TECHNOTES

A PUBLICATION OF THE COMPOSITES MANUFACTURING TECHNOLOGY CENTER
Winter 2019 Edition

Features: The Winter 2019 Edition features three new and three recently completed projects that amount to potential savings of:

$22.6M!

DELTOID FILLER FORMING TOOL FOR CH-53K COMPOSITE BULKHEAD SCRAP RATE REDUCTION

M2684 — BULKHEAD T-FLANGE CREASE ELIMINATION

Objective

T-Flanged composite parts on the CH-53K STA 315 bulkheads experience significant scrap rates as a result of autoclave curing. Recurring defects (bulges) form in low pressure zones on the bag side during the cure cycle causing creases in the radii of the T-flanges. These defects have generated a 20% scrap rate for the T-flanges on the bag side radii of the bulkheads. In an effort to eliminate these recurring defects and, ultimately, minimize the scrap rate, this ManTech project was developed to evaluate a deltoid filler form tool approach into the manufacturing process of the CH-53K parts with T-Flanges, ensuring adequate deltoid region and bag side radius formation. The use of a formed deltoid filler shaped to match the filler region inclusive of joggles was evaluated. This was done to ensure that the exact amount of material in exactly the right shape was repeatedly applied during layup.

Several manufacturing trials were performed using the new manufacturing approach that demonstrated the ability of the formed deltoid filler to significantly reduce the occurrence of bag side radius bulging. This approach proved to be successful in reducing the scrap rate of STA 315 bulkheads from 20% to 6%.

STATUS:
Project Complete

PERIOD OF PERFORMANCE:
October 2016 to April 2019

PLATFORM:
CH-53K

STAKEHOLDER:
PMA-261

MANTECH INVESTMENT:
$300,000

Payoff

After the first manufacturing trial and consultation with Sikorsky CH-53K Materials and Processing, the use of the joggle deltoid forming tool was implemented into the manufacturing process for the fabrication of STA 315 bulkheads. Currently, this process has been used to produce STA 315 bulkheads with an observed scrap rate of 6% representing a scrap rate reduction from the 20% scrap rate observed on parts prior to the implementation of the joggled deltoid filler forming tool. Based on the remaining production a total cost reduction to the CH-53K program will be $814,800 as a result of the scrap rate reduction. Implementation on additional bulkheads could drive cost savings to $1.6M.

Implementation

The use of the joggled deltoid filler forming tool has been fully implemented into the manufacturing process for STA 315 bulkheads as a result of its demonstrated scrap rate reduction.

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CMTC TECHNOLOGY FOCUS AREAS

A BROAD REPRESENTATION OF CMTC'S MOST SIGNIFICANT COMPOSITE ACTIVITIES

COMPOSITES AND ADVANCED MATERIALS

CMTC's goal is to maximize benefits of composites and advanced materials for aircraft, surface ships, submarines, land vehicles, and associated weapons and missiles.

- Fiber-reinforced polymeric (organic) resin composites
- Ceramic-matrix, metal-matrix, and carbon-carbon composites
- Graphite, glass, and polymeric fibers as well as alternate reinforcements
- Signature reducing materials and treatments

COMPLEX STRUCTURES AND DESIGN

CMTC and its partners have the ability to design and analyze complex composite structures. These efforts have been instrumental in increasing the size and flexibility of design for composite structures.

- Composite "internal" stiffening core materials and "external" stiffening concepts
- Materials for electrical applications
- Pourable filling, shaping, and fairing materials
- Adhesives, adhesive bonding, and related technologies
- Mechanical fastening and methodologies for joining composites to composites or metals

TESTING AND EVALUATIONS

CMTC efforts incorporate various testing and evaluation techniques to analyze composites and advanced materials in order to allow CMTC, industry stakeholders, and the DoD to understand the complexities that come with the use on non-metallic materials versus more traditional metallic materials.

- Mechanical, physical, chemical, thermal, and/or electrical testing for characterization of composite or other nonmetallic materials
- Quality assurance/advanced non-destructive evaluation covering all aspects of composites manufacturing from incoming raw material control through in-service inspection
- Modeling and simulation, (i.e., cure modeling, finite element analysis, etc.)

