Defense Standardization Program
Journal
APRIL/JUNE 2017

Standardization Stars

Laminated Polypropylene Composite Armor

DoD Manufacturing Process Standard: Arc Welding of Armor Grade Steel

Avionics Architecture Team, Integrated Product Team

Standardization Force Health Protection for Military Personnel in Workplaces Regarding Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz

DoD Aviation Fiber Optics Standardization

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Journal

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Director's Forum

Each year, we recognize individuals and teams who, through their efforts in standardization, have significantly improved technical performance, increased operational readiness, enhanced safety, or reduced cost.

Every year, it is a great pleasure and honor for me to be able to host the Defense Standardization Achievement Awards. We have been doing this for 29 years now and I have been at every award ceremony, presiding over them for the past 18 years. Each year, I wonder if perhaps the well has run dry. But each year I'm amazed and encouraged by how many nominations we receive, and by the quality of the accomplishments. We've had a few repeat winners, but for the most part we recognize unique achievements and different people. It is a testament to the effectiveness of the Standardization Program, and to the ingenuity and hard work of the individuals who are part of the program, that the Standardization Awards continue to attract attention and high-quality nominees year after year.

Individuals and teams are nominated for the Defense Standardization Program Achievement Awards. These awards honor personnel and organizations from the military departments and defense agencies for outstanding performance in the implementation of the Defense Standardization Program. For FY16, four teams and one individual were identified as being particularly deserving of the recognition. Through their efforts, the winners have played an integral part in keeping our men and women in uniform safe and providing them with the tools they need to get their job done.

Gregory E. Saunders
Director
Defense Standardization Program Office

The winners are as follows:

- B. Jon Klauenberg, from the U.S. Air Force, provided exceptional leadership in standardization force health protection developed for military personnel in workplaces regarding exposure to electric, magnetic, and electromagnetic fields. Dr. Klauenberg led the efforts to develop a new civil standard, IEEE-C95.1-2345, which revises overly restrictive limits proposed by the European Union and removes operational impact restricting personnel from workspaces, especially in shipboard applications. Numerous entities have adopted the standard, and DoD has adopted it by reference in DoDI-6055.11, currently in final coordination.

- The Army's Laminated Polypropylene Composite Armor Team led an effort to characterize a polypropylene fiber while documenting quality assurance parameters for that fiber. Their efforts ensure that the Army is getting an adequate supply of high-quality composite armor produced by the most effective processing available today. As a result of their work, MIL-DTL-32549 will help ensure that the materials procured will provide our soldiers with the expected level of armor protection they need and deserve.

- The Tank-Automotive and Armaments Command Standardization Office collaborated internally and externally to develop a DoD Manufacturing Process Standard, MIL-STD-3040, "Arc Welding of Armor Grade Steel." This standard defines requirements for various arc-welding processes, fabrication, inspection, repair, and qualification of armor grade steel welds (wrought and cast armor grade steel). The standard improves quality by having standard requirements in qualifying both personnel and processes in armor welding.

- The Naval Air Systems Command's Avionics Architecture Team (AAT) developed the technical and business framework for two open architecture initiatives known as the Future Airborne Capability Environment (FACE) and Hardware Open Systems Technologies (HOST). The FACE and HOST technical standards establish and standardize the technical frameworks for software and hardware to enable the acquisition of affordable systems that promote rapid integration of portable capabilities across global defense programs. As a result of the AAT's efforts with FACE and HOST, the Navy and other services will gain the ability to adapt to changing requirements, threats, and technology at a faster rate and continue to provide the warfighter with best-in-class capabilities.

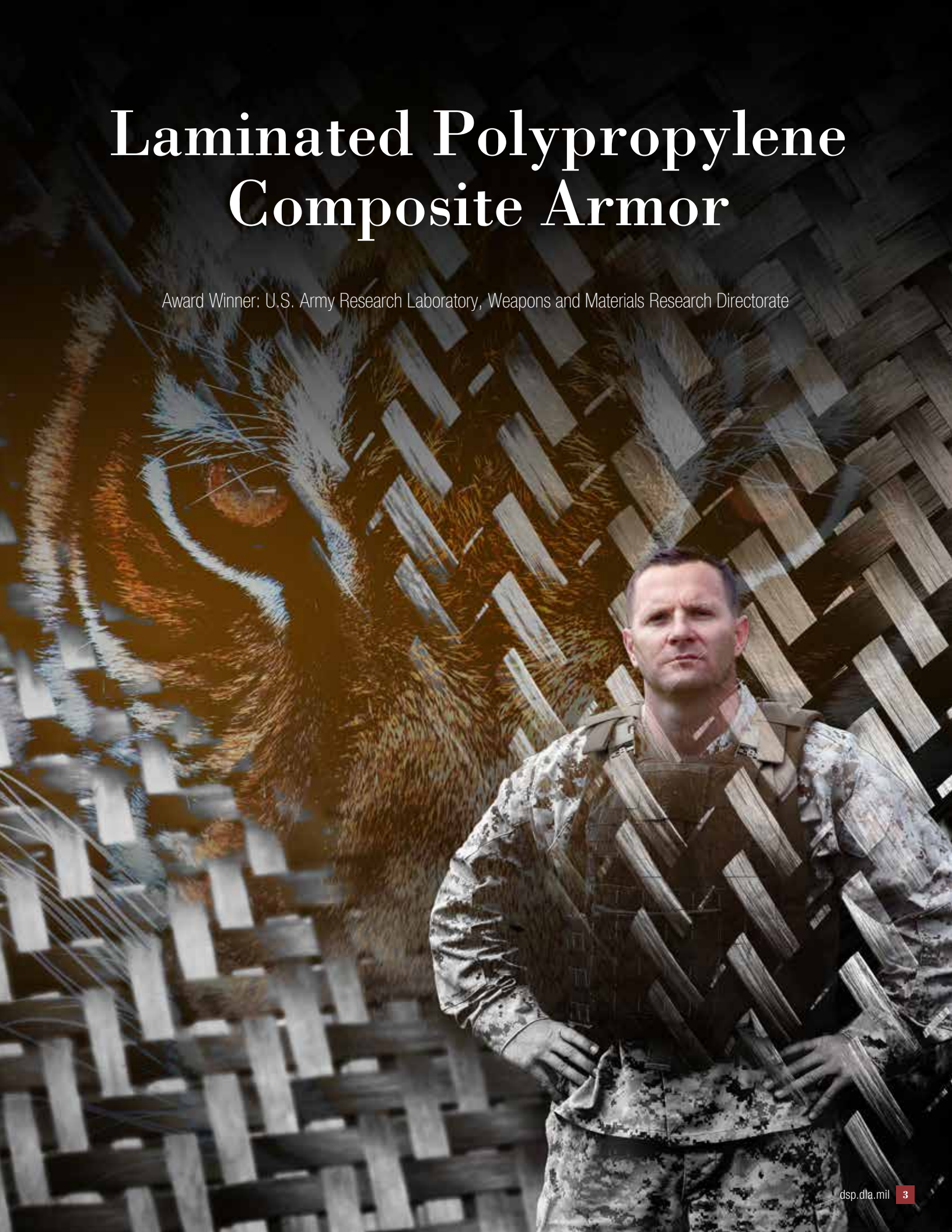
- The Defense Logistics Agency's Joint Fiber Optic Working Group catalyzed the creation and update of fiber optic standards and documents. These standards and specifications are expected to help reduce DoD aviation platform life-cycle costs by reducing exposure to parts obsolescence and increasing parts supportability. The fiber, cable, termini, and splice parts specified in the Mil-Specs are also intended to reduce the logistics footprint by minimizing the number and type of parts to maintain in the fleet. Additionally, the creation of a NAVAIR fleet/field maintenance manual along with the Mil-Specs has significantly reduced the ability of prime contractors to insert expensive proprietary, sole-source, and non-obsolescence-proof solutions into the DoD aviation acquisition infrastructure.

