

# M28876 **BLACK** IN ACTION



## M28876 TRANSITION

*The Environmentally Friendly Evolution of the M28876 Connector*

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There is an ongoing focus in the United States to reduce negative health and environmental impacts from products and manufacturing processes. Importantly, in 2006, the European Union implemented rules and limits to minimize the impact of six known substances categorized as hazardous. This directive, known as the Restriction of the use of Hazardous Substances or "RoHS", bans the sale of new equipment into Europe if such equipment violates RoHS hazardous material limits.

The United States federal government and several individual state governments have enacted similar laws that require equipment and component manufacturers to comply with RoHS requirements. Furthermore, globally, Japan has had a program to reduce lead contamination for years, Korea has enacted a RoHS rule set, and China has adopted RoHS.

As a company that sells and manufactures controlled products domestically and globally, Amphenol continues to work to phase out materials and processes to comply with the RoHS directives.

## AmphenolFSI

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## M28876 HISTORY

MIL-C-28876, or “M28876”, was first released as the fiber optic connector specification in August of 1983. This connector and the optical contacts were designed to pass MIL-STD-901, grade A, class I which represents the unique high intensity shock requirements experienced in combat conditions by naval vessels. In addition to the unique shock requirements, the M28876 specification also called for cadmium plating as the protective surface finish protecting against humidity, corrosion, sand and dust and salt spray, among other environmental tests.

In addition to offering good environmental resistance, cadmium also maintains its electrical conductivity throughout the qualification cycle, a requirement among many electrical connector applications. Cadmium plating has protected aluminum and steel substrates in industry and military products since the 1930s and was included in the 1983 initial release of the MIL-C-28876 specification as a good performing and cost-effective connector surface finish.

## SO HOW DOES THIS IMPACT THE PRODUCT?

For Amphenol FSI (AFSI), the primary impact of the RoHS requirements is the transition to a compliant surface finish of our fiber optic M28876 connectors.

Historically, the US government has used connectors with cadmium plating as a corrosion inhibiting surface treatment on aluminum shells. The cadmium surface finish provides 500 hours of protection for the aluminum base metal during salt spray testing. AFSI has always been at the forefront of eliminating cadmium on newly designed connectors, in addition to AFSI manufacturing and selling military QPL qualified M28876 connectors with cadmium plating.



*M28876 Receptacle*

AFSI used Zinc-Nickel (ZnNi) alloy plating when we began investigating cadmium replacement plating on TFOCA-II® connectors around 1996, long before the RoHS push we see today. In addition to Zinc-Nickel alloy plating, the AFSI connectors also use a Hard Anodized PTFE surface finish. It is this Hard Anodized PTFE option that we submitted to the Navy for consideration to replace cadmium on the M28876 connectors.

The US Navy spent several years testing many different options to find a surface finish for the base aluminum M28876 connectors that would meet the requirements and environmental conditions that naval vessels experience. Of all the materials they tested, the Navy found two different plating options that meet the connector environmental test requirements in MIL-PRF-28876. These surface finish options have been added to the recently released MIL-PRF-28876 Revision F specification to replace the previous cadmium plating requirements. The first is the Black Hard Anodized PTFE (BHA-PTFE) finish and the second is a conductive Tin-Zinc (SnZn) plating.



M28876 Receptacle



**AFSI IS EQUIPPED, STOCKED AND FULLY PREPARED TO MEET CUSTOMER NEEDS**



M28876 Plug With Backshell

# AmphenolFSI

BHA-PTFE is a very hard, durable anodized surface finish with an added PTFE component. The hard anodized surface finish is substantially thicker than the cadmium plating thickness. Additionally, the PTFE additive helps the thick hard anodized surface improve its salt spray corrosion resistance. The resulting M28876 connectors with BHA-PTFE are exponentially more scratch resistant and substantially more salt spray corrosion resistant versus cadmium plating while also maintaining equivalence or better in all the other chemical, mechanical, and environmental conditions called for in the MIL-PRF-28876 specification.

In addition, another main RoHS substance that affects new and legacy military connectors, including but not limited to the M28876 product line, is the hexavalent chromium (Cr+6), also known as hex chrome. Hex chrome is the chemical conversion surface treatment that is applied on top of cadmium or zinc alloys to give these connectors their green, brown, or bronze color. The new BHA-PTFE finish avoids both cadmium and hexavalent chromium and is RoHS compliant. For our commercial off the shelf products, we also offer Black Zinc Nickel alloy plating where the black coloration is made using a RoHS compliant trivalent chromium (Cr+3) chemical conversion coating.

## HOW DO THEY MATCH UP?

AmphenolFSI	Material & Finish		
	6061- T6 Aluminum		
	Attribute	Cadmium	HA PTFE
Temperature Range	-55 to 175 C	-55 to 175 C	-55 to 175 C
Salt Spray Corrosion Resistance	500 HRS	> 2000 HRS	> 1000 HRS
Hardness/Scratch Resistant	Poor	Excellent	Poor
Shielding Effectiveness	≥ 60 dB	≥ 62 dB	≥ 60 dB
RoHS Compliant	No	Yes	Yes

## AFSI PREPAREDNESS

As the world leader in Harsh Environment Fiber Optics (HEFO) Amphenol Fiber Systems International continues to be ahead of the curve on ensuring this environmental-friendly plating transition is seamless for our customers.

From advanced logistical planning, strategic qualification readiness, open communication with customers, and well-planned inventory management, AFSI is ready to meet any M28876 need today and in the future.



M28876 Receptacle

## TRANSITION SUMMARY

- RoHS causing elimination of cadmium and hexavalent chromium
- AFSI M28876 connector finishes changing from cadmium/CR+6 to Black Hard Anodized PTFE or SnZn
- Safer, more environmentally friendly connector finishes
- As good or better than cadmium in environmental and mechanical qualification tests
- During qualification, AFSI's Hard Anodized PTFE M28876 Shielding effectiveness performance exceeded the current Rev F requirement by over 4 dB. The Rev F Electromagnetic effects requirement is  $\geq 58$  dB attenuation for frequencies not greater than 10,000 MHz
- Hard Anodized PTFE has better corrosion resistance and durability

## CONCLUSION

As a direct replacement for cadmium surface finishes, these plating options meet or exceed the performance characteristics of, and are compatible and interchangeable with, cadmium plated connectors. The new BHA-PTFE finish is more durable, harder, more scratch resistant, and more salt spray corrosion resistant than cadmium/Cr+6 finished connectors. Although appearance differences exist, these connectors have been tested to be drop-in replacements for, and compatible with, the cadmium plated connectors of MIL-PRF-28876 Revision E and prior.

Overall, the change in surface finish for the M28876 connectors make them more environmentally acceptable in countries that have adopted policies to help reduce and prevent exposure to these hazardous chemicals.