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Standardization Stars

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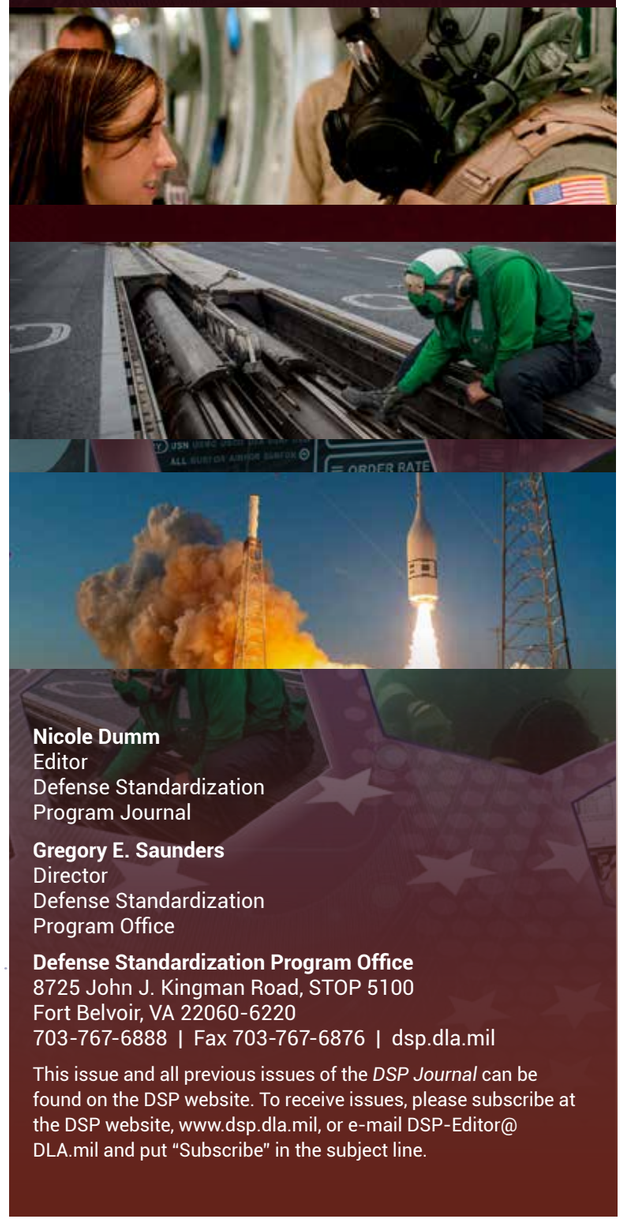

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Director's Forum

Standardization Stars

For the past 32 years, the Defense Standardization Program has honored personnel and organizations of the military departments and defense agencies for outstanding performance in the implementation of standardization through the DSP Achievement Awards. For the first time in 32 years, we made the difficult decision to cancel our annual award ceremony due to the COVID-19 pandemic. These times will certainly go into the history books, but we could not let the DSP history lack a year of recognition for the great work in our community. Therefore, we present the FY19 DSP Achievement Award Winners.

Individuals and teams are nominated for the Defense Standardization Program Achievement Awards. For FY19, we recognized two individuals and five teams. The winners' efforts have contributed to the safety of our warfighters and provided them with the tools they need to get the job done.

The winners are as follows:

- U.S. Army, Data Science–Driven Dynamic Anticipatory Standards to Accelerate Innovation and Transition of High-Loading Rate Adhesives for Bonded Armor Team, for the development of the Department of Defense's first dynamic standard, employing embedded data science and updatable military technical drivers as qualification guides for armor adhesives. MIL-STD-3059 redefines the traditional perspective by promoting a data-driven correlation between the complex ballistic response of adhesively bonded armor assemblies and universally translatable and commercially relevant quasi-static mechanical properties. This disruptive approach reduces the time and cost barrier to qualification of products by two-thirds and incentivizes high-risk and high-payoff innovations. Team members include Gerard T. Chaney, Daniel C. Deschepper, David P. Flanagan, Robert E. Jensen, and Charles G. Pergantis.
- U.S. Navy, Corrosion Prevention and Control (CPC) Protocol and Requirements in Military Design Standards Team, for extensively revising two design standards: MIL-STD-1587, "Material and Process Requirements for Aerospace Weapons Systems," and MIL-STD-7179, "Finishes, Coatings, and Sealants for the Protection of Aerospace Weapons Systems and Support Equipment." These standards form an integral part of CPC by specifying the selection of

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materials, protective coatings, and design considerations that mitigate corrosion through the principles of corrosion prevention. Team members include Craig Matzdorf, Rade Savija, and Rose Webster.

- U.S. Navy, Tactical Intelligence, Surveillance, and Reconnaissance Processing System, Shaun A. Elliott: the Naval Air Warfare Center Aircraft Division Webster Outlying Field Tactical Intelligence, Surveillance, and Reconnaissance Processing, Exploitation, and Dissemination System team joined forces with other Department of Defense organizations to extract as much actionable intelligence from unmanned aircraft system (UAS) video as quickly as possible by tapping into artificial intelligence (AI) and machine learning. Through a standards-based approach, the team deployed AI to the edge of battle for the first time with tactical UASs. The team not only introduced new capability to the fleet but achieved it in 90 days and has supplied iterative capability every six weeks since.
- U.S. Navy, Naval Air Systems Command Composite Repair (NAVCORE) Working Group, for implementing initiatives for shelf-life extension of hazardous materials, material consolidation, process consolidation, composite training alignment, and composite support equipment and repair tooling. The NAVCORE initiatives have saved upwards of $5 million for the U.S. Navy through cost savings and avoidance in training and procurement, and standardization approaches have contributed to condensed repair turnaround time, increased fleet repair capability, reduced Navy spending on redundant programs, and improved mission readiness. Team members include Justin Massey, Chris Rethmel, Steve Starnes, Rob Thompson, and Alyssa Zamora.
- U.S. Navy, Development of Standardized Military Detail Specification for Military Life Rafts (MIL-DTL-32532A) Team: this integrated product team collaborated to create MIL-DTL-32532 to procure militarized commercial off-the shelf inflatable life rafts for the U.S. Navy. MIL-DTL-32532 streamlines acquisition activities, injects quality into production, and enhances life raft lifecycle planning and execution with measurable payoffs through lower contract execution costs, increased component availability through standardization across the services, and enhanced supportability of survival gear. Team members include Paul Beausejour, Miguel Leyva, Amy Puchalsky, Paula Saltzburg, and Dean Schleicher.
- U.S. Air Force, Atlas Corp. Common Payload Interface Standard Team, for developing a major interface standard for satellite bus-to-payload integration. Through standardization of the satellite bus-to-payload interface, this standard enables new space capabilities, such as late or on-orbit insertion and independent integration of one manufacturer's product line. This standard replaces antiquated data buses with forward-leaning, reliable, high-speed technologies and enables weight-saving and distributed payload systems via innovative routing. Team members include Franco Macchia and Aaron Stevenson.
- U.S. Air Force, Compass Call; NH-03 Timothy C. DeShazo: this initiative revitalizes Compass Call combat effects and reduces operational costs. Countering emerging threats, sustaining an aging EC-130H Compass Call fleet, transitioning capabilities to a new aircraft platform, preparing aircraft for retirement, and complying with sunset clause restrictions require significant coordination. Through ongoing weekly meetings, monthly exigency team meetings, and requirements working groups, team members continually assess Compass Call program requirements and rank the warfighters' top priority needs. Once the priorities are compiled, a new list is forwarded to the system program office for funding, supplying teams and the system program office with a real-time feel for combatant commander requirements. This influences system program office decisions to fund the most pressing requirements and evolves Compass Call capabilities to meet future mission needs on demand.

These standardization awards call attention to the significant contributions that standards and standardization make to supporting our men and women in uniform, helping to multiply capability through interoperability and saving taxpayers' money. Maintaining a credible, combat-ready force and strong alliances is essential to deter war and maintain a free and open international order. Congratulations to the FY19 award winners. Your hard work and dedication are appreciated by DoD leadership and throughout the standardization community.

Data Science–Driven Dynamic Anticipatory Standards to Accelerate Innovation and Transition of High-Loading Rate Adhesives for Bonded Armor

Award Winner: U.S. Army Combat Capabilities Development Command Army Research Laboratory, Weapons and Materials Research Directorate, Material Development and Transition Branch

DESCRIPTION

This effort developed a breakthrough military standard that departs from traditional rigid test parameters by employing adaptable military technical drivers as qualification guides and building in data science enablers to innovate, validate, and accelerate technologies that meet these drivers. MIL-STD-3059 is the first dynamic Department of Defense (DoD) standard, enabling real-time inputs of evolving threats so that it is never obsolete and can be applied with precision. This disruptive approach reduces the time and cost barrier to qualification of products by two-thirds and incentivizes high-risk and high-payoff innovation. Embedding military drivers in testing protocols suitable for commercial dual-use applications significantly facilitated the product maturation process to bridge hard science, the benchtop, and production scaling at a rapid pace. MIL-STD-3059 resulted in commercial patent filing and production of a ground-breaking adhesive with 40% increased strength and an 80% increase in strain energy density over any adhesive previously tested for bonded armor. This high-performance adhesive enables advances in lightweight armor, pushing bonding performance to extremes. The application value in the commercial sector is estimated at $2 billion per year for the automotive industry alone, with dual-use scaling supporting lower cost availability for DoD acquisition.

DISCUSSION

Background

MIL-STD-3059, "Acceptance Criteria for Adhesives for High-Loading Rate Applications," presents experimental testing protocols to evaluate and assign priority to candidate adhesives derived from correlations to bonded armor applications. *Figure 1* shows the property assignment regions for adhesive group categories specified in MIL-STD-3059. The assignment regions are defined by a plot of maximum strength (S_{max}) versus displacement at complete failure ($d_{failure}$) as measured from a well-established single-lap-joint test geometry configuration under quasi-static loading conditions.[1] The plot includes the experimentally measured averaged data for various candidate armor adhesives, with their respective global response to ballistic loadings also determined, or known. Group 1 represents a high-strength and high-elongation-to-failure performance region with increases in ballistic damage tolerance of the adhesive bondline expected. MIL-STD-3059 specifies additional hot or wet, elevated temperature, and crack extension requirements as screening checks to minimize common long-term in-service durability issues.[2] MIL-STD-3059 optimizes the damage tolerance of complex, adhesively bonded armor assemblies against ballistic threats in terms of simplified quasi-static testing geometries for easy access by non-DoD academic and industrial researchers.