Congratulations to all of our award winners. I know that DoD leadership appreciates all of your hard work and dedication. These standardization awards help 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.

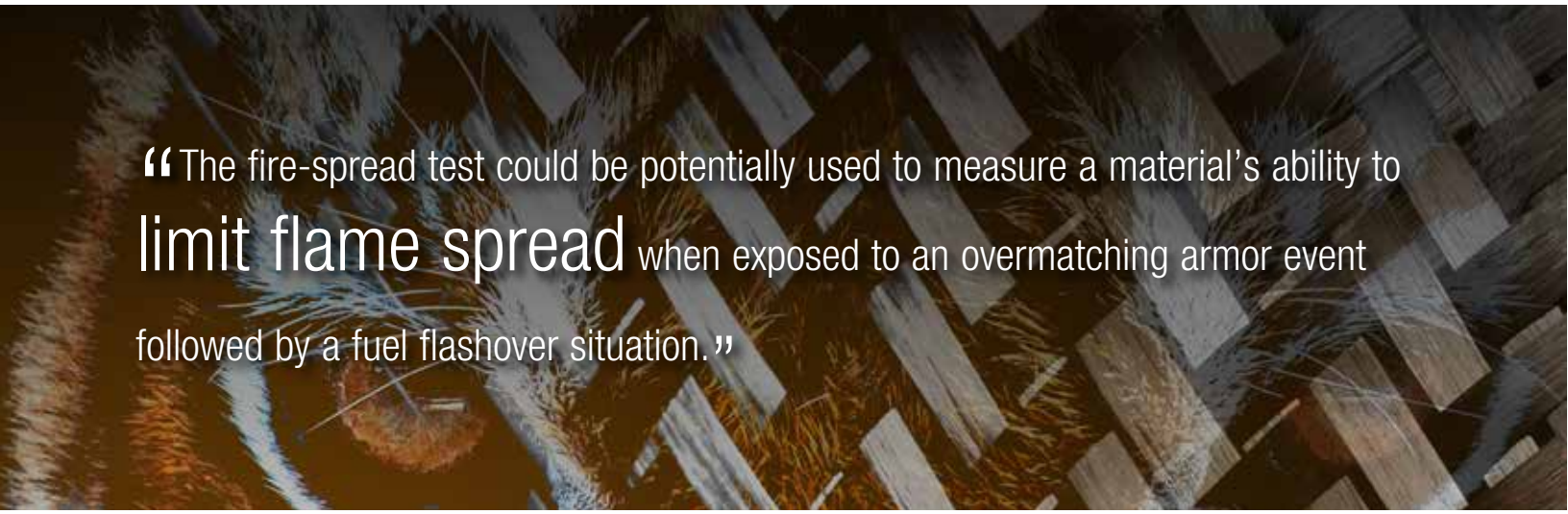
Standards and standardization link common solutions to common problems across all services and frequently across nations. This issue of the ***DSP Journal*** showcases the accomplishments of the FY16 award winners. I hope that reading about their endeavors will pique your interest and inspire you to submit an award nomination on the work you are doing in standardization for the FY17 awards.

Laminated Polypropylene Composite Armor

Award Winner: U.S. Army Research Laboratory, Weapons and Materials Research Directorate



The Army Research Laboratory (ARL) team led an effort to characterize a polypropylene tape-based laminated material along with document quality assurance parameters for the final armor panel. This standardization effort enhances two aspects of DoD acquisition: (1) increasing the robustness of the industrial base for DoD armor material by adding an additional qualified product to the supplier base and (2) reducing the time to manufacture in an emergency situation. Tegris® is a brand of polypropylene laminate evaluated in several vehicle composite armor systems; it has similar (slightly less) ballistic performance to other high-performance fiber based armor laminates, but at significantly lower cost. Its production methods are easily scalable, allowing production to increase quickly to meet demand, a feature critical to product markets (armor) that often see surge demands. Tegris also has commercial applications, allowing for market stability for an application (armor) that normally involves intermittent DoD purchase orders. In the newly created military specification, MIL-DTL-32549, the team developed tests to ensure that any future polypropylene material that DoD would buy meets a minimum number of acceptable performance quality standards. This specification will allow for quicker procurement of composite armor using Tegris. More importantly, it will provide some assurance that the materials procured will provide our soldiers with the expected level of armor protection they need and deserve. Finally, this effort should reduce the possibility of inferior or counterfeit materials from being procured.



Background

Shortly after the U.S. Army engaged in Operation Iraqi Freedom, several well-intentioned companies began developing what they thought were better armor materials and pushed the government toward procuring and incorporating them into the current or future fleet. The preliminary ballistic performance of these materials has shown great promise, and the government has already designed and validated several armor packages with some of these new materials. However, production lot-to-lot variations and environmental effects were largely unknown, which required the development of various acceptance criteria. Another problem was that the many variants offered did not perform equivalently when used on armored vehicle platforms. A means of differentiating among the variants and identifying the minimum acceptable properties was lacking.

The team began an effort to develop and revise specifications to address these problems. The initial requirement for any product or material to be added to an existing or new specification is a practical one. The government cannot afford to write a specification for every product or specific brand of material that a company might think is better. The process is expensive and time-consuming. Instead, an endorsement of a sponsor is expected prior to inclusion as a new class, type, or grade in an existing specification. Once the endorsement is obtained and documented, subsequent hurdles include the successful demonstration of this material in some armor system design, its mechanical characterization, and whether it will meet all the other applicable ballistic, mechanical, thermal, fire, smoke, and toxicity properties that have been determined over the years. Deficiencies of the material related to the inherent differences in durability, flammability, structural capacity, toxicity, chemical compatibility, and thermal stability may still need to be resolved. The vehicle program executive officer/program manager may choose different combinations of requirements depending upon the mission, so the specification should anticipate the range of requirements and provide a broader set of property windows for each possible requirement. However, due to the cost and difficulty involved, usually only those specific properties, currently required, will be incorporated into the specification.

The next step was to detail the specific properties for each material. The team convinced the sponsors and designers to order material components and select the system design using the MIL-DTL specifications and not by brand names. The team worked with each manufacturer (in this instance, Milliken, the manufacturer of Tegris) to specify its material properties in as much detail as possible, to avoid imitations, counterfeit, or inferior materials being awarded in any government contracts or purchase orders. The intent was to freeze the exact material to what was used in the system qualification tests. The cost of re-qualifying our combat vehicles with destructive ballistic tests is prohibitive, so we are forced to qualify the design, specify each component's materials, and make sure that each component is manufactured within tolerances that ensure minimum acceptable performance. The material of each component cannot change over time due to changes in production process or ingredients, otherwise we may have to retest the entire system. In the past few years, the team was able to publish new specifications that prevented the use of the wrong material. For example:

- MIL-DTL-32378, "Laminate: Unidirectional, Reinforced, Cross-Plied, Aramid Fiber, Plastic Armor Material"
- MIL-DTL-32398, "Laminate: Cross-Plied Ultra-High Molecular Weight Polyethylene Unidirectional Reinforced Plastic Armor."

In both instances, several distinct brand variations were commercially available. The properties of the specific variant used in the system qualification tests were used to ensure that only that exact variant was procured for that specific armor system design.

In order to continue its success in publishing detailed specifications for another new and improved composite material, the team focused its attention on one variant of Tegris, a product of Milliken, as a moderate-performance, lower-cost alternative using polypropylene polymer. This product had been found through full-scale ballistic testing to offer a reasonable compromise between weight, cost, and urgent capacity escalation (something important for future mobilization).

Problem/Opportunity

The material testing that was conducted and the subsequent standardization project (CMPS-2010-006) that was created to address the above-mentioned issues culminated with the one specification, MIL-DTL-32549, "Laminate: Multi-layer Polypropylene Thermoplastic Composite Armor" (July 2016). To ensure that DoD programs are procuring the correct material, the material must undergo first article inspection to ensure that all requirements are met. The woven fabric must undergo testing to validate that it meets the minimum tensile strength requirements, and the laminate must undergo performance testing to validate that the final material was manufactured properly (consistent to what was used in the original armor system ballistic tests). These tests for first article inspection and production acceptance include V50 ballistic panel testing, thermal shock panel testing, and flame resistance (potentially in the future) testing. In addition, chemical, mechanical, and lamina architecture properties are specified and confirmation test data must be provided by the supplier. Lot acceptance tests would also require the ballistic testing (V50) of molded panels.

