

Topic: N161-017

Luna Innovations Incorporated

Single Vacuum Bag Process for Rapid, On-Site Repair of Composites

For the repair of composite aircraft components, a Double Vacuum Debulk (DVD) process is commonly performed on a repair patch to reduce void volume, prior to application of the patch to the damaged structure. Luna Innovations Incorporated has developed an advanced single vacuum bag process utilizing a novel Breathable, Resin Barrier (BRB) which can be utilized to fabricate high quality aerospace laminates. The technology eliminates the dedicated equipment, complexity, and size limitations of the DVD tooling, while reducing process time by more than 50%. The developed out of autoclave process is applicable to legacy material systems and a wide variety of fabrication and repair applications, but the initial implementation target will be at Navy depots to simplify and more efficiently repair aircraft, such as the V-22.

Technology Category Alignment:

Fixed Wing Vehicles (includes UAS)

Rotary Wing Vehicles

Maintainability/Sustainability

Readiness

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SYSCOM: NAVAIR

Contract: N68335-18-C-0013

 Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0013

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-722

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WHO

SYSCOM: NAVAIR

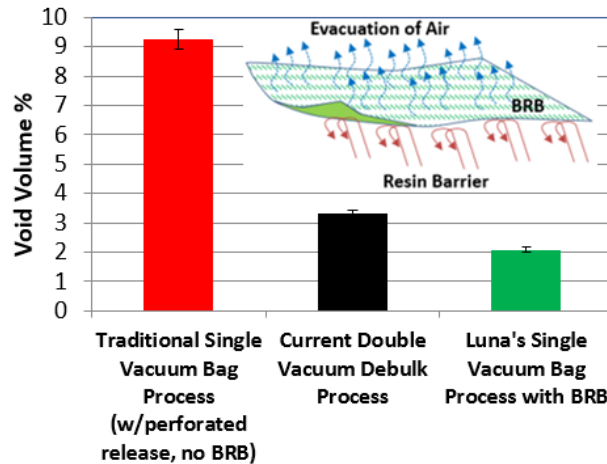
Sponsoring Program: PMA 276 H-1 Helicopter Program Office (Phase I), PMA 275 V-22 Program Office (Phase II)

Transition Target: V-22 Aircraft Repair

TPOC:
(301)342-2181

Other transition opportunities: The technology will be directly implementable to virtually all Navy and other Department of Defense air, sea, and land platforms as an efficient and effective method for rapid, on-site repair and out of autoclave composite fabrication. The technology will be applicable to both wet-resin and prepreg composite processing and could be implemented throughout military and civilian composite sectors

Notes: The figure (above, right) demonstrates lower void volume percentage of identical composite panels fabricated with Luna's single vacuum bag process with Breathable Resin Barrier (BRB) over traditional single vacuum bag and baseline Double Vacuum Debulk processes



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WHAT

Operational Need and Improvement:

- Aerospace flush repairs require machining tapered cavity to remove damage, followed by bonding of mating (scarf) composite patch
- Double Vacuum Debulk (DVD) processes is currently utilized to fabricate patch for wet-resin composite repair
- DVD process requires special tooling, limits the size of the repair, is overly complicated and expensive, and creates logistical challenges when repairs are needed on aircraft in small detachments
- A repair process is desired that provides repair patches of the same or better quality [to current], but minimizes required support equipment and is less labor intensive

Specifications Required:

- Bonded repairs, requiring no additional support equipment, in uncontrolled environments
- Max patch preparation and cure time <8 h, with target of <4 h
- Repair patches of at least 15" x 15" and ≥ 0.120 in thick
- Porosity < 4% with Luna target of < 2%
- Complex curvature and shapes with radius of curvature ≤ 4 in
- Vertical or horizontal orientations; laminate and sandwich panel configurations

Technology Developed:

- For rapid technology insertion, Luna's approach utilizes baseline composite repair materials with innovative process
- Luna's single bag process uses a Breathable Resin Barrier (BRB) which permits air permeability but prevents resin penetration
- Air is continually evacuated over the entire surface of the laminate and uniform vacuum compaction pressure achieved
- Simple single vacuum bag fabrication yields low void/high-quality composite parts

Warfighter Value:

Luna's BRB and single vacuum bag repair process eliminates special tooling, simplifies set-up, removes size restrictions, and can reduce repair time by more than 50%

WHEN

Contract Number: N68335-18-C-0013 **Ending on:** March 20, 2019

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Proof of concept demonstrated in Phase I	N/A	Achieved same or lower void volume % when compared to panels fabricated with DVD process	4	November 2016
Technology demonstrated with legacy repair materials	Med	Achieve same or lower void volume % than panels fabricated with legacy DVD tooling and process	4	November 2018
Technology demonstrated at Navy Depot	Med	Same or lower void volume % for Navy repair patch without need of DVD tooling	5	March 2019
If Phase II Option exercised, sub component repair and evaluation	Med	Equivalent or improved void volume percentage and mechanical strength when compared to identical component fabricated using DVD process	6	September 2019
If Phase II Option exercised, equivalency testing and full scale component repair and evaluation	Med	Equivalent or improved coupon mechanical properties and equivalent or improved component repair quality and strength	7	January 2021

HOW

Projected Business Model: Luna intends to manufacture via a toll producer or license the technology to a specialty fabric or composite fabrication material supplier for distribution to DoD platform integrators. Luna will provide technical assistance and production scale-up support.

Company Objectives: Luna seeks partnerships with DoD Prime integrators and composite fabrication material suppliers for dem/val assessment of the technology as applied to both out of autoclave composite repair and component fabrication for aircraft, ships, and/or ground vehicles.

Potential Commercial Applications: The initial focus of this program will be on the development of an efficient and effective method for rapid, on-site repair of composite aerospace structures for the Navy. The technology will be directly implementable to Navy and other Department of Defense platforms which utilize composite materials. However, the impact on the broad composite commercial market could be enormous. The technology is applicable to virtually every industry where composites are utilized as it covers a wide range of composite material systems, fabrication processes, and applications. It is anticipated that an advanced breathable resin barrier will be developed to produce high-quality composite materials from simple vacuum bag fabrication processes. This will enable the escape of air and reaction gasses while maintaining uniform compaction force to eliminate voids and processing imperfections without the need of specialized and size limiting tooling. The technology will have extreme impact for out of autoclave fabrication methods, although it will be of benefit to autoclave processing as well. The use of these systems will provide economical composite manufacturing and repair options by reducing fabrication costs and increasing production capabilities.

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