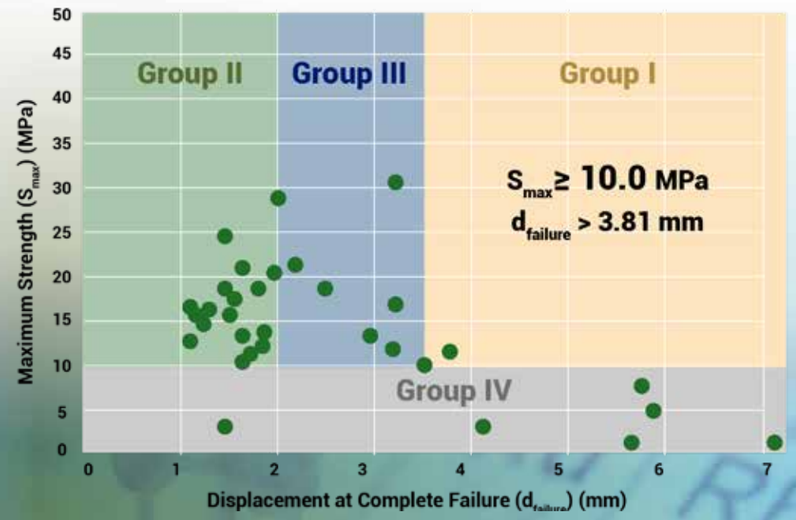


Figure 1. *Adhesive groups based on S_{max} and $d_{failure}$ single-lap-joint performance with U.S. Army Combat Capabilities Development Command Army Research Laboratory (CCDC ARL) experimental population of armor bonding candidates (room temperature average values shown).*

[1] ASTM Standard D1002-10, "Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)," ASTM International, West Conshohocken, PA, 2010, DOI: 10.1520/D1002-10, www.astm.org.

[2] R. Jensen, D. Flanagan, D. DeSchepper, and M. Silton, "Single-Lap-Joint Screening of Hysol EA 9309NA Epoxy Adhesive," ARL-TR-8011, May 2017, http://hdl.handle.net/11256/939.

Problem/Opportunity

MIL-STD-3059 transforms a tremendously complex problem set, deeply rooted in Army-unique issues, into a broadly applicable opportunity by redefining the traditional perspective of a testing standard. The Army always needs adhesives with material properties beyond the current state of the art to optimize the protection-defeat mechanism efficiencies of lightweight bonded armors. Bonded armor assemblies often rely on a ceramic strike face and metal or composite backing plate, preventing the use of conventional joining techniques.[3, 4, 5] Design innovations occur in compressed timeframes to match ever-emerging field threats. High-loading rate mechanisms are poorly understood[6] with limited performance applicability observed from commercially available aerospace- or automotive-grade adhesives. Furthermore, adhesive bonding for armor applications is a demanding challenge to experimentally practice and computationally model. The art of bonding processes has high-variable dimension complexity and potential experimental uncertainty. The interdependent relationship between research and development (R&D) and technical standards add complexity to the infusion of fundamental science in tangible products, resulting in a common perception that standards impede innovation.[7, 8] No structural adhesive had ever bridged basic research to commercial product successfully with ground vehicle armor as the focus application. Conventional adhesive standards measure late lifecycle quality assurance for low-risk bonding applications with long-term historical usage and well understood design allowables.[9] However, the interactive roles between standardization and innovation depend on timing in the technology's lifecycle.[10, 11, 12] MIL-STD-3059 represents a forward-looking[13] standard, coinciding with emergent lifecycle adhesives technologies and drawing commercial and academic R&D attention to unique Army-derived performance needs.

[3] Gao et al., "Influence of Epoxy Adhesive Layer on Impact Performance of TiB2-B4C Composites Armor Backed by Aluminum Plate," *International Journal of Impact Engineering* 122, 60-72 (2018).

[4] Bartus, "A Review: Impact Damage of Composite Materials," *Journal of Advanced Materials* 39, 3-21 (2007).

[5] Bogetti et al., "Predicting the Nonlinear Response and Failure of Composite Laminates: Correlation with Experimental Results," *Composites Science and Technology* 64, 477-485 (2004).

[6] Collaborative Research Alliance for Materials in Extreme Dynamic Environments," funding opportunity by ARL, 2011.

[7] Ortt and Egyedi, "The Effect of Standards and Regulation on Radically New Innovations," 2013 8th International Conference on Standardization and Innovation in Information Technology (SIIT) IEEE (2013).

[8] Hanseth, Monteiro, and Hatling, "Developing Information Infrastructure: The Tension between Standardization and Flexibility," *Science, Technology, & Human Values* 21, 407-426 (1996).

[9] AMS-A-25463, "Adhesive, Film Form Metallic Sandwich Construction," SAE International, July 16, 2013. Originated from MIL-A-25463, Amendment 2, October 19, 1961.

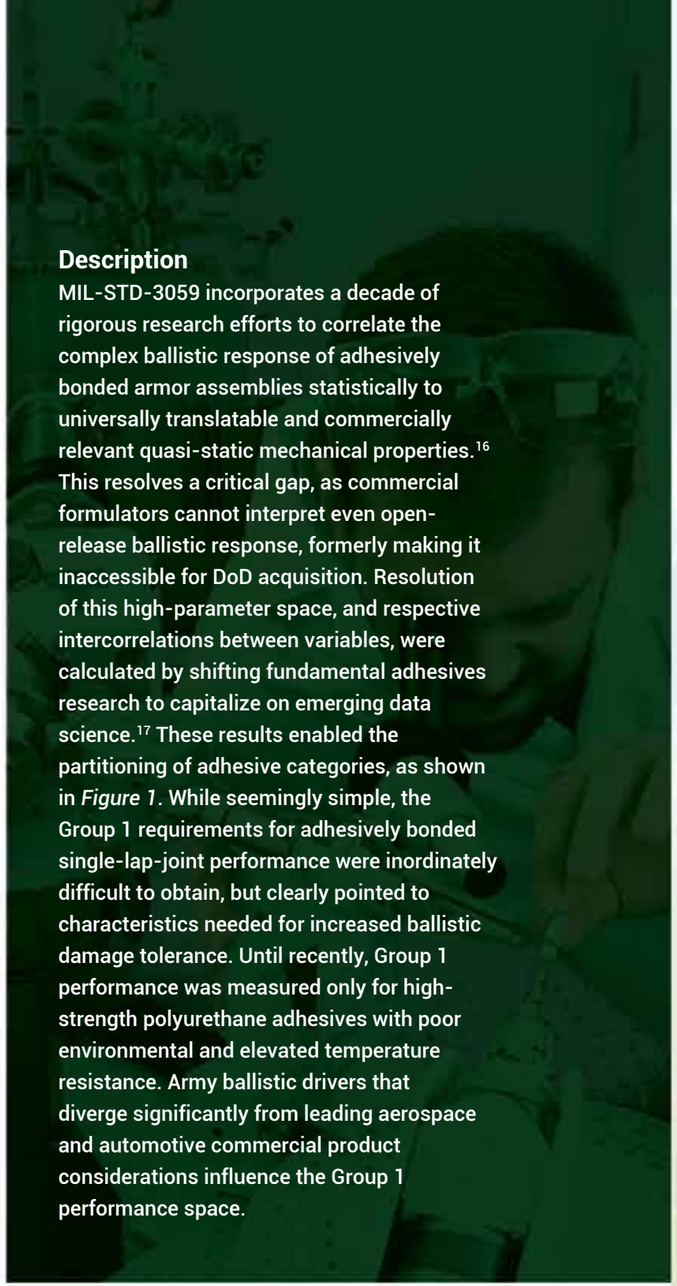
[10] Egyedi and Sherif, "Standards Dynamics through an Innovation Lens: Next-Generation Ethernet Networks," *IEEE Communications Magazine* 48, 166-171 (2010).

[11] Krechmer, "Technical Standards: Foundations of the Future," *Standard View* 4, 4-8 (1996).

[12] Horn, "The Changing Nature of Innovation," *Research Technology Management* 48, 28-31 (2005).

[13] MIL-STD-3059 (MR), "Acceptance Criteria for Adhesives for High-Loading Rate Applications," Department of Defense Test Method Standard, November 22, 2018.

MIL-STD-3059 leverages current state-of-the-art opportunities in data science to incentivize higher risk and higher payoff product development. Military standards represent a unique opportunity to use the tools of data science as the transactional information exchange between the standard development organization and vendors, guaranteeing pedigree, integrity, and completeness. Data visualization of accepted test results and associated metadata descriptors supply a high degree of transparency and insight for continued advancement of the technology. Furthermore, the application of machine learning algorithms, including k-nearest neighbors, Naïve Bayes classifiers, support vector machines, artificial neural networks, and deep learning, can maintain or increase relevance of datasets for MIL-STD-3059 armor design needs as time progresses without resorting to traditional unmanageably large and cost-prohibitive design-of-experiment approaches.[14, 15] MIL-STD-3059 remains dynamic with an efficient test matrix progression as the product lifecycle stage advances. By furnishing transparent and standardized data formatted for machine learning–assisted discovery, MIL-STD-3059 enables adhesive vendors and end users to expand adhesive property-performance correlations to application areas in other avenues of commercial dual-use market development beyond the scope of armor.



Description

MIL-STD-3059 incorporates a decade of rigorous research efforts to correlate the complex ballistic response of adhesively bonded armor assemblies statistically to universally translatable and commercially relevant quasi-static mechanical properties.[16] This resolves a critical gap, as commercial formulators cannot interpret even open-release ballistic response, formerly making it inaccessible for DoD acquisition. Resolution of this high-parameter space, and respective intercorrelations between variables, were calculated by shifting fundamental adhesives research to capitalize on emerging data science.[17] These results enabled the partitioning of adhesive categories, as shown in *Figure 1*. While seemingly simple, the Group 1 requirements for adhesively bonded single-lap-joint performance were inordinately difficult to obtain, but clearly pointed to characteristics needed for increased ballistic damage tolerance. Until recently, Group 1 performance was measured only for high-strength polyurethane adhesives with poor environmental and elevated temperature resistance. Army ballistic drivers that diverge significantly from leading aerospace and automotive commercial product considerations influence the Group 1 performance space.

[14] Gomez-Bombarelli et al., "Automatic Chemical Design Using a Data-Driven Continuous Representation of Molecules," *ACS Central Science* 4, 268-276 (2018).

[15] Liu, Yang, Zio, and Chen, "Artificial Intelligence for Fault Diagnosis of Rotating Machinery: A Review," *Mechanical Systems and-Signal Processing* 108, 33-47 (2018).