Approach

Tegris is a polypropylene material manufactured by Milliken & Company that has been evaluated in armor systems at the U.S. Army Research Laboratory and others. Vehicle armor designs that included the Tegris specific brand of polypropylene, in part, have been found to provide specific levels of ballistic protection. The validation of the armor design is limited to which warhead is used and on

what hull structure the armor is mounted. If the U.S. Army were to select that particular armor design on the same hull, against the same warhead threat, then only a material that conforms to the polypropylene specification should be used in the design. If some other variant of polypropylene material were substituted, then a complete revalidation series of ballistic testing could be required. When incorporated into a multi-layer composite armor laminate system, Tegris performs similar to currently fielded composite armor systems that protect against certain full-scale threats.

To ensure that the same polypropylene material can be fielded in future composite armor designs, the polypropylene material needs to be characterized and documented in a military detailed material specification. The purpose of a detailed material specification is that it will help guarantee that any material purchased by a DoD agency in the future will be of the same chemistry, construction, and quality as the material used in the original armor system qualification tests. The Defense Logistics Agency Research and Development Directorate provided funding for ARL to conduct the additional testing needed on the Tegris material and to document the results. ARL completed various material performance tests along with the accept/reject criteria (quality assurance provisions), as well as those requirements and tests that were used to develop the detailed material specification.

Outcome

Developing this specification provides payoffs in three specific areas:

- **Time to manufacture.** Having material characterization data and quality assurance tests allows an armor system manufacturer to quickly conduct product acceptance testing for each material lot and to integrate the material into an established system design.
- **Quality assurance.** The tests laid out in the specification allow a consumer to validate the authenticity of a material, as it relates to how that material will perform in an armor system, thus ensuring warfighters receive the appropriate level of protection.
- **DoD industrial base robustness.** Characterization and standardization of polypropylene fiber add an additional material solution and a stable armor material supplier to the armor industrial base, thus allowing for more armor solution options, stronger competition for DoD, and DoD supplier redundancy.

In summary, there is now the potential for making large quantities of polypropylene armor materials and products in a relatively short time frame. There are existing armor designs that use this specific material. This same material could be designed into other armor designs but would require additional testing to verify that it is indeed a solution. These critical materials could be needed for the next mobilization, and the polypropylene specification, MIL-DTL-32549, will ensure that we meet and facilitate future mobilizations.

Current Status

Implementation is complete in the effort to publish this new armor specification. The new classes at least doubled the amount of other composite armor materials available and better reflect current industrial practices. This ensures that the Army is getting an adequate supply of high-quality composite armor that is produced by the most effective processing available today. Implementation of the product specified in this specification is ongoing and will continue. It's very possible that the existing external kits will be mounted on other legacy or future vehicles. Now that design packages

and material specifications are ready for immediate production, the reduction of imitations and substitute/counterfeit materials is evident. The specification will be modified further as these products evolve within the armor materials industry. Future specifications are currently being developed to reflect even newer materials, such as glass fiber unidirectional reinforced plastic armor, and variants of aramid and ultra-high molecular weight polyethylene unidirectional reinforced thermoplastic laminates.

Challenges

The fire-spread test could be potentially used to measure a material's ability to limit flame spread when exposed to an overmatching armor event followed by a fuel flashover situation. Delays associated with test facility conversion limited the completion of anticipated tests within the time frame of completing the specification. It is expected that those tests will be completed within FY17 and the resulting information could be incorporated into future vehicle requirements. The U.S. Army needs to decide if such a requirement is necessary for any of its vehicles, and if it does, some test data are now available to help define what such a requirement might entail. Then a modification to the existing specification would be necessary.

About the Award Winner

The team included Richard J. Squillacioti and Brian R. Scott.

Richard Squillacioti led the standardization effort, which included initiating the standardization project, initial drafting (outline) for the specification and coordinating of multiple drafts, responding to all the comments received from various coordinations, and final review and publication of the document. Justifications for the document's modifications were written and the implementation of the changes was documented, as well as the performance of all the statistical analyses required to develop the accept/reject criteria for ballistic acceptance and mechanical properties.

Brian Scott was responsible for all the technical aspects of the documents, including the creation of a distribution list of reviewers and potential users. In addition to performing the original research leading to many of the armor system designs, he also was involved with the qualification testing of those designs along with contractor provided systems. He collected mechanical and ballistic data from the industry, performed ballistic confirmation testing, and worked with the industry (material suppliers, etc.) to define optimum constructions for the newest materials.

Acknowledgments

Sincere thanks are extended to all of the individuals and organizations listed below for providing technical input and/or financial support toward the development of MIL-DTL-32549. Without their contributions and participation over the past few years, this specification would not have been possible.

Alion Science and Technology

Stacy Y. Cabrera Newstead

Samuel P. Stein

Milliken & Company

Edward Brockman

Hal Eleazer

Heather Hayes

Defense Logistics Agency Research and Development Directorate

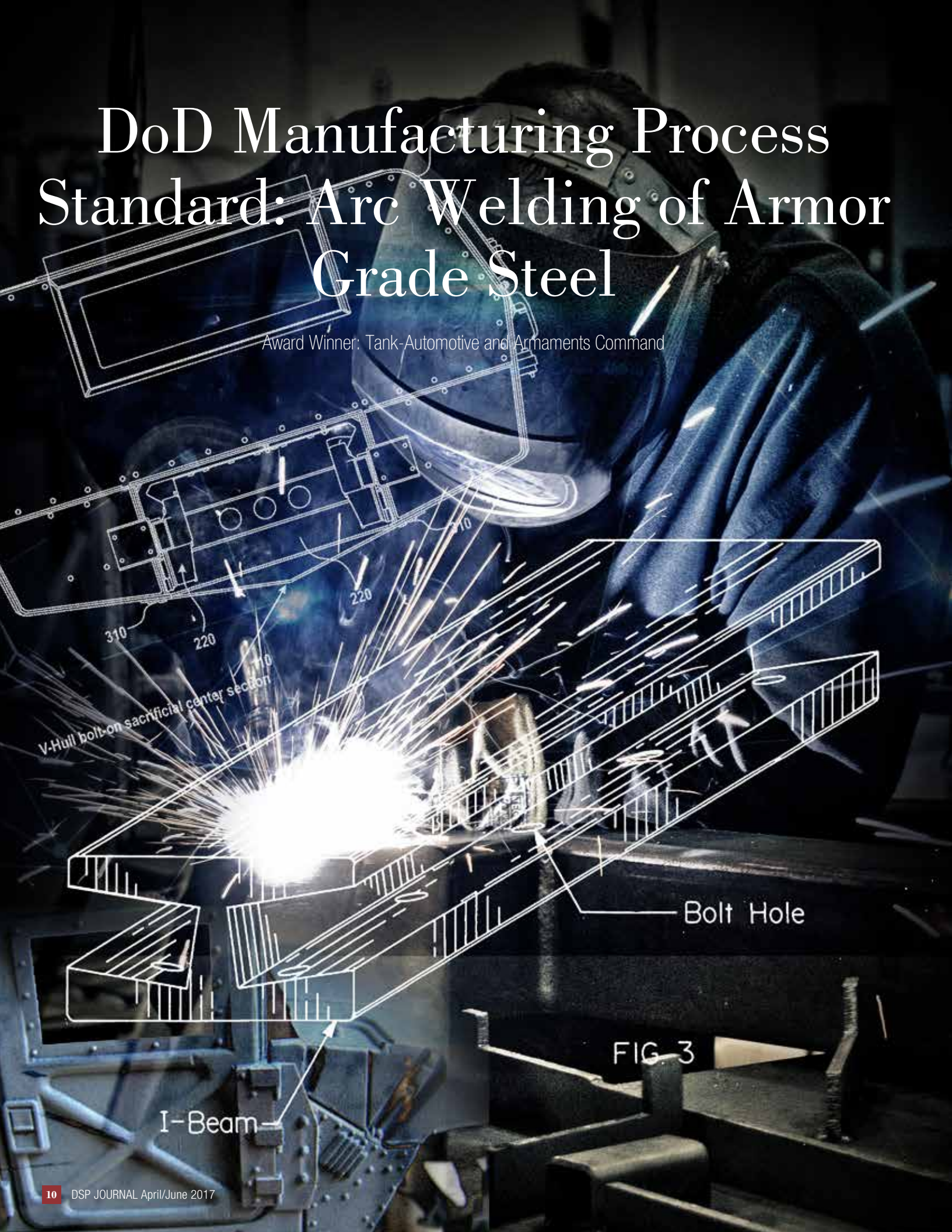
Brian M. Gabriel

Mather B. Hutchens

Manuel M. Vengua, Jr.

