electroplated ZnNi	Nickel PTFE	Electroless Nickel	Corrosion Resistant Steel	Other**	
MIL-DTL-3607C	X	X	X	X	X		Silver, Tin	Active
MIL-DTL-12520D	X					X	Zincated Al w/copper	Not for New Design
MIL-DTL-21097G	X					Passivated		Active
MIL-DTL-21617A	X							Active
MIL-DTL-22992G	X	X	X	X		X	Hard oxide	Active
MIL-DTL-24308G	X	X	X	X	X	Passivated	Zinc, tin, gold	Active
MIL-DTL-25955A	X						Gold, tin	Not for New Design
MIL-DTL-26482H	X	X	X†	X	X			Active
MIL-DTL-27599D	X	X	X	X				Not for New Design
MIL-DTL-28731F	X					X		Active
MIL-DTL-28748D	X					Passivated	Zinc, anodized AA	Active
MIL-DTL-28840C	X	X	X	X				Active
MIL-DTL-32139A	X	X	X	X	X	Passivated	Titanium	Active
MIL-DTL-38999L	X	X	X†	X†	X†	Passivated	Tin, anodized	Active
MIL-DTL-55181E	X				X	Passivated		Active
MIL-C-81511F	X				X		Tin	Not for New Design
MIL-C-81582B	X							Active
MIL-DTL-83513G	X	X†	X	X	X	Passivated		Active
MIL-DTL-83527B	X							Active
MIL-DTL-83723G	X	X	X	X	X	Passivated	Tin, anodized AA	Active
MIL-PRF-28876E	Compatible					Passivated	Any	Active
MIL-PRF-64266						Passivated	Any	Active
SAE-AS-50151	X				X	Passivated	Tin	Active
SAE-AS-81659	X				X			Active
SAE-AS-85049A	X	X	X	X	X	Passivated	Black anodize	Active

*Finishes are typically selected by connector class. Not all finishes or platings are available for all classes. Some classes of connectors still require cadmium to meet performance requirements, but others could be replaced by currently allowed alternative plating/finish classes.

** Other finishes or platings may only be appropriate for a limited selection of parts, e.g., contacts, and not allowable on backshells, etc. PRF specifications do not explicitly specify platings, only that they must meet performance requirements.

†A qualified connector with alternative plating on Qualified Parts List is available.

Specification Work

- **Searchable database of connector specifications created at Naval Surface Warfare Center, Dahlgren Division (NSWCDD)**
- **Generated reports provide information and guidance:**
 - **What are my performance requirements?**
 - **What is the level of risk associated with a coating change for each performance requirement?**
 - **Possibilities for qualification by similarity**
 - **Generic test plan based on high and medium risk to performance requirements**
 - **Known “gotchas” of changing from cadmium to an alternative**
- **Will update and adapt information as additional test data is obtained.**

Collecting the Data

- **Enormous body of work exists; spread across multiple fields and dozens of organizations.**
- **NSWCDD searchable database currently contains test results for:**
 - **AlumiPlate**
 - **Ni-PTFE**
 - **Zn-Ni**
- **Reports generated by user criteria:**
 - **Coating**
 - **Tests performed**
 - **Sample type: connector, lab coupon, fastener, etc.**
 - **Including specific connector, e.g. M38999**

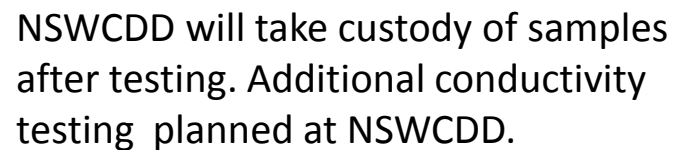
Understanding the Data

- **Variety leads to variability.**
 - Increasingly complex chemical formulations and processes
 - Multiple coating types increase risk of incompatibility
- **Only cadmium behaves like cadmium.**
 - Differences in corrosion mechanisms, oxides, surface chemistries
- **Contradictory data may indicate different conditions:**
 - Variability in coating process
 - Variability in test process
- **Document, document, document!**

Expect the unexpected.

NSWCDD Test Efforts for M28876 Fiber Optic Connectors

- **Primary goals of test effort**
 - **Identify candidate(s) for full qualification of M28876 fiber optic connectors**
 - **Seventeen coatings initially identified, representing eight types of coatings**
 - 340 connector pairs with backshells
 - **Candidates for full qualification will undergo compatibility testing**
 - **Utilize data to provide overarching guidance for all Navy connectors**
 - **Overall coating performance by type**
 - **What to test**
 - Qualification by similarity
 - **What not to test**
 - **Down selecting coating types**



Wrap Up

- **M28876 testing will provide greater insight into the performance of cadmium alternatives over a broader range of requirements.**
 - Candidate(s) for full qualification
 - Guidance for all Navy connectors
- **Continuing work to gather test reports and data for inclusion in cadmium alternative database.**
 - We're going to need a bigger database.

The challenge is enormous. You are not alone.