[16] J. Robinette, J. Gardner, R. Jensen, and S. McKnight, "Lap-Shear Strength versus Elongation to Failure of Candidate Composite Armor Adhesives," ARL-TR-4862, June 2009.

[17] R. Jensen, W. Kosik, J. Gardner, and D. O'Brien, "Critical Adhesive Needs for Army Applications and Opportunities for Innovation," ARL-RP-323, June 2011.

Once the ballistic correlations were known, the effort departed from traditional basic research by not pursuing internally generated adhesive formulations and subsequent peer-review publications, but rather communicated the findings as a military requirements standard.[18, 19] This decision leveraged a much larger expertise base beyond the capability of DoD. Bench-level scientists' tentative relationship with requirements standards often presents them with the infamous, and frustrating, valley-of-death obstacle to successful technology transition. However, requirements standards influence commercial industry, where any product obtained by DoD acquisition ultimately originates. The data-driven correlation approach enabled rigorous minimization of the testing matrix for MIL-STD-3059, offering a cost-efficient incentive for proofing higher risk and emergent adhesives technologies.

Incorporating workflows to derive the correlations between ballistic performance and single-lap-joint testing results embeds this data-driven approach into MIL-STD-3059.[20, 21] The scientific peer-review process rigorously vetted the workflows, demonstrating that the process can yield large datasets robust enough for multivariate statistical analysis of the single-lap-joint processing parameters used for MIL-STD-3059.[22] Embedded data science makes MILSTD-3059 the first and only dynamic DoD standardization document, enabling the Army to input emerging threats and match optimal adhesives in real time. The standard will never be outdated as the data grows and our ability to respond to any threat improves. In addition, the data-science workflow formats are transferrable to commercial vendors submitting results for MILSTD-3059, which can save millions of dollars in redundant testing by DoD laboratories and rapidly speed technology transition. The initial draft concepts for MIL-STD-3059 were first documented for CCDC ARL ISO 9001 quality management system certification in 2014.[23]

OUTCOME

Payoff

MIL-STD-3059 drove new product development from industry with previously unachievable performance. Through collaboration with CCDC ARL, PPG Industries received the draft release of MIL-STD- 3059 in 2016. The Group 1 requirements were just beyond reach of the state of the art,

[18] R. Jensen, W. Kosik Chaney, D. DeSchepper, and D. Flanagan, "Leveraging Army Unique Mission Requirements to Advance the State-of-the-Art in Adhesives Development," ARL-RP-360, March 2012.

[19] R. Jensen, W. Kosik Chaney, J. Kaufman, and B. Henrie, "Screening Adhesively Bonded Single-Lap-Joint Testing Results Using Nonlinear Calculation Parameters," ARL-RP-362, March 2012.

[20] D. DeSchepper, D. Flanagan, E. Elburn, R. Jensen, B. Henrie, and P. Wimberley, "Support and Development of Workflow Protocols for High Throughput Single-Lap-Joint Testing—Data Management," ARL-RP-426, April 2013.

[21] D. Flanagan, D. DeSchepper, E. Elburn, and R. Jensen, "Support and Development of Workflow Protocols for High Throughput Single-Lap-Joint Testing—Experimental," ARL-RP-425, April 2013.

[22] R. Jensen, D. DeSchepper, and D. Flanagan, "Multivariate Analysis of High Throughput Adhesively Bonded Single Lap Joints," *International Journal of Adhesion and Adhesives*, 89, 2019, 1-10.

[23] R. Jensen, D. DeSchepper, D. Flanagan, W. Kosik-Chaney, J. Robinette, G. Chaney, and C. Pergantis, "Adhesives: Test Method, Groups Assignment, and Categorization Guide for High-Loading Rate Applications," ARL-ADHES-QA-001, 00 Rev. 1.0, ARL-SR-288, June 2014.

as confirmed by PPG researchers unable to find a match from their adhesive product catalog. However, PPG was not deterred, as the performance objectives set in MIL-STD-3059 have significant overlap for non-DoD dual-use applications. In 2017, the efforts of significant PPG internal R&D, and ongoing collaboration with CCDC ARL, yielded the first laboratory-scale adhesive formulation meeting Group 1 requirements and passing subsequent hot or wet and elevated temperature conditioning requirements. PPG's research-grade adhesive was adapted heavily from in-house expertise in formulating for the original equipment manufacturer (OEM) automotive industry with production scalability. PPG filed for patent disclosure in early 2019 and specifically cited Army ballistics as the technology motivator. Commercial production scaling of the PPG adhesive at Technology Readiness Level (TRL) 6 was achieved in September 2019 and will be marketed as PR-2901 through its High-Performance Aerospace Division. PPG PR-2901 has a 40% increased strength with an 80% increase in strain-energy density over any adhesive tested for bonded armor previously, as shown in *Figure 2*. The state of the art was pushed from TRL 1 to 6 in 3 years using a DoD military standard as the driving technology motivator.

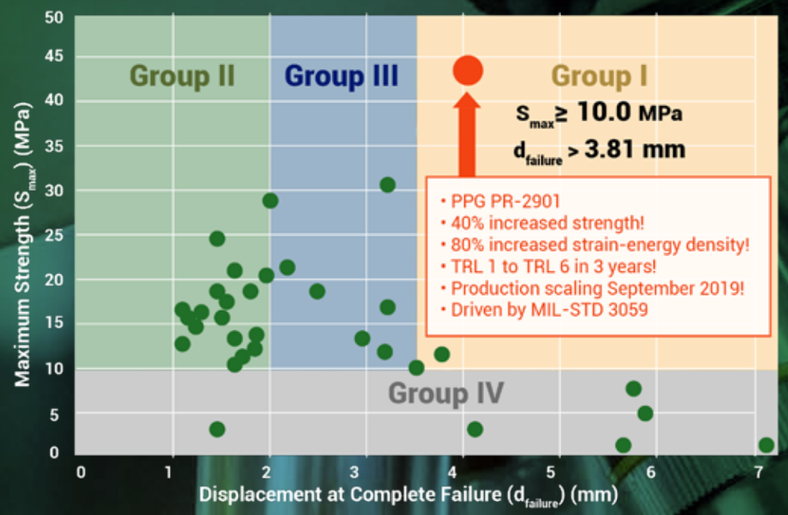


***Figure 2**. MIL-STD-3059 drives commercial product development with performance gains.*

Current Status

Independent characterization of PR-2901 by the City College of New York (Ground Vehicle Systems Center [GVSC] contract) validated experimentally that the quasi-static Group 1 loading requirements in MIL-STD-3959 correlate to enhanced ballistic-bending, ballistic-shear, and blast-bending performance. CCDC GVSC is also sponsoring the National Center for Manufacturing Sciences (Oakland University, Rockland, MI) in designing durable multi-material bonded Group 1 adhesive joints. CCDC ARL, PPG, and CCDC GVSC work with the data science department at Worcester Polytechnic Institute for online website hosting and database platform development to realize the dynamic capability of MIL-STD-3059. Armor demonstrations are planned to reduce the manufacturing logistical difficulties and increase the ballistic performance of gunner protection turret kits with the armaments center. The soldier center will demonstrate PR-2901 for bonded body armor. CCDC ARL's Specifications & Standards Office is drafting an accompanying performance specification to MIL-STD-3059 to facilitate an associated qualified products database.

Challenges

The cultural indifference, or resistance, to connecting the possibility of driving technical innovation through an adaptively written military standard based on rigorous science was the largest obstacle to MIL-STD-3059. As the scope of the technological innovation increases, a standard's influence also increases.[24] MIL-STD-3059 marries a challenging Army problem, a minimal entry barrier, and the transparency of being housed on a data management platform so commercial vendors can envision a much broader market beyond DoD. In the case of Group 1 armor adhesives, the awardees estimate the commercial dual-use overlap for OEM automotive crashworthiness applications at potentially $2 billion per year. Understanding how these factors interact with military standards ensures the availability of answers to the most difficult DoD foundational research questions for the warfighter through the acquisition process.

About the Award Winners

Robert E. Jensen: Dr. Jensen conceptualized focusing the output of fundamental R&D as an anticipatory requirements document to entice industry into developing high-risk products for DoD applications. MIL-STD-3059 resulted from the convergence of a difficult Army ballistics challenge in adhesives, the emergence of data science, and the experiential realization that Army needs required a divergence from the aerospace and automotive industries as technology leads. Dr. Jensen piloted MIL-STD-3059 with a "History and Rationale" document for transparency.[25]

David P. Flanagan: Mr. Flanagan translated the experimental art of adhesive-bond processing to the robust and repeatable data science workflows embedded in MIL-STD-3059. These efforts are embodied in the supplementary adhesive processing, bondline thickness measurement, and mechanical testing travel sheets for vendor submission of experimental test data in MIL-STD-3059. The travel sheets ensured the trustworthiness of the testing results, which were finalized through numerous iterations and experimental validations. Mr. Flanagan's expertise is included in MIL-STD-3059 as an attached "how to" portable document format (PDF) technical report to assist vendors in complying with the testing requirements.[26]

[24] See Note 7

[25] R. Jensen, D. Flanagan, D. Deschepper, and C. Pergantis, "Adhesives: Test Method, Group Assignment, and Categorization Guide for High-Loading-Rate Applications—History and Rationale," ARL-ADHES-QA-001.01, Rev. 2.2, ARL SR-0371, April 2017.

[26] R. Jensen, D. DeSchepper, D. Flanagan, G. Chaney, and C. Pergantis, "Adhesives: Test Method, Group Assignment, and Categorization Guide for High-Loading-Rate Applications—Preparation and Testing of Single Lap Joints," ARL-ADHES-QA-001.01, Rev 2.2, ARL SR-0356, April 2016.

Daniel C. Deschepper: Mr. Deschepper proofed the workflow concepts of MILSTD-3059 at high-sample numbers and adapted database input schemas for maximum pedigree and integrity, while minimizing manual technician data entry efforts.[27] To achieve compatibility with modem relational databases, accurate data input is of vital importance. This linkage enables MIL-STD-3059 to serve as an access point to the datasets needed to derive future correlations between adhesive properties and armor response.

Gerard T. Chaney: Mr. Chaney drafted the testing coupon geometries and sample preparation alignment fixtures for MIL-STD-3059 as graphic images in drawing eXchange format and PDF included in the online digital version of the standard as file attachments. MIL-STD-3059 is plug-and-play ready with auto-computer assisted drafting software by any modem computer numerical control milling machine. MIL-STD-3059 eliminates the decades-old tradition of engineers manually transcribing sample dimensions from an image captured only on paper, significantly lowering the barrier of entry for commercial vendors.