PROCESSING AND AUTOMATION

CMTC and its partners seek to refine and mature manufacturing processes for composite and advanced material fabrication that are predictable, repeatable, and reduce the defect rate experienced with current manufacturing approaches therefore reducing overall maintenance costs.

- Process analytics
- Robotic or automated processing
- Polymeric additive manufacturing technologies
- Repair technologies
- Sealant, coating, and filling material technologies, including mixing, application, and removal
- Composite manufacturing and similar processes and related equipment, including best practices, maintenance, set-up, and environmentally safe disposition. Composites manufacturing processes include but are not limited to wet hand lay-up, prepreg hand lay-up, automated fiber placement and tape laying, resin transfer molding, pultrusion, etc.

NEW PROJECTS

S2764 — *Analysis of Alternatives to Reduce Life-Cycle Costs for Deck Edge Safety Nets*

PERIOD OF PERFORMANCE: APR 2019 TO SEPT 2019 **PLATFORM:** DDG 51
STAKEHOLDER: PMS 400D, PMS400, NAVSEA PMS 501 **MANTECH INVESTMENT:** $194,000

The manufacturing process for surface ship deck edge safety net (DESN) frames is highly labor-intensive. The materials used for the frames are prone to corrosion and surface damage, resulting in frequent maintenance and replacement only a few years into their service life. When corrosion resistant materials are used to address corrosion issues, welding represents a manufacturing challenge during frame assembly. The metallic frames currently in the fleet also pose a safety hazard, as they can be difficult for sailors to handle due to their weight.

The objective of this CMTC project is to identify a low-cost, adaptable manufacturing process aimed at producing a damage-resistant DESN frame while reducing part cost and weight. To determine the feasibility of this endeavor, the composite DESN system trade study will be focused on the following three key variables: manufacturing approach, material systems, and viable component designs. Contingent upon successful identification of key metrics, a follow-on project will be initiated to develop a production-ready alternative composite surface ship DESN frame and manufacturing process.

A2791 — *Flexible Robotic Composites Manufacturing Cell (FRCMC) supporting the CH-53K Program*

PERIOD OF PERFORMANCE: APR 2019 TO APR 2021 **PLATFORM:** CH-53K
STAKEHOLDER: PMA-261 **MANTECH INVESTMENT:** $8M

The U.S. Navy has a need to reduce composite structures fabrication costs while maintaining product quality requirements. One of the U.S. Navy's focus areas to achieve cost reduction is improved and innovative manufacturing processes supporting key, high priority platform acquisitions, including the CH-53K. Increased use of innovative flexible accurized robotic manufacturing technology will satisfy the U.S. Navy's need by developing and implementing manufacturing processes that offer benefits through improved process repeatability, performance at production quantities and reduced risks as production rates increase. This technology will meet strict aerospace tolerance requirements not achievable with standard off-the-shelf robotics while lowering fabrication costs with increased throughput and repeatability in support of high-rate production.

Currently under the CH-53K program, Aurora must perform trim/drill machining and 3-D inspection on all parts prior to assembly. The Aurora FRCMC is an advanced machining and inspection technology for complex composite structures such as found on the CH-53K as well as most current and planned DoD aircraft. The implementation of advanced robotic machining and dimensional inspection equipment coupled with automated part transfer will significantly reduce the cost and schedule burdens on the CH-53K Program.

Novel Low-Cost Composite Solutions for Virginia Payload Module

Objective

This effort further refined and developed gateway technologies, techniques, and processes that demonstrated that cost-effective design and manufacturing solutions are achievable with acceptable risk for faired structures fabricated from composite and / or hybrid material systems. Several innovative technologies used either individually or in conjunction with one another are under consideration for use in VIRGINIA Payload Module (VPM) configurations. Each employs the use of enhanced composite materials with integrated stiffness and damping, or a combination thereof, to form the fairings that make up the boundary of the VPM.