DoD Manufacturing Process Standard: Arc Welding of Armor Grade Steel

Award Winner: Tank-Automotive and Armaments Command



The Tank-Automotive and Armaments Command (TACOM) Standardization Office collaborated internally with Ground Systems Survivability, Product Life Cycle, and Center for System Integration—and externally with the Anniston Army Depot, Army Research Lab, Aberdeen Testing Center, Naval Surface Warfare Center, Carderock Division, Department of Energy Oak Ridge National Lab, academia, nonprofit organizations, and industry—to develop a DoD Manufacturing Process Standard, MIL-STD-3040, "Arc Welding of Armor Grade Steel." This standard defines requirements for various arc-welding processes, fabrication, inspection, repair, and qualification of armor grade steel welds (wrought and cast armor grade steel). This applies to all platforms in the Department of Defense and other federal agencies that weld armor grade steel.

Background

In 1998 during a blueprint for change, MIL-STD-1941, "Metal-Arc Welding of Homogeneous Armor," was canceled leaving no military or industry standard for the welding of armor grade steel. With increased demands for a welding standard, the Army developed MIL-HDBK-1941 and TACOM Drawing 12479550, Ground Combat Vehicle Weld Code. As a handbook, MIL-HDBK-1941 could not be used for contracts, and TACOM Drawing 12479550 could not be easily maintained and had limited visibility across all services. Because Drawing 12479550 was not updated, it has not allowed for combinations of newer grades of armor and new welding techniques.

Additionally, TACOM Drawing 12479550 had no engineering guidance for the selection of weld wire. Since the implementation of Drawing 12479550, there has been a general decrease in welding quality, and the government has seen an increase in weld defects such as hydrogen embrittlement cracking, causing increases in life-cycle costs. These costs come in the form of approximately $1 million per year in failure analysis at TACOM alone, not counting analysis costs from the depot or unit levels. Additional costs are incurred with more than 10,000 man-hours per year spent in weld repairs of various military systems at Anniston and Red River Army Depots.

To ensure better-quality armored welding, DoD mandated that Drawing 12479550 be replaced with a new format that included updated thermal joining practices and provided higher visibility for welding of armor grade steel. TACOM Standardization attempted to work with the American Welding Society (AWS) to develop a commercial standard that would incorporate all government requirements. The government began working with civilian standards groups to develop this standard, but because the government requirements were only interested in armor grade steels, as AWS already addresses mild steel, it was determined that it was in the best interest of the government to develop its own steel armor welding standard.

Problem/Opportunity

No military or civilian standards were applicable to the welding of armor grade steel or welding of mild steel to armor grade steel. Furthermore, civilian standardization groups, such as AWS, had little interest in writing a standard specific to armor grade steel. Very few applications in the civilian realm use armor grade steel, therefore there's little profit to writing a standard that specifically covers armor welding. During the writing of the document, there was immense interest and feedback from multiple DoD entities and government contractors. TACOM hosted numerous contractors to discuss their comments and concerns during the ASSIST coordination effort. In coordinating with the Navy, the standard was able to include information that is spread across multiple standards

and specifications, bringing them together for the first time. The development of this standard has encouraged the Navy standardization team in charge of welding materials to review and update its standards and specifications that further welding quality across the federal government.

The impact of the document on production cost and safety of the end user was such that more than 150 different military groups, program offices, government laboratories, government agencies, universities, civilian standardization organizations, and civilian contractors were enlisted in the ASSIST coordination. The first coordination elicited more than 750 responses, prompting a second coordination once all comments were addressed. With the cooperation of all of these groups, TACOM has been able to implement the most up-to-date information and technology to be used by all federal agencies and U.S. allies for the welding of armor grade steel.

Approach

MIL-STD-3040 clearly defines the requirements to qualify all personnel and processes needed to weld armor grade steel. Weld qualifications are based on the importance of the weld with regards to occupant-centric survivability. All required qualification testing is laid out on how to conduct the testing and what the acceptance criteria are for the testing. These requirements were developed through internal TACOM testing that will eliminate the hydrogen embrittlement cracking in steel armored systems. MIL-STD-3040 also details the requirements for fabrication of systems or subsystems; this provides for reliable and repeatable welds that will add to the safety and survivability of the end user and equipment.

Finally, the standard discusses requirements for inspecting and repairing welds. This standard provides general requirements that can be used to inspect and repair welds without superseding any system-specific repair requirements. Inspection of the welds will allow repairs by contractors when weld defects are found, further ensuring that quality products are delivered to the end users.

Outcome

Developing this standard provides benefits in the following areas:

- **Quality.** The standard improves quality by having standard requirements in qualifying both personnel and process in armor welding. The standard is material specific (armor grade steel), which allows for better description and details in the welding process, the testing requirements, and the inspection.
- **Safety.** As a result of the better quality, safety to the warfighter is enhanced due to the decrease in weld failures. Bad welds and subsequent weld failure negatively impact the integrity of the weapon systems and the well-being of the warfighters in the vehicles.
- **Cost.** Life-cycle cost goes hand and hand with the improvement in quality. The problems seen with Drawing 12479550, such as differences in interpretation of the drawing or hydrogen embrittlement cracking, have been eliminated with MIL-STD-3040. With a decrease in weld defects and a more standard process, the costs are reduced.

There may be an increase in cost initially due to qualifying personnel and processes, but this is a definite long-term benefit in quality, safety, and cost.

Current Status

MIL-STD-3040 has been published through ASSIST, and it available for all of DoD and its contractors to use. Currently, government contractors such as General Dynamics, BAE, and Oshkosh have begun qualifying their welding personnel and welding processes per the new standard in anticipation of future contracts.

Challenges

As with any new standard with new requirements, there has been resistance to change from both government program offices and government contractors. The rationale is that they see the initial cost increasing with the increased safety and quality on the front end of the life cycle. Government and contractors wish to keep costs as low as possible, but the cost savings from this standard will be seen when measured across the entire life cycle of the system. TACOM is worried there will be reluctance to meet all of the initial requirements in the standard so as to save money during qualification in future contracts. It will be the responsibility of program managers and quality assurance offices to ensure that all requirements are met to produce the safest armor welds possible, reduce overall life-cycle costs, and provide the warfighters with the most reliable systems.

About the Award Winner

The team included Bryan Pruess, Daniel Stearns, Matthew Rogers, Martin McDonnell, and Demetrios Tzelepis.

Bryan Pruess was the project lead from 2011 through 2014, coordinating all parties involved and ensuring proper format of the document in accordance with the latest revision of MIL-STD-962.