Charles G. Pergantis: Mr. Pergantis translated basic research science perspectives to the formatted rigor needed for a requirements document. He worked hand in hand with Dr. Jensen to draft technical language from an experimental team normally focused on peer-review publication output and applied the attention to detail for acceptance and coordination with commercial vendors. Mr. Pergantis was instrumental in orchestrating the draft release of the precursor to MIL-ST0-3059 in ISO 9001 format.[28]

[27] R. Jensen, D. DeSchepper, and D. Flanagan, "Multivariate Analysis of High Through-Put Adhesively Bonded Single Lap Joints: Experimental and Workflow Protocols," ARL-TR-7966, June 2016, http://hdl.handle.net/11256/699.

[28] See Note 23.

Corrosion Prevention and Control Protocol and Requirements in Military Design Standards

Award Winner: Naval Air Systems Command, Mission Operations and Integration Department, Systems Standardization and Packaging, Handling, Storage, and Transportation Branch, Joint Base McGuire-Dix-Lakehurst, New Jersey

DESCRIPTION

The team published two important military standards addressing corrosion prevention and control (CPC):

1. MIL-STD-1587, "Material and Process Requirements for Aerospace Weapons Systems." This design criteria standard establishes materials and process requirements for aerospace weapons systems. This standard furnishes requirements and protocols for timely and comprehensive consideration of limited materials and processes during systems design and the lessons learned over the years from military-unique operational systems worldwide. The standard employs military-unique design criteria and considerations that exceed commercial design practices to meet the military rigors and environment that the operational systems encounter. Using this document results in more durable systems in operational service.
2. MIL-STD-7179, "Finishes, Coatings, and Sealants for the Protection of Aerospace Weapons Systems and Support Equipment." This standard defines the material specifications required as finishes, protective coatings, and sealants in aerospace weapons systems and support equipment. The methods and materials in this standard are for the protective surface treatments and finishes on weapon system parts (including spares) and assemblies (such as fuselages, wings, cowlings, empennage, and rotor blades), in addition to all support equipment.

DISCUSSION

Background

The Department of Defense (DoD) recognizes that CPC planning is critical and paramount to an acquisition program's success. U.S. Code (law) mandates CPC and directive,

instruction, and policy requires it. DoD policy mandates that Acquisition Category I programs formally document CPC planning in the systems engineering plan and the lifecycle sustainment plan. Program managers develop and implement these formal plans to prevent and control corrosion from affecting the availability, cost, and safety of military programs.

Problem/Opportunity

During the 1990s, the elimination of many corrosion specifications and standards made it difficult to include CPC requirements in system acquisition. With many important specifications and standards no longer available, hundreds of individual requirements from numerous sources needed to be negotiated in the contract.

Previously, to include CPC requirements in system acquisition, hundreds of individual requirements were negotiated from the following:

- System finish specifications
- CPC verification and validation criteria
- Aircraft structural integrity
- Prohibited materials
- Non-destructive inspections
- Environmental testing
- Hundreds of individual specifications for primers and coatings, surface treatments, metals, composites, adhesive bonding, etc.
- Legacy lessons learned
- CPC risk management
- Corrosion teams
- Materials and process selection criteria.

The reinstatement and subsequent upgrade of the military standards and the incorporation of a new nongovernment standard for corrosion and control planning addresses CPC through five key standards (including MIL-STD-1587 and MIL-STD-7179) in lieu of the hundreds of individual requirements: MIL-STD-1530, MIL-STD-1568, MIL-STD-1587, MIL-STD-7179, and NACE SP21412-2016/SSPC CPC-1.

Description

This effort worked extensively to revise the two design standards: MIL-STD-1587 and MIL-STD-7179. These standards form an integral part of CPC by specifying the selection of materials, protective coatings, and design considerations that mitigate corrosion by applying the principles of corrosion prevention. Consideration of corrosion prevention during the early stages of the acquisition process (including sustainment) effectively reduces the overall cost of ownership of military equipment, systems, and facilities by balancing the additional acquisition costs associated with improvements in the initial products with the greater reduction in maintenance resulting from improved systems. While investments in CPC may increase acquisition costs, those costs are more than offset by the reduction of maintenance costs over the life of the system.

OUTCOME

The team published the standards for implementation on contracts and reference in other military documents, technical manuals, and joint service specification guides (JSSGs). Initial designs include corrosion prevention and control requirements with verification as a part of the test and acceptance programs, applicable across all services' aerospace weapon systems. The two standards improve the safety, reliability, and maintainability of DoD's aerospace weapon systems. Increased CPC ultimately reduces fleet downtime and improves mission readiness.

Payoff

Avoiding instituting a proper corrosion protection program is costly to DoD. Approximately $20 billion annually goes to maintenance needed due to corrosion, almost 25 percent of every maintenance dollar. Half of these costs are associated with DoD's aviation systems. Corrosion degrades the readiness and safety of equipment and results in substantial, often avoidable, costs.

The Defense Science Board Task Force[1] estimated that 30 percent of corrosion costs could be avoided through proper investment in prevention and mitigation of corrosion during design, manufacture, and sustainment. For DoD, this yields a potential cost savings or avoidance of $3 billion annually.

Current Status

The two standards are published and reside in the Acquisition Streamlining and Standardization Information System database for institution and implementation in system acquisition documents. Specifications, such as MIL-P-5518, "Aircraft Pneumatic Systems, Design, and Installation," and MIL-M-8856, "Missiles, Guided, Structural Integrity," reference MIL-STD-1587. MIL-PRF-81352, "Aircraft Touch-up Coatings," JSSG-2007 "Engines, Aircraft, Turbine," and various other military materials specifications implement MIL-STD-7179. Referencing the two design standards in materials specification ensures uniform material selection and coating compatibility, influencing corrosion protection, prevention, and control.

Challenges

- Required coordination beyond DoD.
- Logistics of the extensive coordination with stakeholders.
- Pursuing the participation of corrosion specialists, program managers, systems engineers, lifecycle logisticians, contracts, and cost estimate and budget personnel.
- Adjudicating the voluminous amount of comments.
- Resolving any controversy and disagreement; negotiating with the stakeholders.
- Pursuing final concurrence of the military standards.
- Accounting for the numerous existing products and facilities that follow different processes, requirements, and protocols.

About the Award Winners

Craig Matzdorf, Rade Savija, and Rose Webster incorporated technical changes and revised drafts of the standards. They circulated and coordinated the drafts, adjudicated controversial comments, held meetings to resolve issues, and eventually published the two standards. The coordination cycle was extensive, and the stakeholders included all the military services, original equipment manufacturers, industry finishers and platers, and academia. The team adjudicated all comments and incorporated changes into the standards.

[1] Defense Science Board Task Force 2004 Report, https://www.gao.gov.

Tactical Intelligence, Surveillance, & Reconnaissance Processing System

Award Winner: Shaun A. Elliott

DESCRIPTION

Each day, across multiple theaters of operations, thousands of unmanned reconnaissance, surveillance, and target acquisition systems collect vast amounts of video, still imagery, and communications data to help define a dynamic battlespace, locate targets of interest, and better inform the decisions of combatant commanders engaged in offensive and defensive operations around the globe. Turning that data into actionable intelligence requires uniquely trained intelligence analysts who are already drowning in information. That skilled, but thinly stretched, workforce is outnumbered by systems collecting the data—almost 99% of video from unmanned aircraft systems (UASs) is never analyzed. The Naval Air Warfare Center Aircraft Division (NAVAIRWARCENACDIV) Webster Outlying Field (WOLF) Tactical Intelligence, Surveillance, and Reconnaissance (ISR) Processing, Exploitation, and Dissemination System, or TIPS, team joined forces with other Department of Defense organizations to better the odds and extract as much actionable intelligence from UAS video as quickly as possible by tapping into artificial intelligence (AI) and machine learning. Through a standards-based approach, the team deployed AI to the forward edge of battle for the first time with tactical UASs in combat. The team not only introduced new capability to the fleet but achieved it within 90 days and has supplied iterative capability every six weeks since.

DISCUSSION

Background

In 2017, the Deputy Secretary of Defense (DEPSECDEF) signed a memorandum establishing the Algorithmic Warfare Cross Functional Team (AWCFT) to accelerate the Defense Department's integration of AI into operational use. The AWCFT, also known as Project Maven, was given several high-priority tasks, the first was to assist the counter-ISIS campaign by leveraging AI to reduce the burden on full-motion video analysis and produce actionable intelligence faster, automating intelligence tasks that could be automated by AI and augmenting those that could not. To ensure maximum interoperability with several small tactical unmanned systems, a standards-based approach to system implementation was crucial to deploying these new capabilities.

Problem/Opportunity

The DEPSECDEF prioritized tackling the massive amounts of video collected by small tactical unmanned vehicles, specifically Group 3 and below systems integrated with the standards-based TIPS, like RQ-21A Blackjack, ScanEagle, and Aerosonde. U.S. Africa Command and U.S. Central Command used these systems extensively to support counterterrorism and counter-insurgency operations, but lacked the intelligence analysts to exploit the data collected quickly to produce reliable, actionable intelligence. AI computer vision and object classification in particular could aid intelligence analysts in monitoring UAS video feeds in real-time; however, integrating these deep learning algorithms into multiple programs of record and contractor-owned and -operated ISR platforms requires extensive knowledge of UAS architectures, data standards, video processing frameworks, cybersecurity, and tactical ISR operations.

Description

The team worked with the Office of the Under Secretary of Defense for Intelligence (OUSD[I]) AWCFT, Johns Hopkins University Applied Physics Lab, industry partners, and PMA-263's Advanced Development Team to overcome the technical and financial challenges of this dynamic and high-visibility project. The highly compressed timeline of this venture and the large number of potential AI algorithms to test required that the Naval Air Systems Command team define and enforce a standards-based integration plan for the algorithms. This enabled deployment of multiple algorithms from various industry partners while still meeting the timeline and required security accreditations. The combined team continues to advance the real-world applicability of AI technology. This approach's success serves as a model for future AI deployments.

