

Conformable, Compact Isolation System for Repairs

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PROBLEM STATEMENT

The use of composite materials in an increasing number of aircraft structures has resulted in the need to develop better repair processes for these composites when damaged. Repairs must be performed in-field in all types of environments, including those where protection is needed from sand, dirt, water spray, and other elements. It is also desirable to contain repair-generated debris, such as carbon dust and fibers, and prevent it from becoming airborne, which could pose significant threat to personnel and equipment.

Current containment devices are pieced together with plastic sheeting and taped to the plane, if one is used at all. These ad-hoc devices are not user-friendly and take too much time to assemble. A lightweight, low-cost system that could contain and protect aircraft composite repairs would be of significant benefit to the advanced next generation strike fighter aircraft as well as other composite-intensive platforms.

WHO CAN BENEFIT?

Almost all aircraft platforms in the DoD fleets utilize composite structures to some degree. Any of these planes risk composite damage, due to combat, bird strikes, hail, ground collisions, etc. Whether serving in combat, support, or domestically, these aircraft must be repaired without cover, either out of necessity or convenience.

Aside from composite repair, all aircraft must be continuously coated in areas of damage, wear, and corrosion. This is particularly true with low-observable aircraft, such as the F-22, advanced next generation strike fighter aircraft, and the B-2, which require a great deal of maintenance. With slight modifications, the technology developed in this project could be used to contain coating repairs and offer a means of curing the repair at elevated temperatures, reducing the cure cycle many times over.

BASELINE TECHNOLOGY

There does not currently exist a turn-key solution to this problem. If an enclosure is used, it is usually an ad-hoc structure fabricated with plastic film and tape. In some cases, asbestos removal glove bags have been employed. Significant time is wasted in locating material and piecing these structures together. These structures also lack internal support, so film is constantly interfering with the technician's work, falling into the repair and obscuring his/her visibility. As one could imagine, these structures are not the most reliable or secure, invariably allowing some contamination into the area. Improper repairs that require rework can double or triple the cost associated with the repair.

In other cases, composite repair is done in a clean room, but this necessitates removal of the damaged component from the aircraft. Compared to doing the repair in situ, this adds hours of extra work and probable delays.

These structures do provide some flexibility to the technician to customize the shape and size of the bag, but the high cost of wasted time and rework associated with this approach greatly overshadow their usefulness.

TECHNOLOGY DESCRIPTION

The system developed in this project is much more reliable than the baseline, offering much more protection from contamination and increasing efficiency. It is adaptable and requires no assembly, attaching to the repair site in seconds and saving the technician significant time and frustration compared to the baseline. The following Table illustrates features, advantages, and benefits of each aspect of the technology.

Table 1: Features, Advantages, and Benefits.

Feature	Advantage	Benefit
Internally supported	Guards against collapse	Repair better protected
Sealed interior	Repair uncontaminated; repair debris contained	Minimize rework, reduce costs
360° viewing area	Unobstructed vision	More effective repair
Collapsible	Minimal storage space	Ease logistics burden
Conformal	Adaptable to surface	One size to stock
Self-sealing ports	Reduce contamination	Minimize rework
Repositionable ports	Adaptable to repair	Increased ergonomics
Low cost	Disposable	User convenience
Environmental controls	Control temp/humidity	More reliable repairs

CURRENT STATE OF DEVELOPMENT

Representative production of the beta model has completed, yielding 250 units available for in-field testing and samples. Initial supply lines, manufacturing lines, and processes have been finalized.

Improvements based on observations from initial testing and from the representative production run have been completed. These improvements address both functionality and ease of manufacture. Units have been updated with these improvements and are currently undergoing in-field testing. In parallel, manufacturing plans are being revisited to address the changes.

Units have been used on test bed aircraft in operational environments. Units have also been used to perform repairs on aircraft components at repair facilities. In light of this, the technology is considered to be at a TRL of 7.

Further in-field testing will be conducted over the ensuing months. By the conclusion of this Phase II in November 2010, a tested and validated product will be available for procurement in quantities of thousands. Customers that do not require extensive testing of the device can procure the units at this time.

REFERENCES

Wilson Boynton at RAA/ACT (519-473-2663, boynton@raacomposites.com) is responsible for training commercial and military personnel in aircraft composite repair. He has personally evaluated CRG's product and has performed trials using the device.

Andy Guy (301-757-2326, andrew.guy@navy.mil) and Matt Tillman (301-995-7561, matthew.tillman@navy.mil), both at NAVAIR, are intimately aware of the technology.

ABOUT THE COMPANY

Cornerstone Research Group (CRG) is a R&D service company focusing on material development and engineering systems. Key areas of expertise include composite design and fabrication, finite element modeling, polymer synthesis, and aerospace structure development. The company employs over 110 scientists, engineers, technicians, and support personnel. CRG has a strong commitment to developing technology for its customers on a very accelerated time table. This practice, along with a significant commercialization focus, allows CRG and its customers to be first to market with their technologies.