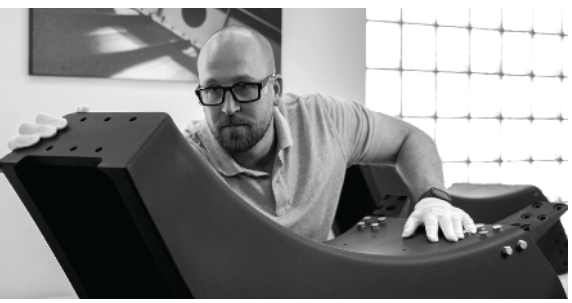
Carbon fiber satellite arm reduces weight, simplifies assembly onto naval vessels

Satcom developer EM Solutions partnered with ACS Australia to replace an aluminum arm design with a 65% lighter, one-piece, corrosion-resistant carbon fiber/epoxy alternative.

Satcom systems developer EM Solutions sought a lighter, simpler-to-install design for the identical azimuth arms on its King Cobra naval-mounted satellite. Partner ACS Australia provided a design and manufacturing solution that resulted in a 65% lighter arm versus metal, reducing dozens of pieces to one per arm. Source | EM Solutions via ACS Australia



Each 2-meter arm was designed to fit onto the existing satcom system with as few changes as possible to the original end fittings. Source | ACS Australia

» Satellite communication (satcom) systems can be complex, carefully designed to access and communicate with satellites in various orbits and consisting of — at their most basic — a dish-like antenna reflector assembly mounted to a rotating arm. This arm is a critical structural element, which needs to be strong enough to support the antenna load, provide attachment areas for all of the electronics, and enable 360-degree rotation with precision. For satcom systems mounted atop naval vessels, in particular, there are a range of additional requirements needed.

In 2021, satcom technology developer EM Solutions (Brisbane, Queensland, Australia) began designing a new satcom system, called the King Cobra, intended for use on naval vessels. The King Cobra is a 2-meter-diameter satcom terminal, designed to transmit and receive signals for both military and commercial bands, to and from GEO, MEO, HEO and LEO satellite constellations.

Typically, the two identical arms for this satcom system — sometimes referred to as azimuth arms — would be made from machined aluminum, composed of up to dozens of small components joined with metallic fasteners. While standard, this type of arm can be relatively heavy for a small naval vessel, complex to install because of the high number of components and prone to corrosion from water contact.

EM Solutions ultimately partnered with Advanced Composite Structures (ASC) Australia (Port Melbourne), with the goal to develop an all carbon fiber/epoxy composite arm for the King Cobra, with a simplified, easy-to-install design that saved weight compared to an aluminum alternative. The arm also needed to be designed to fit the existing system and assembly process without any major adjustments to the adjusting end fittings.

The resulting arm design is a single-piece arm, measuring approximately 1.5 × 0.5 × 0.5 meters in size, constructed from plies of carbon fiber fabric cut via CNC machining and infused under vacuum with liquid epoxy resin. ACS Australia designed the parts and manufactures them at its facility.

According to ACS Australia, one of the biggest challenges in redesigning the part in composites was ensuring the same high-quality finish. A solution was perfected over several iterations. Among its improvements versus the metallic alternative, the composite version is reported to be 65% lighter weight with approximately 50 fewer components (thus requiring fewer fasteners and fittings). The composite version is also corrosion-resistant, durable, takes less time to assemble and has fewer expected maintenance needs and costs. This design also helps reduce topside weight for navy vessels, and reduces power consumption and sizing requirements for subsystems.

The design ultimately met static and dynamic requirements, including the high blast requirements of topside naval structures. The arm was first validated by ACS Australia engineers via finite element analysis at various load conditions.

As of late 2023, the arms are now successfully integrated into the King Cobra satcom product and are now operating in service. CW