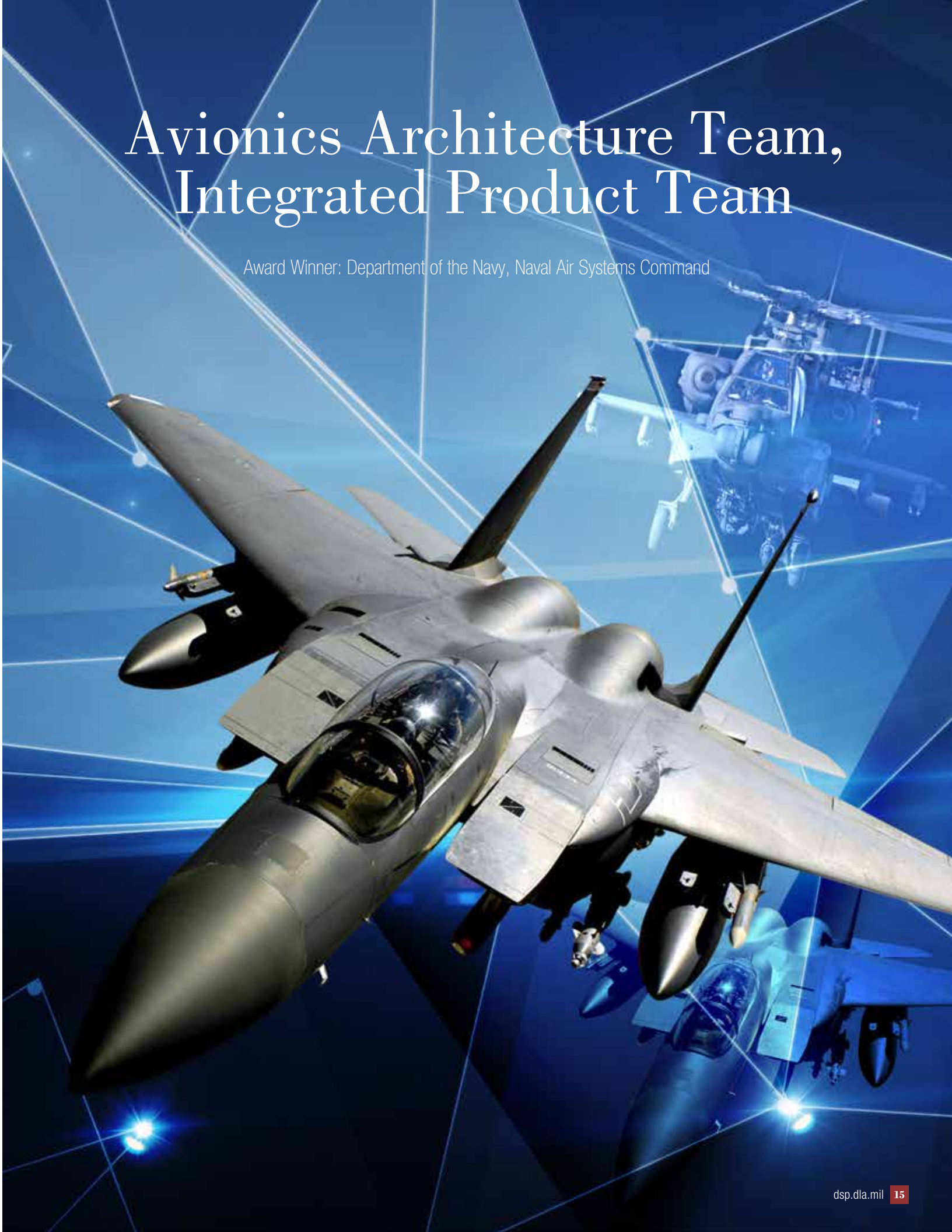
Daniel Stearns worked on the project starting in August 2014, assisting Mr. Pruess. Mr. Stearns took over as project lead when Mr. Pruess moved from the Standardization team in March 2015. Mr. Stearns continued working with all document contributors, consolidated research, and did final editing of the document. He also submitted the document for operational security review and two separate ASSIST coordinations.

Matthew Rogers and Martin McDonnell were the main subject matter experts for welding processes and personnel qualification requirements. The research conducted by both individuals provided the technical data required for weld acceptance criteria. As engineers, their knowledge and experience were instrumental in the writing of the document. Besides their technical expertise, both Mr. Rogers and Mr. McDonnell had multiple professional contacts that could be called upon to confirm information, answer questions, and offer advice.

Demetrios Tzelepis was the subject matter expert for the materials aspect of the document. He offered his knowledge and experience in materials testing to provide invaluable information for all mechanical testing sections of this standard. He and his team members at the TACOM Materials Laboratory performed hundreds of hours of research and testing to provide information to the standard.

Avionics Architecture Team, Integrated Product Team

Award Winner: Department of the Navy, Naval Air Systems Command



The Avionics Architecture Team (AAT) is a Naval Air Systems Command (NAVAIR) integrated product team (IPT) that analyzes acquisition program objectives and operational requirements to identify and plan for implementing open standards on Navy and DoD aircraft. The AAT is led by IPT Lead Keith McDonnell and consists of Rod Dailey, Chris Kimmel, and Mike Hackert, who together worked to develop the technical and business framework for two open architecture initiatives known as the Future Airborne Capability Environment (FACE) and Hardware Open Systems Technologies (HOST). The FACE and HOST technical standards establish and standardize the technical frameworks for software and hardware to enable the acquisition of affordable systems that promote rapid integration of portable capabilities across global defense programs. The payoff will be a common avionics architecture that enables a product-line approach and supports the ability to reuse software and hardware across platforms and services. This product-line approach will reduce duplicative development costs and speed integration. As a result, DoD will gain the ability to adapt to changing requirements, threats, and technology at a faster rate and continue to provide the warfighter with best-in-class capabilities.

Background

It is widely acknowledged throughout the DoD aviation community that the expansion of future aviation capabilities will mostly come from integration of software-intensive systems. Historically, embedded avionics software systems have been developed, procured, and implemented with platform-specific designs, resulting in tightly coupled systems with unique interfaces and proprietary hooks that inhibited reuse and adversely affected interoperability. The AAT recognized that it is no longer possible to continue these practices in light of today's fiscal environment. In the current world of portable applications for cell phones, the AAT has focused on whether avionics capabilities could be acquired and implemented using a similar approach. The AAT is addressing the standardization of both hardware and software by managing two primary efforts: HOST and FACE. By defining open software and hardware architectures and standardizing key interfaces, FACE and HOST provide the infrastructures that will result in improved operational readiness, interoperability, cost savings, reliability, sustainability, improved performance, quality, and a reduced logistics footprint.

Problem/Opportunity

The FACE and HOST standards address several issues that plague modern avionics and the aviation community:

- **The lack of common, standardized systems and enforceable standards has limited interoperability and reuse of capabilities across aircraft platforms.** Developing interoperable and reusable software capabilities is an essential AAT philosophy. The FACE technical standards enhance the interoperability of software components by standardizing the software

architecture design, the application programming interfaces, and the corresponding data model. Products will be verified as conformant to the FACE technical standards through a process defined by the FACE consortium. This ensures that FACE-conformant components can be reused on multiple platforms hosting the FACE software infrastructure and interfaces.

- **The lack of open competition creates limited options.** The hardware and software currently fielded in avionics systems often represent "one-off" point solutions, which result in vendor-locked mission systems limiting competition for new and innovative capabilities. Use of the FACE technical standards and HOST enables open and increased competition throughout the life cycle of a product or system. Adopting and implementing the standard interfaces and basing procurement on preference for certified conformant products will provide the government with a wider range of choices and enable competition down to the component level. Increased competition for hardware and software will open the market to additional suppliers, allowing the government to procure from a wider supplier base to ensure the warfighter is getting best-in-class systems.

- **Readiness is being affected by slow development and implementation timelines.** Having to deploy obsolete capabilities due to lengthy development, integration, and test times is a significant challenge for DoD. The current timeline to field capabilities can be 6 years or more. Having open frameworks in place with well-defined and standardized interfaces will ease integration issues and result in faster implementation timelines. Obsolescence risk will become less of an issue as new capabilities are fielded more quickly and seamlessly into infrastructures that are modular and easily upgradeable when new technology is developed.