OUTCOME

NAVAIRWARCENACDIV WOLF's TIPS personnel traveled overseas to an area of operation, alongside members from the AWCFT, to support Project Maven's inaugural deployment. In less than one week, the TIPS team integrated the new capabilities with U.S. Southern Command–owned TIPS assets and performed operational checks with multiple concurrent unmanned systems as well as downstream intelligence and satellite communication backhaul systems. Because of the positive feedback from on-the-ground analysts and the overwhelming need for "more Maven," the TIPS team, with AWCFT members, continues the cycle of dynamic model retraining, algorithm updates, and site integration:

- Integrations in Iraq and Afghanistan.
- The first maritime integration in FY19.
- DEPSECDEF integration of AI at several sites in two theaters of operation.
- Eight deployments to nine sites to integrate these capabilities with four unique ISR platforms operated by nine customers.
- Daily ongoing deployments and integration of new platforms and sensor types as well as research and development to further push AI into smaller UASs and ground stations.

Payoff

In less than 90 days, the NAVAIRWARCENACDIV WOLF TIPS team incorporated AI software with tactical UASs by integrating an OUSD(I) initiative, known as Project Maven, with the TIPS framework. The team deployed to the forward edge of battle with the new capability to ensure successful integration of TIPS and Project Maven. This extraordinary feat marked the first time UAS used AI in combat operations and will change the way the military fights.

Current Status

The TIPS team continues to support Project Maven daily with ongoing deployments and integration of new platforms and sensor types as well as research and development to push AI into smaller UASs and ground stations. Ship-based installations have enhanced this capability with a standards-based approach to bidirectional communications across security classification domains. Standards for command and control have enabled AI to remotely supervise payloads and sensors. The team furnishes field service representatives for in theater Project Maven installations of TIPS.

In less than 90 days, the NAVAIRWARCENACDIV WOLF TIPS team incorporated AI software with tactical UASs by integrating an OUSD(I) initiative, known as Project Maven, with the TIPS framework.

Challenges

While the AWCFT externally pursued algorithm development with multiple vendors, the TIPS team defined two critical architectures—first, an open standards-based interface for algorithm vendors to create their tools to integrate with TIPS's existing video processing pipeline and, second, a structured data format to capture and disseminate object detection data to downstream national security systems. This standardization meant that AWCFT could task multiple AI developers in parallel to craft algorithms uniquely suited for specialized target sets and environments, while ensuring that each vendor's product would integrate quickly, consistently, and predictably with TIPS. In addition, defining a non-proprietary data format to organize and disseminate object detection data to other systems meant those same downstream systems wouldn't require the high-performance and cost of graphical processing units in TIPS. This realized Project Maven's ability to get structured detection data to as many intelligence processing, exploitation, and dissemination systems as possible, maximizing the number of analysts who could benefit from the AI-enabled, previously burdensome, tasks of object detection and classification.

About the Award Winner

Shaun A. Elliott led a highly technical team of UAS, data receiving and dissemination, and cybersecurity experts through a standards-based, system-of-system approach to implement AWCFT's AI and object detection capabilities rapidly.

Naval Air Systems Command Composite Repair Working Group

Award Winner: Naval Air Systems Command

DESCRIPTION

High-value ($100,000–$4 million) advanced composite components have been fielded on naval aircraft over the last 36 years. Subsequently, composite repair has become integral to keeping aircraft mission capable. However, due to the infancy of this technology, each aircraft program repair site has different composite repair materials and processes. As more naval aircraft incorporate composite materials, having a specific repair approach for each program becomes unsustainable. The Naval Air Systems Command (NAVAIR) Composite Repair (NAVCORE) working group, with engineers from multiple NAVAIR sites, was formed to address the uncoordinated approach to composite repair. NAVCORE aligns and standardizes composite repair materials and processing approaches nationally to ensure logistically supportable and rapid repair solutions. NAVCORE has national alignment initiatives for composite repair training, repair processes, consolidation of repair materials, tooling, shelf-life extension testing, fleet repair manuals, and fleet-level training. The NAVCORE initiatives have not only saved upwards of $5 million for the U.S. Navy (USN) through cost savings and avoidance in training and procurement, but all standardization approaches have affected or contributed to reduced repair turnaround time, increased fleet repair capability, reduced Navy spending on redundant programs, and increased mission readiness.

DISCUSSION

Background

When the Department of the Navy placed the F/A-18NB Legacy Hornet in service in 1983, the first aircraft primarily manufactured with advanced composite materials was cemented into USN aviation history. This aircraft contained roughly 10% advanced composite material by weight. Since the adoption of the F/A-18 Hornet, almost every air vehicle has included advanced composite materials on primary, secondary, or tertiary structures. Increases in overall composite weight percentage has grown over the last four decades as shown by these aircraft programs (percent weight composite in parenthesis): F/A-18E/F Super Hornet (20%), AV-8B (23%), F-35 (33%), V-22 (60%), H-53K (75%), and unmanned aerial vehicles (75–90%). The rising use of composite materials places higher importance on advanced composite repair capability due to the increased cost of manufacturing composite components over metallic components. However, as the Navy brought more composite aircraft into service, each program implemented a unique repair approach with dissimilar materials and processing due to differences in the repair procedures of the original equipment manufacturers (OEMs) and subcontractors.

Problem/Opportunity

Each aircraft type adopted new material, processing, and support equipment for in-service repair. In addition, with the increasing number of composite aircraft programs in the Navy, repair materials and support equipment have become less logistically supportable due to the diversity of supply. For example, five different aircraft programs perform similar or the exact same repair processes; however, all use different repair materials and support equipment. While not a big issue with limited repair capability at an organizational (O) squadron level, this becomes a problem at intermediate (I) and depot repair facilities when repairing multiple type, model, and series of aircraft. The programmatic setup also results in separate training, tooling, and repair processes. As more aircraft entered the force without a standardized repair approach, repair strategies became more convoluted and less cost effective.

Description

In 2017, the Non-Program Related Engineering (NPRE) program created the NAVCORE working group to ensure standardization and alignment for composite repair of multiple aircraft programs. This group includes senior- and journey-level composite materials and process engineers from the NAVAIR enterprise, with representatives from Fleet Readiness Centers (FRC) Southwest (SW), Southeast (SE), and East (E); Naval Air Warfare Center Aircraft Divisions (NAWC-AD) Patuxent River (PAX) and Lakehurst; and Naval Air Warfare Center Weapons Division (NAWC-WD) China Lake. These members have years of in-service maintenance repair and overhaul (MRO) and acquisition engineering experience related to composite repair and interface with industry, academia, and other government agencies in the composite repair community to impart knowledge of best practices, including standardization outside the Navy. This national team created multiple initiatives to improve the platform-specific repair strategy.

a. **Shelf-Life Extension of Hazardous Materials (HAZMAT)**: Each naval repair site uses many of the same HAZMAT (adhesives, polymers, preimpregnated materials, etc.); however, a centralized approach had not been adopted for how and when to test these materials to increase shelf life without compromising material performance. This initiative standardizes testing and shelf-life extension of HAZMAT pertaining to composite repair at all sites, regardless of the aircraft program requirement, to save procurement cost without sacrificing key performance parameters.

b. **Material Consolidation**: Each aircraft program uses different HAZMAT, but mainly for the same purposes. This initiative surveys all HAZMAT and finds common materials to categorize as workhorse performers that logistically support and eliminate the need for redundant materials due to acquisition requirements.

c. **Process Consolidation**: Each repair site performs many of the same repair processes with slight differentiations due to requirements set by the aircraft OEM during acquisition. Standardization of processes reduces the variability in products at each site or in each aircraft program while implementing best practices.

d. **Composite Training Alignment**: Each platform requires unique training for many of the same skills. The training is also site-specific, with each site training its personnel differently. Therefore, a national alignment of composite technician training was completed to consolidate training based on skills learned and all sites teaching the same requirement. This initiative adopted a new online quality assurance certification system, aligning with Department of the Navy Vision 20/20 initiatives.

e. **Composite Support Equipment and Repair Tooling**: Each platform has different support equipment that performs the same task. Some I-level sites have entire storage facilities dedicated to all the tool kits required for multiple aircraft repair with repairers picking the most effective tool. Consolidation of tooling and support equipment into common non-platform-specific repair kits and consumable tooling for multiple aircraft are being created.

f. Other Initiatives: Other initiatives underway include O and I site surveys for mission readiness, adoption of common repair materials from industry (SAE specifications), rapid repair tooling solutions, guided research topic-area lists for acquisition repair research, consolidation of Navy repair data from acquisition programs, and standardization of facility requirements.

OUTCOME

Payoff

The NAVCORE working group yielded large payoffs (total savings for all initiatives to date has been over $5 million) in multiple initiatives:

a. Shelf-Life Extension of HAZMAT: This initiative guided all depots in reliable shelf-life extension for multiple safety critical structural materials. The standardization of testing increased safety by ensuring critical mechanical values are met and increased quality and sustainability of multiple materials. The cost avoidance from extending material life has saved up to 50% for each item tested and extended. This can range from $50,000–$200,000 per year per site, depending on the material procurement requirements. This initiative will be implemented at all NAVAIR depot locations and aligned with Department of Defense (DoD) requirements for shelf-life extension testing. The cost of implementation is approximately $80,000.

b. **Material Consolidation**: The standardization and reduction of repetitive materials not only avoids an estimated average of $100,000 in costs per year for each repair site, but increases interoperability because multiple aircraft programs can use the same materials. This increases readiness because materials have Navy-owned substantiating data already, are logistically supportable with a national stock number, and are available at all sites. Unstocked materials often have wait times of 6–8 weeks from distributors due to the naval procurement process. The cost avoidance for new acquisition programs by using Navy-owned substantiating data is upwards of $1 million–$3 million for a material development program. Multiple systems (over five) in the Navy will implement the changes and solicit other branches of DoD to do the same. The cost of implementation for this initiative is approximately $80,000.

c. **Process Consolidation**: Consolidation has realized improved reliability, safety, quality, and performance as all sites align with best practices from Navy lessons learned and industry standardization. This increases readiness because training by site and aircraft type, model, and series is not required for standardized processes. The implementation of standardized processes decreases

variability in Navy repair sites and increases quality. National standards will ensure interoperability between Navy organic and contractor repair sites. The consolidation of processes reduces the engineering labor required to update local specifications at a savings of $25,000–$50,000 per year per specification. The standardized processes will be used across naval aircraft programs and repair sites, including organic and contractor organizations (domestic and foreign). Implementing standardized processes costs approximately $125,000.

d. **Composite Training Alignment**: Standardized training avoids costs and improves efficiency, reliability, interoperability, and readiness. By standardizing composite repair training by skills rather than aircraft, a single person can be trained on multiple aircraft, reducing costs. The cost avoidance for one technician is conservatively estimated at $40,000 in classroom labor alone for one extra platform. Extrapolating to three platforms and including on-the-job training requirements, cost avoidance can increase to $150,000 per employee. Each depot composite repair site has anywhere from 10 to 60 employees. Standardization of depot-level training opened the door for pilot programs of fleet I-level personnel training for depot-level composite repair certification for the first time in Navy history, realizing a combined cost avoidance of $4 million in seven months (http://www.navair.navy.mil/news/FRCW-Sailor-Earns-First-Depot-level-Certification-Saves-Navy-Millions/Fri-08022019-1017). This standardization is not only applicable in the Navy, but will be shared with other branches of DoD. Applying standards to all fielded naval composite aircraft programs costs $150,000.

e. **Composite Support Equipment and Repair Tooling**: Standardizing equipment improves reliability, sustainability, interoperability, and readiness for composite maintainers. The composite repair technician benefits from less kits taking up valuable space, more accessibility, and standardized tooling at all locations. Removing one tool kit saves $150,000–$200,000 in material costs. Most sites have three to four tool kits, depending on the aircraft repair programs. This consolidation increases sustainability of kits through standardization of consumable materials, preventing procurement issues with one-off tools in repair kits. Readiness increases, as tooling will be standardized and available at multiple repair shops even in the same location. This standardization will be used across systems in the Navy and shared with counterparts in other DoD branches with similar aircraft. Standardizing equipment costs approximately $60,000.

f. **Other Initiatives:** Adoption of industry standardized repair material and consolidation of current repair material data will avoid up to $3 million in costs for multiple aircraft programs. Standardization of repair materials data will also avoid costs from repeated research efforts. These initiatives will be cross-platform and across services with the U.S. Air Force, with an implementation cost of approximately $200,000.