Payoff

Successful incorporation of the project results into the VPM design has the potential to provide significant total ownership cost savings to the VIRGINIA Class submarine (VCS) for Block V and following ships. For the remaining class of VPM-enabled ships, acquisition savings are estimated to be up to $2M, and life-cycle savings for all of the options included are estimated to be between $18M and $21M, depending on the implementation schedule. Potential weight savings are estimated to be approximately 7,600 lbs. with implementation of hybrid composite forward and aft fairings.

Implementation

The Low-Cost Hybrid Fairing (LCHF) project completed a major design review which resolved stakeholder concerns from a number of disciplines. Notably, the preliminary assessments for shock indicated acceptable results for the LCHF and substructure. However, the meeting revealed additional design concerns related to the alignment of the safety track, isolation of the carbon for cathodic protection, and performance technical readiness level of the hybrid material. Testing and analysis activities were scheduled through August 2018 to resolve or mitigate performance concerns. On successful completion of the project, the technology will be available for incorporation into current redesign activities on VCS VPM. The project results will also facilitate consideration for similar technology insertion into COLUMBIA Class components and structures of comparable design / function. The implementation targets are SSN 806 and following ships with anticipated implementation to occur in FY20.

S2601: LOW-COST HYBRID FAIRINGS

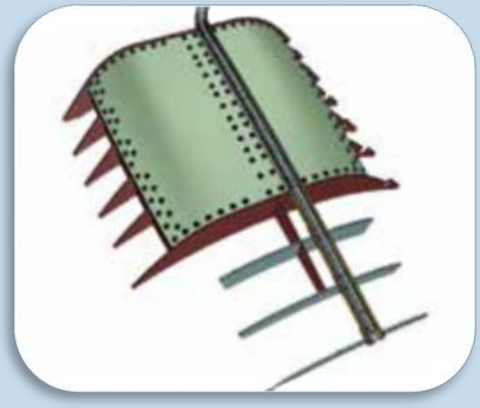
STATUS:
Project Complete

PERIOD OF PERFORMANCE:
April 2015 to March 2019

PLATFORM:
VCS / CLB Submarines

STAKEHOLDER:
PMS-450, PMS-397

MANTECH INVESTMENT:
$2,284,000



CMTC IS NOW ACCEPTING RESEARCH PROJECT CONCEPTS

CMTC seeks concepts for research projects that drive manufacturing improvements and ultimately reduce the cost and time required to build Navy platforms. Any U.S. company or academic organization that is part of the U.S. defense industrial base is welcome to submit project ideas to be considered for funding under the CMTC program.

CMTC IS CURRENTLY ACCEPTING PROJECT IDEAS THAT WILL REDUCE THE COST AND TIME TO MANUFACTURE OR IMPROVE THE PERFORMANCE OF THE FOLLOWING U.S. NAVY PLATFORMS.

- Columbia Class Submarine
- DDG 51 Class Destroyer
- CVN 79 Class Carrier
- F-35 Joint Strike Fighter
- Virginia Class Submarine
- FFG(X)

To discuss your project ideas, please contact:
Jon Osborn - Executive Director, CMTC
Phone: 864-646-4508
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Blind Fastener Preparation System for Production Savings

M2740: F-35 Automated Blind Fastener Preparation

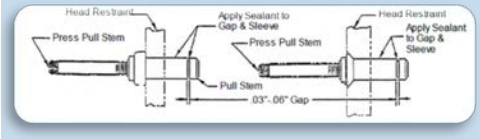
STATUS:
Project Complete

PERIOD OF PERFORMANCE:
July 2018 to June 2019

PLATFORM:
F-35

STAKEHOLDER:
JSF Program Office

MANTECH INVESTMENT:
$450,000



Objective

Blind fasteners are manually installed into many areas of the F-35 Lightning II. The current process, which requires significant hours per unit, involves multiple mechanics in each area to clean and apply sealant to the substructure, locate the skins to the structure, and install temporary and permanent fasteners. Prior to installation, each fastener is cleaned and promoted. Due to lubrication inside the sleeve in the locking mechanism of the blind fasteners, the fasteners cannot be cleaned using a slosh method and are instead cleaned and promoted individually to ensure that the cleaner / promoter does not enter the mechanism.