- **The current economic climate suggests that less funding will be available for defense programs.** Establishing architectural frameworks for software and hardware like those defined by FACE and HOST will enable the leveraging of capabilities developed for other platforms and systems. This potential cost savings will allow program offices to take advantage of additional upgrades that would not be possible under current funding constraints and would also allow them to acquire the upgrades at a faster pace.

Approach

The goal of the AAT is to follow a holistic approach to open architecture (OA) with central management of common functionality and standardized hardware and software technical reference frameworks to yield higher benefits. The AAT uses a multi-pronged strategy to continue its path to success. Two academia institutions are under contract to validate and verify the FACE and HOST standards, research other OA standardization initiatives, and serve as technical experts to the AAT. Concurrently, the AAT is engaged with industry and other military services through a voluntary consortium hosted by an internationally renowned standards body to develop a consensus-based solution and ensure industry adoption. With widespread industry buy-in and cooperation to develop the FACE technical standards and business practices, the AAT has saved the government time and money by capitalizing on the knowledge and experience of industry experts.

FACE expands upon existing modular open system architecture, integrated modular avionics, and OA principles and uses current widely adopted industry standards for distributed communications, programming languages, graphics, and operating systems. In contrast to other OA initiatives, which offer only general guidance on designing open systems, the FACE technical standards clearly describe reference architecture and specify the key interfaces that will ensure a product-line approach to software development, resulting in increased portability and reuse of software capabilities and decreased costs and fielding schedules for DoD software aviation capabilities.

Outcome

The AAT's main objective is to reduce life-cycle costs and time to field warfighting capabilities by developing a common operating environment supporting portable software components across multiple aviation platforms. FACE and HOST provide the environments that will sustain the platforms and systems in use today and keep them technically relevant so they will safely and effectively bridge the gap until future aviation platforms are delivered. Platforms hosting the FACE software infrastructure will be able to leverage FACE-conformant applications acquired by other programs and services without modifying application code or creating a proprietary interface, both of which adversely affect interoperability. HOST will enable computing platforms to be more modular, upgradeable, interoperable, and adaptable to other platforms. As a result, the Navy and other services will gain the ability to adapt to changing requirements, threats, and technology at a faster rate and continue to provide the warfighter with best-in-class capabilities.

Establishing a standardized architecture approach culminating in an open DoD product line is no minor task, but the end result will lead to significant benefits for DoD and the warfighter. These benefits will be driven primarily by the consolidation of platform-unique architectures and interfaces into a government-defined and government-managed open product-line architecture. This will enable common capabilities to be reusable across multiple platforms and multiple services, competition throughout the life cycle, the ability to integrate emerging capabilities affordably, and more. These benefits are key to being able to sustain warfighting dominance of the United States and its allies. The acquisition community must make a cultural shift away from sole-source, platform-unique solutions and adopt a holistic OA approach to cost-effectively deliver the most capability across DoD and preserve the relevance of the warfighter.

Current Status

Edition 3.0 of the FACE technical standards details how to achieve high degrees of software reuse and reduce the cost of software development through a modular, product-line approach. This effort is being directly applied to PMA209's Required Navigation Performance/Area Navigation application to create a reusable, FACE conformant application to be applied across DoD aircraft.

The HOST approach that the AAT is pursuing is intended to provide requirements and guidance for developing open hardware computing systems for hardened military use. In conjunction with the HOST standard, PMA209's Mission Computer Alternative is attempting to change the status quo by providing a standardized, modular, next-generation computer that will enable faster tech refresh and software upgrades. MCA is looking to demonstrate this approach with a ruggedized, flight-qualified system.

The AAT also is collaborating with international partners via the Technology Cooperation Program, an organization that fosters technical exchange among the most trusted U.S. allies. The goal is to align the Navy's FACE standards with other nations' standards such that software technology upgrades funded via one nation can be directly leveraged by other nations. While this alignment is designed to drive down developmental costs of future technology upgrades, it also enhances the interoperability of a multi-national coalition force.

Challenges

The AAT has had to address and overcome numerous cultural, political, technical, and monetary barriers. To achieve standardized and interoperable avionics capabilities, the first barrier to overcome was the current development practices and culture that have generally resulted in stove-piped, tightly coupled systems. The AAT is attempting to shift the organizational thought process toward focusing on the capabilities needed to perform a mission and which of those capabilities are common across multiple platforms. The second barrier to overcome was achieving a sustainable level of industry involvement and adoption. To ensure industry buy-in for what promises to be a major change to the status quo, the AAT IPT lead helped facilitate the formation of a government and industry consortium in June 2010. Despite the challenges of dealing with what has grown to more than 900 engineers and business development personnel with different backgrounds and motivations, the team has continued to foster a collaborative environment within the consortium and built a cohesive team of nearly 100 diverse, competitive companies, the Navy, Army, and Air Force.

The last major challenge is developing an acquisition workforce with the right knowledge, skills, and abilities to manage the standardized architectures and promote the product-line approach. With the current cultural focus and acquisition alignment around platform-unique solutions, the AAT is working to increase its skill set to shift toward the architecture, design, and development of standardized solutions.

About the Award Winner

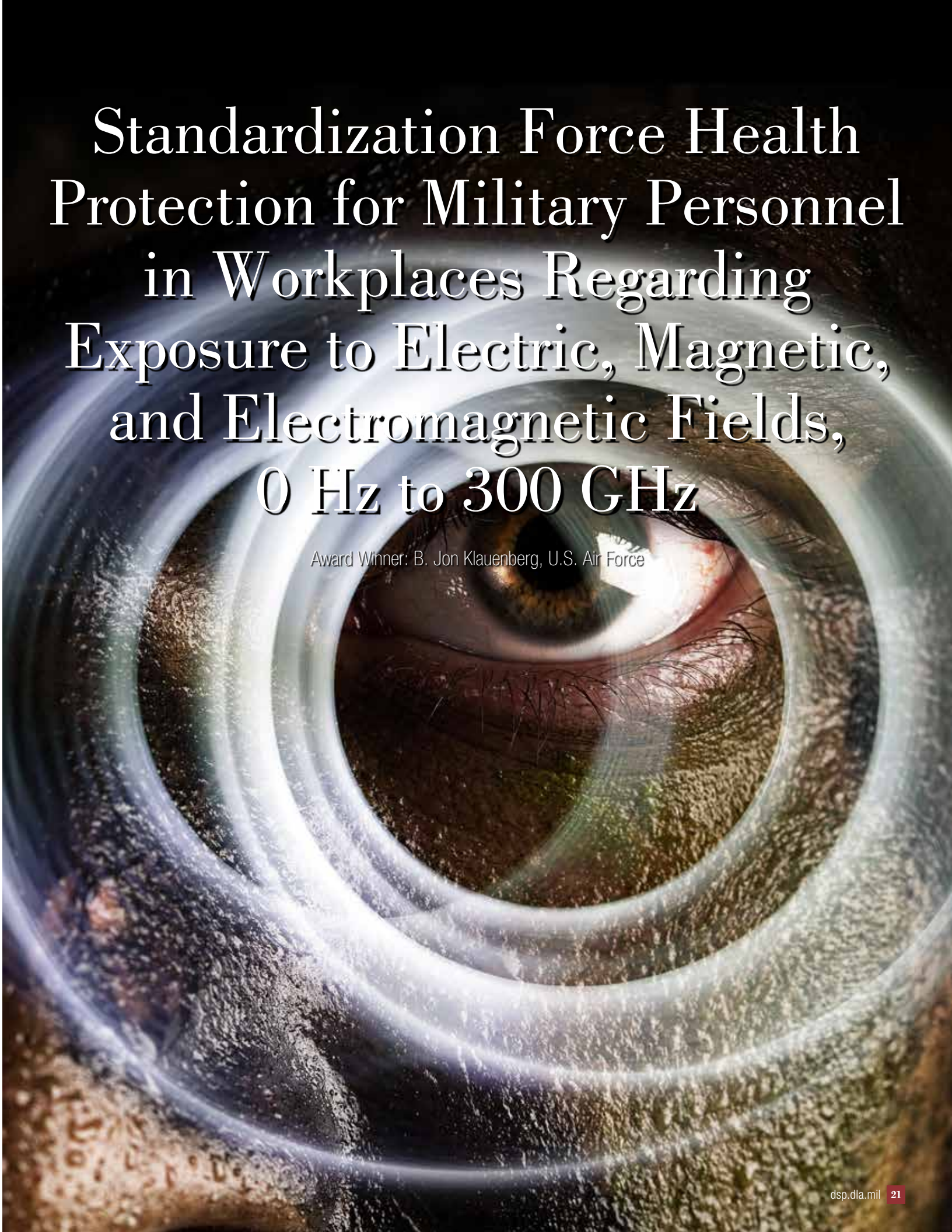
The team included Roderick Dailey, Chris Kimmel, and Mike Hackert.