Current Status

For the HAZMAT shelf-life extension and process consolidation initiatives, local process specifications are being updated to reflect standardization of processes. National process specifications have been drafted for new consolidated processes. Implementation should be completed within one year.
A materials consolidation list has been published via an engineering white paper and consolidation efforts have begun for all fielded aircraft programs; implementation is complete. Training standardization has been completed and is being published in a national job qualification requirement (JQR) document for all Navy sites. All sites have updated local training documents to mimic the JQR until final publication; implementation is complete. Standardized common composite repair support equipment has been documented with changes communicated through PMA-260 (common support equipment) to update a non-platform-specific composite repair kit to replace all current repair kits; implementation is expected to be complete in one year.
Other initiatives—implementation of industry standardized materials and consolidated Navy repair data—have been initiated; therefore, expected implementation for these two initiative is one year.

Challenges

Barriers for implementation of some standardization of composite repair initiatives include funding for larger initiatives and political or cultural implications for others. Some of the acquisition Navy aircraft programs stated that, due to contracts already in place with OEMs, implementation of Navy standardized materials and processes would not occur unless justification could overturn any decisions already made by the program office. Implementing Navy organic composite repair approaches based on years of experience are still being outweighed by Navy contracts with OEM suppliers. This is prevalent on multiple fielded programs; however, on almost every program, a fleet support team in the operation and maintenance portion of the lifecycle implements many changes to the repair strategy. Therefore, many of the initiatives are not implemented until after the aircraft has been fielded and costly maintenance (over $3 million) has been completed by the OEM, resulting in instructions to field new repair materials and procedures. This is an ongoing battle, where programs in acquisition minimally reach back to MRO engineers for lessons learned or best practices.

About the Award Winners

The awardees have been instrumental in creating NAVCORE and implementing strategies that are nationally aligned to best solve underlying issues with composite repair. **Justin Massey** (FRC SW) is the primary investigator; the founding members (**Stephen Starnes** [FRC SE], **Chris Rethmel** [NAWC-AD PAX], **Rob Thompson** [FRC E], and **Alyssa Zamora** [FRC SW]) act as chairpersons for one or more initiatives and ensure that progress is tracked and resolutions are implemented. These members shaped the structure and voted on the most influential initiatives. Representation from NAVAIR depot sites (FRCs) and acquisition sites (NAWCs) uncovered common national issues with composite repair. Administrative duties rotate yearly to each site to logistically support in-person meetings, side meetings, and the NAVCORE website.

Development of Standardized Military Detail Specification for Military Life Rafts (MIL-DTL-32532A)

Award Winner: Combatant Craft Division

DESCRIPTION

The Naval Surface Warfare Command Carderock Division Detachment Norfolk (NSWCCD DN), also known as Combatant Craft Division, acquires and manages the lifecycle of all United States Navy (USN) shipboard life rafts with the objective of procuring, certifying, and sustaining life rafts that enable sailors to deploy ready for all contingencies.

The Life Raft Program found two issues requiring immediate attention:

1. 40% of life rafts would reach the end of their service life in five years.
2. Manufacturing defects were significantly reducing reliability, adversely affecting service life.

An integrated product team (IPT), with stakeholders from In-Service Engineering Agent (ISEA) at NSWCCD DN, product management support from Naval Supply Systems Command Weapon Systems Support (NAVSUP WSS), program management from PMS443, and contracting personnel from the Defense Logistics Agency (DLA), intervened to resolve the issues by developing MIL-DTL-32532(SH). The IPT contributions affected the following lifecycle dimensions:

1. **Positive Product Reliability, Maintainability, and Availability Effects on Fleet Readiness**: meeting underway prerequisites for ship deployment objectives with critical survival equipment upgraded to the latest industry standards.
2. **Survival Equipment Currency**: supplying sailors with the latest innovations to enhance survivability in emergencies while on deployment.
3. **Stock Recapitalization Pacing**: awarding three indefinite delivery, indefinite quantity contracts using MIL-DTL 32532(SH) to purchase militarized commercial off-the-shelf (MCOTS) inflatable life rafts for U.S. Navy ships and craft, U.S. Army ships, and U.S. Coast Guard cutters.
4. **Lessons Learned Capture**: incorporating recommendations from the active contracts into MIL-DTL-32532(SH).
5. **Coordinated Timely Response**: developing MIL-DTL-32532(SH), starting January 22, 2019; publication was scheduled for November 2019.

DISCUSSION

Background

1. Life rafts are mandatory onboard USN ships as critical safety items for the crew's primary means of survival when abandoning ship. Fleet ships and crafts use two basic Navy types of inflatable life rafts:
   - 25-person (MK-7 Mod. 1 and 2)—carried by surface force ships, aircraft carriers, and service craft, encapsulated in a fiberglass container.
   - 50-person (MK-8 Mod. 1 and 2)—carried by aircraft carriers, littoral combat ships, and DDG-1000 class ships, encapsulated in a fiberglass container.
2. Over 8,000 life rafts service USN and other services' vessels. A life raft database system manages inventory, tracking the life raft population and recording critical data on life raft quantity, manufacture date, physical locations, repair, modification, and service history.

Problem/Opportunity

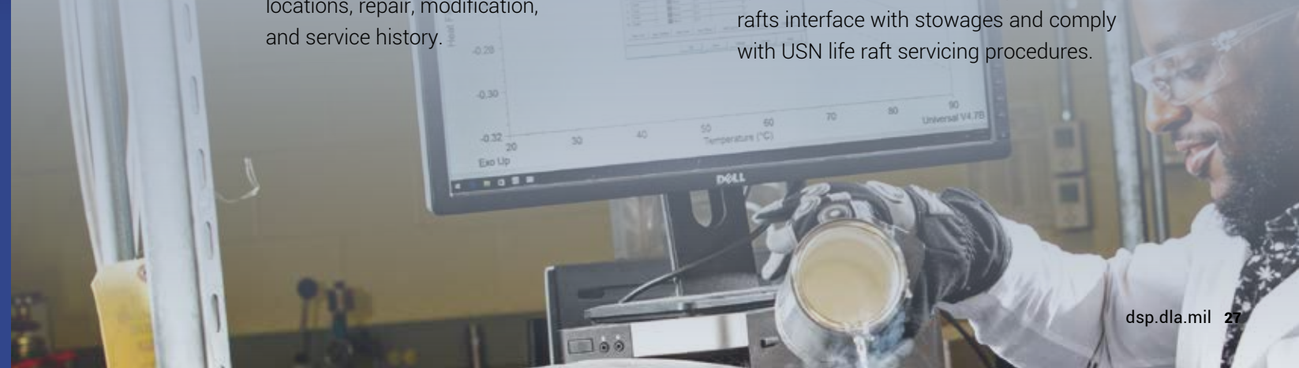
A recent review of the life raft inventory revealed two issues requiring immediate attention:

1. 40% of the life raft population will reach the end of service life in five years, presenting a potential inventory shortfall given manufacturing capacity constraints and requiring concurrent production contracts to overcome throughput and time constraints.
2. Production required quality enhancement to mitigate a manufacturing defect contributing to a significant drop in life raft reliability and service life.

Description

The technical warrant holder assembled an IPT quickly, consisting of stakeholders from ISEA at NSWCCD DN, product management support from NAVSUP WSS, program management from PMS443, and contracting from DLA.

1. The IPT members collaborated to create a detailed specification, MIL-DTL-32532(SH), to procure MCOTS inflatable life rafts for the U.S. Navy. In fact, NAVSUP WSS used this MIL-DTL in a competitive contract for the acquisition of 25- and 50-person Mod. 2 inflatable life rafts.
2. MIL-DTL 32532(SH) scoping includes MK-7 and MK-8 Mod. 2 inflatable life rafts and their associated inflation system and survival gear packed in a rigid stowage container, ready for use as abandon ship survival equipment. The specifications ensure that all procured life rafts interface with stowages and comply with USN life raft servicing procedures.



In addition, the specification addresses life raft configurations suitable to support dynamic military mission sets and their harsh environments and, as such, meet or exceed many performance and equipment requirements in U.S. Coast Guard Safety of Life at Sea (USCG/SOLAS) regulations.

OUTCOME

The MIL-DTL streamlines acquisition activities, invokes quality into production, and enhances life raft lifecycle planning and execution with measurable payoff.

1. **New contracts were awarded to three qualified bidders, who can supply**
   a. **the throughput required to meet the life raft replacement schedule and**
   b. **equipment configuration commonality with existing life rafts to meet lifecycle management supportability goals.**
2. **The MIL-DTL improves quality in the following aspects:**
   - **Consistent life raft design**
   - **Standardized packing procedures**
   - **Consistent inspection criteria**
   - **Standard requirements in qualifying personnel, processes, and certifying facilities.**
3. **The MIL-DTL supports seamless life raft replacement planning and execution with the following:**
   - **Minimal disruption to the fleet**
   - **Level workload to certifying facilities**
   - **Minimal new training requirement.**

PAYOFF

1. Lower contract execution cost.
2. Production quality and reliability improvement.
3. Quality inspection improvement.
4. Configuration, standardization, and enhanced supportability of survival gear. Identical configuration between the Army, Navy, and Coast Guard versions, saving money and increasing component availability.