Individual cleaning of blind fasteners is a labor-intensive process that requires a fine paint brush to apply the cleaner to the fastener after which the fasteners must dwell in open air for 15-plus minutes after each application to ensure sufficient drying prior to handling. The task occurs in the work area where the fasteners are used and must be installed within eight hours or the process must be repeated. This Composites Manufacturing Technology Center (CMTC) project developed an automated blind fastener preparation system to apply cleaner to large quantities of blind fasteners to eliminate the "one-at-a-time" method. The system accelerates drying time after applications to further reduce preparation time.

Payoff

The conventional take-off and landing forward assembly contains over 790 blind fasteners and the Electronic Mate and Assembly Stations (EMAS) has 290. To clean the fasteners prior to installation takes an average of nine hours per unit and four hours per unit, respectively. Preparation time can be reduced by 56 percent in forward assembly and by 50 percent in EMAS, providing approximately $2.2M in production savings.

Increased shelf life is critical in order to allow enough time for fasteners to be prepared and kitted for use in the automated installation system. The proposed system process will increase shelf life for the fasteners by five days. The automated skin installation system enabled by this automated fastener cleaning system is anticipated to impart 50-60 hours of savings per aircraft depending on the variant.

Implementation

Implementation will begin with the development of a pilot system based on the technology developed under this ManTech project. The pilot system is anticipated to be placed into production in FY2020. Benefits of a pilot system include quick implementation, knowledge of real production needs, and lower probability of system changes on the capital system.

After gaining experience on the pilot system in a production environment, Lockheed Martin will develop a full-scale capital system. This fastener cleaning capital system will integrate with the future automated fastener insertion system for the forward fuselage that is being funded separately. Production break-in of the capital fastener cleaning system is anticipated in FY2022 to coincide with the planned break-in of the automated fastener insertion system. Other opportunities for the insertion of this technology are being investigated on F-35 and other platforms.

QUESTIONS CORNER:

The "Questions Corner: is dedicated to what YOU want to learn more about CMTC, advanced materials, new technologies, etc. It is also a space for CMTC to learn about what YOU would like to see featured within the CMTC *TechNotes*. We will use your questions and suggestions in order to ensure we are providing you with the most current, relevant information within the industry. CMTC will highlight questions that are asked and provide insight to all *TechNotes* readers.

Q: WHAT IS CMTC'S RELATIONSHIP TO THE COMPOSITES CONSORTIUM (TCC)?

A: The Composites Consortium is a stand-alone organization. It is comprised of industry-focused, balanced, team comprise of prime contractors, composites industry suppliers, universities, and institutes that serve as a technology resource for CMTC. TCC members not only support CMTC, but have also served as performers for other federal agencies including the Department of Homeland Security, NASA, and the Army Research Laboratory. For additional information about The Composites Consortium please visit their website at **https://tcc.ati.org/** or contact:

Mark Snider
Chairman, The Composites Consortium
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Q: DOES MY COMPANY NEED TO BE A MEMBER OF TCC IN ORDER TO PARTICIPATE IN CMTC EFFORTS?

A: No! Membership in TCC is NOT a requirement to participate in CMTC efforts. TCC is a stand-alone organization that has no bearing on the CMTC efforts pursued.

Q: WHO DO I CONTACT IF I HAVE A QUESTION ABOUT CMTC OR A REQUEST FOR FUTURE TECHNOTES?

A: Please send your questions, suggestions, and requests to:

Leslie Hill
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Email: Leslie.Hill@ati.org

Recent & Upcoming Events:

CAMX 2019:
SEPTEMBER 23-26
ANAHEIM, CA
Booth: S69

TCC TECHNICAL MEETING:
NOVEMBER 13-14
FALLS CHURCH, VA

DMC 2019:
DECEMBER 2-5
PHOENIX, AZ
Booth: 705

Look for these friendly faces!

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