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Top Stories

NAVSEA Looks to Composite Technology to Improve Warship Components

By Gretchen Jacobson

Considering the numerous tasks involved in maintaining a typical U.S. Navy aircraft carrier, it is no wonder that it takes thousands of man-hours each year to protect the aircraft carrier fleet from the open ocean's extremely corrosive elements. The Navy's warships, which are more than 1,000 feet long and powered by steam turbines, have myriad features that enable them to live up to their legendary reputation.



U.S. Navy photo by Photographer's Mate Airman Kathleen Gorby.

The carriers can launch aircraft with steam-powered catapults, recover planes with steel-arresting cables, and they have an expansive, four-acre flight deck. But the catapults, cables, and flight deck remain vulnerable to the sea's corrosive elements.



Corroded brass electrical boxes are a costly and time-consuming maintenance problem on Navy vessels. Photo courtesy of NAVSEA.

It may be surprising to learn, therefore, that one of the carrier's principal sources of corrosion-related maintenance challenges involves the metallic boxes that house the ship's electrical equipment, indicator lights, and connectors. For sailors who operate the ship, electrical-box failure causes critical operational and communications problems that must be resolved in the short term with extension cords, hand signals, and other undesirable means.

The Navy estimates that the Department of Defense has spent more than \$13 million per year, and nearly \$400 million over 30 years, to resolve corrosion problems in the fleet related to metal boxes.

To address the issue, researchers at the Naval Sea Systems Command (NAVSEA) embarked on a cost-effective program in 2002 to leverage composite box technology being used on Air Force cargo aircraft in order to develop corrosion-resistant composite boxes to replace the corroding metal ones. Small-scale testing revealed that composite boxes are a valid technical solution that can be used on Navy vessels at a reasonable cost, and they significantly reduce the need for maintenance, said

Mark Ingle, a Program Manager at NAVSEA.

"Our composite electrical boxes with stainless steel hardware do not corrode, do not need to be painted, do not degrade in the sun, and require virtually no maintenance for the life of the ship," said Ingle. "In fact, our cost/benefit analysis shows a return on investment of more than 11 to one by implementing these composite boxes as the brass ones fail."

Each aircraft carrier contains approximately 477 topside electrical boxes. This type of box is also used on smaller Navy ships, Army watercraft, and Military Sealift Command vessels. The Navy reports that repairing, repainting, and rewiring

the brass, aluminum, and steel housings on a single carrier can cost more than \$1 million over a 10-year period. In addition to maintaining the boxes themselves, which generally requires repainting and repair every three years and replacing half the boxes every six years, the brass boxes cause galvanic corrosion of the ship's adjoining steel superstructure and mounting hardware, which requires further repair.

Constructed of gray, fiberglass-reinforced Ultem resin with stainless steel hardware, the boxes incorporate durable, spring-loaded covers that are easy for sailors to use. The covers are designed to close automatically, preventing electrical connector corrosion. The Ultem/fiberglass material is lightweight, fire retardant, inherently stable in ultraviolet light, and durable enough to pass Navy shock requirements.

Leveraging Hours and Dollars by Installing New Boxes

Technicians install the composite boxes on the ship using simple tools and materials like a conventional stud welder, a needle gun, and high-solids paints. During the process, they simply remove the old, metallic box, eliminate any corrosion with the needle gun, stud-weld the stainless mounting bolts on the hull, and then protect the entire area around the installation with a high-solids coating system.

To prevent paint damage and galvanic corrosion on the steel hull, technicians use stainless steel shoulder studs that are easily welded onto the hull's surface. Galvanic corrosion occurs when a brass box in direct contact with the hull traps moisture.

NAVSEA has conducted numerous demonstration installations of composite electrical boxes on Navy ships and has drafted a standard drawing for the products. Once the standard drawing is approved, NAVSEA will initiate discussions with the supply system managers to stock composite boxes. When the composite boxes become standard items in the stock system, NAVSEA estimates that roughly a quarter to a third of boxes on a ship or craft will be replaced at every maintenance opportunity until the entire complement of boxes consists of composite.

"By replacing metal boxes that would have been replaced or repaired because of corrosion-related damage, we are leveraging man-hours and dollars that were already required," Ingle explained. "Composite boxes are more expensive than metallic boxes, but are designed to last for the life of the ship; so, by leveraging box replacement tasks that would have been funded whether a metallic or a composite box were used, and an investment of approximately \$5 million for the composite boxes, the Navy could potentially avoid up to \$396 million in maintenance costs over 30 years."



The new composite electrical box is expected to have a lifetime of 30 years and avoid millions of dollars in man-hours, repair, and replacement. Photo courtesy of NAVSEA.

The new composite boxes will still require some maintenance, but that is largely related to electrical system adjustments such as tightening wires and cleaning contacts. Even then, only an estimated 10 percent of boxes will be affected because of the improved latch system.

Ingle is also working with Army Tank-Automotive and Armaments Command Headquarters personnel on the project. The Army conducted its first test installation of composite electrical boxes on a landing craft in 2005 and will evaluate their performance over the coming year. Based on the results thus far, replacing corroding metal boxes with the composite variety will significantly reduce the topside maintenance burden on sailors and improve ship operational readiness, Ingle said.

"The bottom line is that our program is helping to resolve a serious topside corrosion maintenance problem," he said.