CURRENT STATUS

Although the project's implementation is complete, improvements are continually made and exemplified:

- Ongoing updates and modernization of the existing first aid kit
- Planned testing and evaluation of non-pyrotechnic signaling devices as potential replacement for pyrotechnic flares, which are regulated and handled as hazardous material. Testing will be coordinated with the Navy Search and Rescue School.

2. Publication of MIL-DTL-32532A was scheduled for November 2019 for use by any government department or agency.
3. USCG and the U.S. Army ceased using SOLAS life rafts and adopted the USN MK-7 life raft for cutters and ships. Commercial life rafts must be tested and recertified annually while the MIL-DTL-32532A product has a test and recertification period of 60 months, resulting in significant lifecycle cost reductions. A 2014 business case analysis compared 5-year costs of a commercial off-the-shelf (COTS) life raft (with an annual recertification requirement) with the USN MK-7 life raft (with a 5-year recertification requirement). The COTS life raft costs $18,750 for annual recertification over a 5-year period while the MK-7 life raft costs $6,000 for its recertification over the same period (a $12,750 cost reduction per life raft). Other benefits include compressed air versus CO_2 as the propellant for inflating the life raft, eliminating standard life rafts as a greenhouse gas user and enabling superior performance in arctic conditions.

Challenges

1. Stakeholder solution concurrence.
2. Contract delays.
3. Original equipment manufacturer's lack of readiness for first article testing.
4. Fleet pushback on the replacement plan, including related expenses.

About the Award Winners

The IPT members' roles and contributions are described as follows:

1. **Life Raft Acquisition Engineering Agent and ISEA**: Acquires and creates support products, and supplies lifecycle sustainment engineering to preserve and enhance shipboard life raft systems.
   - **Lead Engineer**: Paul Beausejour (NSWCCD DN)
   - **Subject Matter Expert**: Dean Schleicher (NSWCCD DN)
   - **Inventory Manager**: Miguel Leyva (NSWCCD DN)
2. **NAVSUP WSS**: Manages the supply chain for all aspects of the life raft and associated components.
   - **Life Raft Supply Chain Supervisor**: Paula Saltzburg (NAVSUP WSS)
3. **DLA Contracting**: Performs life raft contract awards and all other aspects of pre-and post-award contract administration.
   - **Contracting Officer**: Amy Puchalsky (DLA Maritime Mechanicsburg)

Atlas Corp. Common Payload Interface Standard

Award Winner: Space and Missile Systems Center

DESCRIPTION

Starting in 2017, the Space and Missile Systems Center (SMC) Atlas Corp. systems engineering division began developing a major interface standard for satellite bus-to-payload integration as a first step toward meeting the 2017 National Defense Authorization Act (NDAA) requirement to apply the modular open system approach (MOSA) to the greatest extent practicable to major system interfaces. SMC decided that a standard for such a major space system interface should be created incrementally, starting with the command and data handling interface. Thus, development began on a common payload interface standard for command and data handling (CoPaIS-C&DH). CoPaIS-C&DH modernizes C&DH technology across the satellite industry and enables the very high data rates needed to support future space mission objectives. It initiates greater modularization of payloads to enable the development of weight-saving and distributed payload systems on satellites via a new innovative routing capability.

DISCUSSION

Background

CoPaIS-C&DH standardizes the C&DH interface between any satellite bus and payload. The standardization of the C&DH portion of the satellite bus-to-payload interface, in turn, standardizes special test equipment for satellite integration testing, enabling independent testing of the bus and payload C&DH subsystems. Development of the rest of the CoPaIS sections enables completely independent launch and testing of the bus and payload.

Problem/Opportunity

Major satellite vehicles (bus and payload) have traditionally been manufactured and integrated uniquely for each major mission area. Through standardization of the satellite bus-to-payload interface, SMC enables new space capabilities, such as late, or on-orbit, insertion and independent integration of one manufacturer's product line. CoPaIS-C&DH is a first step in achieving a full MOSA bus-to-payload interface and advances C&DH technology beyond the decades-old MIL-STD-1553 technology engrained in almost every satellite design.

Description

For the development of the CoPaIS-C&DH standard, SMC changed the paradigm for standards development by ensuring consensus-based development. Atlas Corp. funded three Space Enterprise Consortium—Other Transaction Authority (SpEC-OTA) contracts for BAE, Honeywell, and SEAKR and their SpEC-OTA partners to create the requirements for CoPaIS-C&DH. Atlas Corp. further ensured wide consensus-based development by requesting and receiving subject matter expert (SME) support, as delegated by vice presidents from Ball, Boeing, Lockheed Martin, Northrop Grumman, and Raytheon, to review the CoPaIS-C&DH requirements and further mature them. SMC published CoPaIS-C&DH as a technical reference document and it completed the SMC specifications and standards (S&S) stakeholder review process for inclusion on the SMC S&S compliance list.

OUTCOME

Payoff

CoPaIS-C&DH enables satellite vehicle bus-payload plug-and-play style interface simplification and efficiencies. This standard enhances C&DH interface capabilities by replacing antiquated data buses (e.g., MIL-STD-1553) with forward-leaning, reliable, high-speed technologies. The modular design of CoPaIS-C&DH conforming components fosters use of commercially available technologies with common interfaces at the component level. The CoPaIS-C&DH effort ($2.2 million) achieved an excellent cost-benefit ratio relative to the cost of SMC satellite acquisitions.

Current Status

CoPaIS-C&DH completed the S&S process for inclusion on the SMC compliance list.

It applies to all SMC medium-to-large satellite programs.

Challenges

CoPaIS-C&DH was a self-designated SMC pace-accelerator project for developing a standard in one year (the process typically takes two to three years). To facilitate the accelerated schedule, SMC/Engineering (EN) leveraged the SpEC-OTA contract vehicle to obtain industry support for consensus-based development of the standard. With the low-dollar funding per contractor, major space industry contractors did not bid. However, support from the major contractors maintained the consensus-based nature of CoPaIS-C&DH development. Being resourceful and capitalizing on the enthusiasm generated for CoPaIS-C&DH before and after the CoPaIS-C&DH Industry Days event, SMC/EN sent letters to five major contractors requesting and receiving technical support from SME teams, as delegated by their vice presidents, to review the CoPaIS-C&DH requirements developed by the SpEC-OTA contractor teams. The SME teams and the SpEC-OTA requirements development teams voluntarily participated in two cycles of peer review and maturation for CoPaIS-C&DH. CoPaIS-C&DH completed the final SMC S&S stakeholder review process, with concurrence from all major SMC industry partners, a year after kickoff.

About the Award Winners

Franco Macchia and Aaron Stevenson (SMC) led the development of the CoPaIS-C&DH. This highly collaborative effort enabled an objective requirements development and review process that maintained synergy with SMC enterprise mission objectives. Hence, CoPaIS-C&DH is an industry consensus-based enterprise solution that meets all the 2017 NDAA MOSA objectives.

Compass Call

Award Winner: NH-03 Timothy C. DeShazo

DESCRIPTION

On April 1, 2016, the Assistant Secretary of the Air Force for Acquisition tasked the 645th Aeronautical Systems Group (645 AESG), also known as the Big Safari Program, to execute the Compass Call Recapitalization Program and transfer the EC-130H Compass Call weapon system to a new aircraft. 645 AESG modernizes, upgrades, and sustains the EC-130H Compass Call aircraft fleet. Detachment 1, 645th Aeronautical Systems Squadron (645 AESS), Waco, Texas, executes full-spectrum EC-130H Compass Call cradle-to-grave acquisition support. The EC-130H Compass Call aircraft is an offensive counter-information electronic warfare platform, engaging in non-kinetic attacks to deny, disrupt, or degrade adversaries' command, control, and communication systems. NH-03 Timothy C. DeShazo serves as the EC-130H Compass Call platform integration manager. He liaises with Compass Call program offices, Air Combat Command, and contractors L-3 Harris and British Aerospace Systems on various aspects of lifecycle sustainment and program integration. Mr. DeShazo oversees aircraft depot scheduling, maintenance, logistics, contracts, engineering, testing, and quick reaction capabilities. He applies his platform integration manager expertise to modernize the Compass Call program and drive the EC-37B Compass Call program transition, developing requirements for technical interchange meetings, contract technical evaluations, and design reviews.

DISCUSSION

Background

To counter emerging threats, EC-130H Compass Call requires quick reaction capabilities that dominate the electromagnetic battlespace and render enemy command-and-control targets useless. The EC-130H Compass Call fleet's average aircraft age is 45 years. The EC-130H components require continuous inspection, upkeep, and replacement, resulting in tremendous maintenance overhead. Compass Call mission system modernization, international regulatory compliance, obsolete parts, diminishing manufacturer sources, and material shortages require constant surveillance and coordination. Manufacturer and maintenance shortfalls constrain EC-130H Compass Call's fleet sustainment. The Assistant Secretary of the Air Force for Acquisition directed 645 AESG to execute the EC-37B Compass Call Recapitalization Program to re-host the Compass Call mission system on a new airframe. This initiative revitalizes Compass Call combat effects and reduces operational costs.

Problem/Opportunity

Several opportunities presented themselves for improvement:

1. The platform integration manager's role is challenging, especially obligating and prioritizing limited funding. Prioritizing funding required an understanding of what combatant commanders and warfighters need.

2. Countering emerging threats, sustaining an aging EC-130H Compass Call fleet, transitioning capabilities to a new aircraft platform, preparing aircraft for retirement, and complying with sunset clause restrictions required significant coordination to forecast funding requirements in 5-year increments.

3. Air Combat Command retired three EC-130H aircraft over the last 2 years and is slated to retire two more by 2021. Prior to retiring aircraft, extensive coordination must be performed among management accounts to remove special equipment and transition parts to spares inventory. Future sustainment efforts need to secure stock for high-failure parts.

4. The EC-130H Compass Call fleet received a mandate from the Chairman of the Joint Chiefs of Staff to upgrade its ARC-210 aircraft radios by the end of fiscal year 2019. The short timeline and risk to loss of a link with ground communication capabilities necessitated quick action.

5. In support of EC-37B Compass Call Recapitalization, a quality assurance surveillance plan established government oversight for contract logistics services maintenance operations. Support contracts were tailored in meticulous detail with the prime contractor and subcontractor.