As the FACE IPT lead, Rod Dailey is responsible for the planning and execution support for Air Combat Electronics programs and for multiple platforms to support operational requirements for FACE implementations. In his role, he oversees the activities of the Technical Working Group, Business Working Group, and Enterprise Architecture Committee. His personal efforts were instrumental in the completion of the *FACE Business Guide* and *FACE Contract Guide* and he continues to provide key inputs to the Business Working Group's Library, Conformance, and Business Model subcommittees. Mr. Dailey has also played a key role in educating the aviation community on the benefits of standardization as well as promoting industry support of the FACE product-line approach for software-intensive systems.

Chris Kimmel is the PMA209 lead FACE software and architecture engineer. He contributed to the FACE technical standards and *FACE Reference Implementation Guide* and participated on the FACE Conformance Test Suite Configuration Control Board. He is a driving force for bringing programs aboard that can benefit from aligning their future acquisitions and planned upgrades to FACE implementations. He has provided strategic assistance in the form of technical implementation of white papers and subject matter assessments. Mr. Kimmel has conducted effective outreach aimed at strengthening awareness of FACE and educating programs on the benefits of standardizing key interfaces and developing capability requirements that can span multiple platforms.

Mike Hackert is the PMA209 lead HOST architecture engineer. His responsibilities include authoring the HOST Standard and complimentary Reference Integration Guide. His efforts also extend to determining whether HOST implementation will help meet the program management goals of reduced cost, schedule, and risk on acquisition programs. Currently, Mr. Hackert is supporting PMA209's Mission Computer Alternative effort, as well as aiding the Joint Strike Fighter in hardware updates for obsolescence. He is continually serving the warfighter by helping to develop open system hardware and also improving the quality of the HOST standard by factoring in direct customer feedback.

Standardization Force Health Protection for Military Personnel in Workplaces Regarding Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz



Award Winner: B. Jon Klauenberg, U.S. Air Force

B. Jon Klauenberg's 27 years of service to DoD and NATO militaries have provided unparalleled leadership in multiple areas of personnel electromagnetic safety standardization. He led the Institute of Electrical and Electronic Engineers International Committee on Electromagnetic Safety (IEEE-ICES) in developing a new military standard, IEEE-C95.1-2345, and as custodian oversaw the ratifications and promulgation of covering NATO Standardization Agreement (STANAG) 2345. He shepherded the standard's adoption under Department of Defense Instruction (DoDI) 6055.11, "Protecting Personnel from Electromagnetic Fields." He led NATO Science Technology Organization Research Task Group (RTG) 189 in editing the final publication that supports consensus that a 50-year-old, high-peak-power, ultra-short electric field limit was unnecessary and impacted the development of directed-energy weapons and counter electronics.

Dr. Klauenberg completed a decade-long effort to restructure standardization approaches and introduced a novel standardization paradigm shift that provides commanders and developers of electromagnetic-based systems with new options facilitating combat operations. As membership chair of the IEEE-ICES Administrative Committee, he recruited 25 members in FY16, expanding the committee's international standardization footprint. His membership in the ICES Editorial Working Group ensures that the development of new standards does not impact the military. He also obtained Defense Standardization Program Office funding to sponsor a 5-year IEEE "GET" program that provides access to 10 standards by everyone, anytime, anywhere, saving over $5 million.

Background

Electromagnetic field (EMF) emissions are a virtually ubiquitous component of military operations. Exposure of personnel can occur from radars, communications, navigational aids, and directed-energy weapons, among other systems. It is essential that personnel be protected from EMF overexposure in the workspace. Military operations require maximizing necessary allowed exposure limits while ensuring personnel health and safety. Multinational operations such as NATO require interoperability, the NATO standardization linchpin.

Dr. Klauenberg is globally recognized as a distinguished expert on radio frequency science-based safety standardization. He is frequently asked to participate in World Health Organization workshops and reviews, is an IEEE-ICES leader, serves as personnel safety expert on EMF bioeffects to the NATO Medical Standardization Force Health Protection Working Group and the Electromagnetic Environmental Effects Radiation Hazards Working Group, has chaired the DoD Transmitted Electromagnetic Radiation Protection Working Group, and continues to serve as the U.S. Air Force standardization lead. He has provided standards-based environmental impact and risk communications support to installations of major radio frequency (RF) emitters.

Dr. Klauenberg led the development of the new STANAG 2345, revising overly restrictive limits for personnel in workspaces. Systems that had been degraded to meet unnecessary restrictions

when personnel were present could operate as intended under the updated STANAG, significantly increasing operational availability of RF systems without impacting personnel safety. He directed a 3-year Science Technology Organization RTG review of high-peak-power, ultra-short electromagnetic pulses that concluded that the ultra-short pulses were not a health hazard and could be eliminated from future standards. He leveraged the DoD investment of $60,000 over 5 years, which in turn influenced over $1 million of contract cost avoidance to draft the standard. He saved U.S. and coalition partners more than $500 million that would have been required to purchase land, move fences, reestablish safe distances, revise manuals, and retrain compliance personnel without impacting DoD mission or risk personnel safety.

Dr. Klauenberg's leadership of DoD, NATO, and IEEE collaboration expands the global reach of U.S. military standardization activities. He developed the first military expert-only EMF access zone using the buffer zone below the adverse health effects limit, thereby expanding workspace and providing increased command operational flexibility.

Problem/Opportunity

Electromagnetic fields have many parameters that make establishing safety limits challenging, requiring a multidisciplinary approach. Placing unnecessarily restrictive limits on electromagnetic emissions has been shown to have critical impacts to safety operations that have created new alternative safety hazards. A prime example was the 50-year-old unnecessary limit on high-peak-power, ultra-short electromagnetic fields. Developers had directed energy and other high-power devices in the pipeline waiting for a thorough review. Military-appropriate standardized limits on exposure were lacking or needed revision or update. Obtaining buy-in by NATO nations with differing national standards was extremely challenging but necessary for interoperability. Using non-governmental standards that are copyrighted was another challenge, especially for populating the NATO and DoD ASSIST databases. Funding the necessary actions, including sponsorship of free access to the IEEE standards, was another major challenge.

Approach

Dr. Klauenberg took the following actions:

- **NATO STANAG 2345 promulgation.** He was vigilant in identifying the potential effects and determining whether the exposure limits were justified. He worked diligently with several NATO national experts to address dissenting nations' concerns, explain the benefits of the new STANAG, eliminate dissent, and obtain ratifications. Most difficult was communicating to nations that did not have EMF experts. He employed numerous literature reviews and expert statements to convince hesitant nations to ratify. He exceeded promulgation criteria by five nation ratifications. The STANAG 2345 MEDSTD, "Military Workplaces—Force Health Protection Regarding Personnel Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz

to 300 GHz," published in November 2015, has been lauded as a major advancement in military workplace EMF safety standardization.