6. To further support EC-37B Compass Call, aircraft support equipment needed to be researched, acquired, and delivered to the host unit, with flight testing scheduled for 2021 and full operations capability scheduled for 2023.

7. In preparation for the host unit to receive EC-37B Compass Call, hangars and support facilities were necessary to the full operational capability of the program. The congested parking aprons and lack of available hangars presented a logistical battle.

Description

- Multi-level cross-communication informed all stakeholders of the need to sustain the legacy EC-130H fleet while prioritizing next-generation capabilities. Weekly, quarterly, monthly, and annual telephone conferences discussed issues, schedules, delays, funding, and pertinent information regarding the EC-130H to EC-37B transition. The Detachment 1, 645 AESS Exigency Contract Team conducted monthly meetings with squadron and contractor representatives. Exigency meetings prioritized emerging and quick reaction capability needs using input from Air Combat Command weapon systems managers. The combined efforts of Detachment 1, 645 AESS, the Compass Call Program Office, and Air Combat Command formed a Requirements Working Group that established multi-year funding using a program objective memorandum (POM) to define funding requirements for EC-130H and EC-37B programs.
- Detachment 1, 645 AESS, the Compass Call Program Office, and Air Combat Command conducted Weapon System Iron Flow meetings. The Weapon System Iron Flow cycle furnished detailed depot-level representation of aircraft inputs and delivery schedules. This meeting supplied a forum for major commands, the system program office, the contracting office, and squadron representatives to create one master schedule, supporting all sustainment contracts, drop-in modifications, test events, and deployed field teams. During 2019, Detachment 1, 645 AESS was tasked to explore procurement of additional high-failure parts to sustain EC-130H Compass Call capabilities until EC-37B Compass Call is fielded.
- In addition to programmed depot maintenance and modification efforts, Detachment 1, 645 AESS formed an EC-130H Integrated Wave Form Action Team and EC-37B Compass Call Recapitalization Program Working Group. These teams devised an attrition-based temporary modification to use installed radios while upgrading them during returns for service.
- In conjunction with weapon systems managers and the Compass Call Program Office, a quality assurance surveillance plan was created to oversee the prime contractor.
- A Support Equipment Recommendation Data Working Group was formed by Detachment 1, 645 AESS, Compass Call Program Office, and Air Combat Command. The team researched, sourced, and postured aircraft support equipment for the host unit in support of EC-37B Compass Call.
- To further support EC-37B Compass Call, the Site Activation Task Force investigated the need for hangars and support buildings. The task force included Detachment 1, 645 AESS, Air Combat Command weapon systems managers, and multiple host-unit agencies. With support from the EC-130H Compass Call unit, the task force devised a plan to establish a support infrastructure for EC-37B Compass Call.

OUTCOME

Payoff

Weekly telephone conferences furnished all stakeholders with the latest information regarding schedules, events, issues, and possible courses of action (COAs). These events ensured all stakeholders knew of task progressions, completions, and schedule conflicts, and empowered decision-makers to respond accordingly. Cross-team communication synergized the EC-130H and EC-37B Compass Call teams to adapt to changing factors and unique weapon system dynamics. Teams leveraged this openness and organizational agility to focus on the highest priority goals and objectives. Leaders ensured that the right people engaged the right issues at the right time and could supply the highest level of support across the entire weapon system architecture.

To sustain combat operations through 2025, EC-130H Compass Call working groups prioritized lifecycle funding. The working groups defined program requirements, categorized funding, and estimated unforeseen expenses to support out-of-year POMs. These initiatives ensured funding to meet the warfighter needs and protected critical acquisition, maintenance, and modifications to support future endeavors.

Mr. DeShazo, with the Exigency Contract Team, prioritized 24 urgent task approvals and obligated $5.6 million to expedite delivering new attack capabilities to combatant commanders. The completed 5-year cost analysis presented the system program office and command-level decision-makers with the justification to procure $710 million in fleet lifecycle sustainment.

The aircraft cycle developed by the Weapon System Iron Flow meetings painted a total force strategic picture for program offices and commands. The aircraft cycle gave decision-makers the ability to plan; select non-retribution COAs; project aircraft availability, deployment, and delivery schedules; and track weapon systems upgrades. A master schedule, called an Iron Flow, compiled all participants' inputs into an invaluable visual planning tool used across major commands, system program offices, squadrons, and contractors. The Iron Flow schedule enabled decision-makers to allocate aircraft for upgrades, testing, and deployments effectively. It yielded decision-makers at all levels with viable working solutions and eliminated the need to submit multiple schedules or solicit extraneous inputs. These efforts affected deployed combat operations by mitigating logistics obsolescence with vanishing parts vendors. The five COAs enabled multiple solutions for sourcing of high-failure and critically needed parts from retiring aircraft.

The efforts of the EC-130H Integrated Wave Form Action Team and EC-37B Compass Call Recapitalization Program Working Group saved the Air Force $4 million in procurement costs by avoiding unnecessary purchases of additional ARC-210 radios. Also, the establishment of a one-for-one exchange mitigated extended downtime or delays in parts availability.

The quality assurance surveillance plan established a government oversight standard for the EC-37B program. Mr. DeShazo's efforts helped to safeguard the flight testing scheduled for 2021 and full operations capability scheduled for 2023. Mr. DeShazo's oversight in the Support Equipment Recommendation Data Working Group preserved $710 million for fleet lifecycle sustainment and obligated $1,500 for additional support equipment items in preparation for the EC-37B. Mr. DeShazo's

astute actions with the Site Activation Task Force converted existing and abandoned space, saving the Air Force over $50 million in infrastructure development costs.

CURRENT STATUS

As a result of ongoing weekly meetings, monthly exigency team meetings, and Requirements Working Groups, team members continually assess Compass Call program requirements and rank the warfighters' top priority needs. Once the priorities are compiled, a new list is forwarded to the system program office for funding. Mr. DeShazo's inclusiveness supplies teams and the system program office with a real-time feel for combatant commander requirements. This influences system program office decisions to fund the most pressing requirements and evolves Compass Call capabilities to meet future mission needs on demand. The first two EC-37B Compass Call Recapitalization aircraft are in production.

Challenges

In early 2018, a review of the EC-37B Compass Call Recapitalization Program found unstable funding. During the review, funding was put on hold, causing the prime and subcontractor to delay or stop work. The Compass Call program prioritized EC-130H programmed depot maintenance and other maintenance actions to mitigate cascading effects.

About the Award Winner

NH-03 Timothy C. DeShazo served as Detachment 1, 645 AESS platform integration manager, liaising between the Compass Call Program Office, Air Combat Command, and contractors on various aspects of the EC-130H and EC-37B electronic attack weapon system. He applied his program integration manager expertise to lead the Exigency Contract Team, participating actively in monthly contract and telephone conferences to support the EC-130H program. He coordinated with major command liaison offices and combat field units to obligate and distribute funding for 24 urgent task approvals.

Mr. DeShazo led efforts to compile data and produce digital working copies of the Compass Call cycle. The cycle supplied a detailed graphical representation of depot-level aircraft input and deliveries to support what-if scenarios. Mr. DeShazo's use of the cycle enabled him to devise a 5-year sustainment cost analysis for the EC-37B program. As the program integration manager, Mr. DeShazo formed a team between Detachment 1, 645 AESS quality assurance subject matter and logistics experts. He led a team to prioritize EC-130H Compass Call logistics and supply for future sustainment as the program sunsets. In addition, he created five COAs that were presented to Air Combat Command on cannibalization and acquisition sources for high-failure parts in the EC-130H program.

Mr. DeShazo assembled the EC-130H Integrated Wave Form Action Team and organized a 30-member EC-37B Compass Call Recapitalization Program Working Group. His expertise helped establish a one-for-one exchange of the upgraded ARC-210 radios and mitigate extended downtime or delays in parts availability for the EC-130H program. His plan created a cross-utilization flexibility with the ARC-210 radios for the EC-37B program. Mr. DeShazo is the head member of the Support Equipment Recommendation Data Working Group. With his maintenance proficiency, he analyzed the required list of support equipment needed for EC-37B. His recommendations eliminated excessive equipment that was already on hand at the host unit. He is a core member of Site Activation Task Force, which pioneered a strategy to repurpose four old and abandoned buildings and retrofit two existing aircraft hangars. The four buildings that supply support and administration functions and the hangars will be dual purposed for EC-130H and EC-37B.

Mr. DeShazo assisted the Defense Contract Management Agency and performed a technical evaluation of the contractor's logistics services proposal. He researched historical documents and deferred maintenance actions to create performance work statements, contract data requirements lists, and, ultimately, a quality assurance surveillance plan that supported EC-37B at the host unit.

Program News

Topical Information on Standardization Programs and People

ADOPTION OF A NEW OBSOLESCENCE MANAGEMENT STANDARD

The International Electrotechnical Commission (IEC) 62402 Obsolescence Management standard has been adopted for use by the Department of Defense. According to the DoD DMSMS lead at DSPO, this international "standard was developed by experienced DMSMS practitioners from around the world, including three members of the DoD's DMSMS community. IEC 62402 is aligned in many ways with both the department's own SD-22, 'DMSMS: A Guidebook of Best Practices for Implementing a Robust DMSMS Management Program' and the SAE-STD-0016, 'Standard for Preparing a DMSMS Management Plan.' The new IEC 62402 is an important addition to the DMSMS management toolset as it can be referenced in contract language in directing companies to implement DMSMS management in their processes. The fact that these three documents are so aligned is important in establishing standard DMSMS management practices around the world." https://www.dau.edu/training/career-development/logistics/blog/Adoption-of-New-Obsolescence-Management-Standard

DISCOUNT ON STANDARDS

As part DoD's ANSI membership, which is funded for DoD by the Defense Standardization Program Office, ANSI provides a member discount for the single-user purchase of qualified standards in its inventory. Up to a 20% discount is available on the following standards collections:

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- AGMA—American Gear Manufacturers Association
- ASIS International
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- IEST—Institute of Environmental Sciences and Technology
- OPEI—Outdoor Power Equipment Institute
- PMMI—Packaging Machinery Manufacturers Institute.

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Upcoming Issue

Call for Contributors

We are always seeking articles that relate to our themes or other standardization topics. We invite anyone involved in standardization—government employees, military personnel, industry leaders, members of academia, and others—to submit proposed articles for use in the DSP Journal. Please let us know if you would like to contribute.

The following is our theme for the upcoming issue:

Issue	Theme
September—December 2020	Modular Open Systems Approach (MOSA) II


DEFENSE STANDARDIZATION PROGRAM
MAKING SYSTEMS WORK TOGETHER