- **Renewal of IEEE "GET" program.** Copyright issues were met with a cost-effective mechanism to provide the standards free to users. Dr. Klauenberg had previously established a collaborative NATO-IEEE technical agreement and then a sponsorship of the IEEE "GET" program, which provides global no-cost access to all 10 C95 series standards for everyone with Internet access. He renegotiated the contract for a second 5-year renewal with the IEEE Standards Association, reducing the proposed cost back to that of the original 5-year contract, $50,000. He briefed numerous Air Force and DoD activities and submitted several proposals. The director of the Defense Standardization Program Office granted funds to extend the contract.

- **Elimination of unnecessary limit on high-peak-power, ultra-short electromagnetic fields.** Dr. Klauenberg prepared the final report of the 3-year Science and Technology Office report on Research Task Group 189, which reviewed the literature and recent research and reached a consensus that some RF limits were unnecessary and were not included in the new C95.1-2345 standard. This removed a roadblock to deploying several high-energy systems waiting to clear the pipeline.

Outcome

STANAG 2345 adopted an IEEE civil standards organization (SDO) standard, C95.1-2345, prepared under an IEEE-NATO technical cooperation agreement engineered previously by Dr. Klauenberg. Adopting this first-ever transfer of management of a NATO standard to an SDO saved time and funds as the world's expert members of IEEE-ICES worked on the document for 4 years as volunteers. Travel by the eight-person editorial committee to biannual meetings was the primary expense, borne individually. They did most of the work in monthly video telecoms, conserving funds. This ensured that experts well acquainted with standardization of EMF safety and DoD and NATO policy were leading the effort. The NATO Medical Board has designated STANAG 2345 as an "Essential STANAG," recognizing its importance to interoperability and safety. STANAG 2345 covers a civilian and military workplace safety and health standard protecting personnel from EMF exposures. Numerous entities have adopted the standard, and DoD has adopted it by reference in DoDI-6055.11, which is in final coordination.

Because this is a renewal and expansion of a previous contract with IEEE for the "GET" program, data exist that show the month-by-month incidence of electronic downloads of the standards over the last 4-year period has totaled 11,784. Military users alone accounted for 942 downloads, or $1,047,504.00 if complete sets were purchased. Other groups identified in the access records included government, industry, research, and standards setters. The total number of downloads has averaged 3,000 a year. Sponsorship has significantly reduced safety standards-related costs through the IEEE "GET" program. No-cost access was key to obtaining nations' ratification of the STANAG. Internet access increases global use of the DoD-selected standards, thereby increasing interoperability.

The removal of the high-peak-power, ultra-short electromagnetic field limit from the standard has cleared away an impediment to fielding systems. In addition, the military-compatible standards limits covered by STANAG 2345 saved the Air Force, DoD, and our coalition partners millions of dollars that would have been spent buying land, moving fences, reestablishing safety distances for ranges and communications equipment, revising manuals, and conducting training. These operational impacts were deemed to be non-mitigatable by U.S. and coalition military agencies. Dr. Klauenberg's standardization actions ensured continued safe operations, minimized mission impacts, and fostered interoperability globally.

Challenges

Although derogations from European Union (EU) Directive 2013/35 for the militaries operating in the EU had been obtained through Dr. Klauenberg's efforts, several nations would not ratify the derogation, claiming the EU directive required them to follow it by law. This is not so, and the NATO EMF group continues to work with these few nations. Access to the standard covered by the STANAG through the IEEE "GET" program was essential. The challenge of obtaining $50,000 funding was extremely difficult, but was successful using year-end fall-out dollars. If Dr. Klauenberg had been unsuccessful in acquiring the funding for the "GET" program, the entire program would have ended and the STANAG would have been placed in jeopardy. DoD and component personnel working with standards would find it difficult to obtain the copyrighted documents without paying for them—a cost of over $1,100 for the set of 10. Funding of travel to participate in high-level international standardization activities has always been a problem and threatens continued DoD influence and insight into international positions. Electronic communications have provided a limited effective means of working group interaction; however, direct interaction is essential for conducting multifaceted projects and maintaining currency.

The custodian is working with colleagues in the DoD Transmitted Electromagnetic Radiation Protection Working Group to advocate future funding of the "GET" program as well as occupational safety and health standardization in general. Rotating the funding responsibility among the services has been discussed.

Current Status

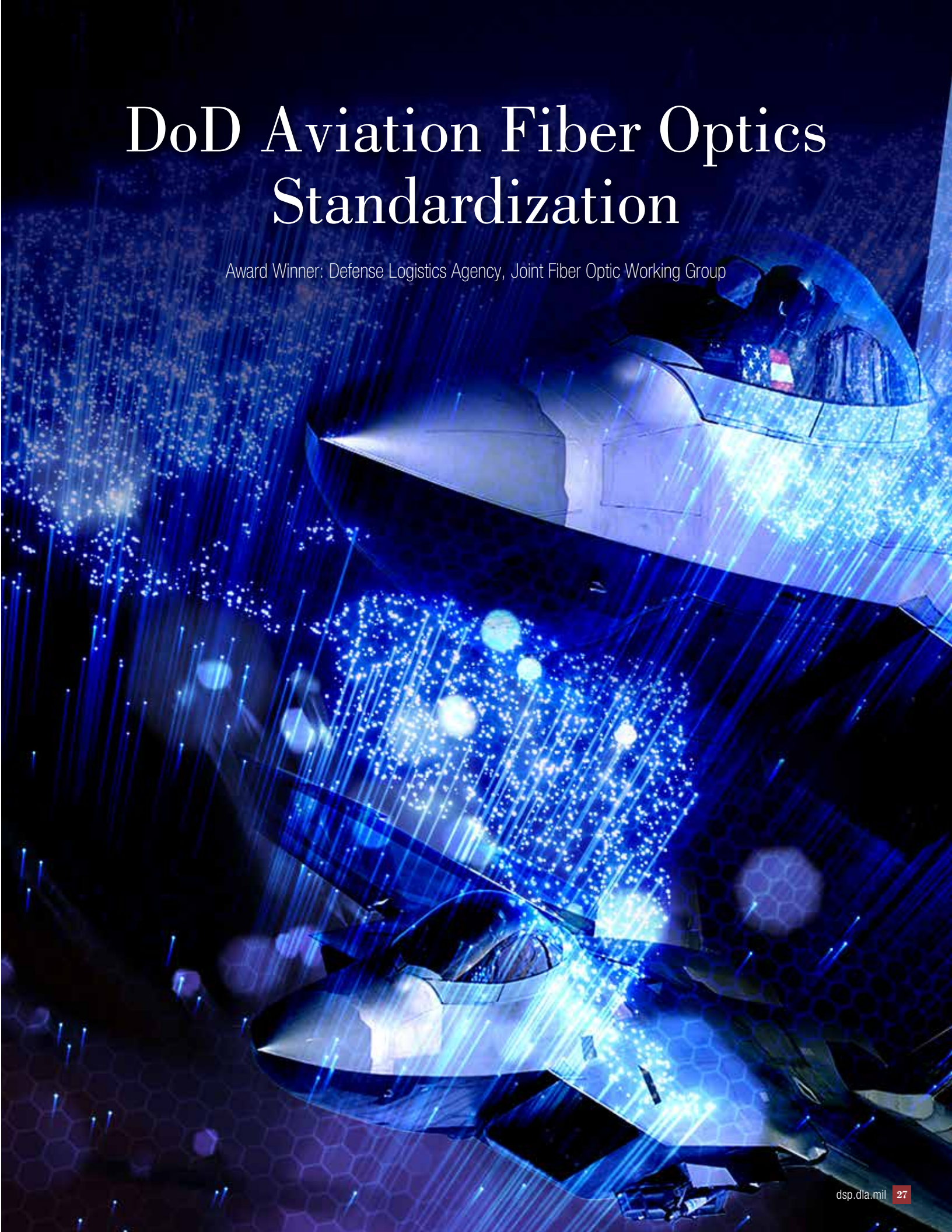
STANAG 2345 has been promulgated. The 3-year timeline for review, revision, or cancellation has begun with November 26, 2018, as the expected record date. Dr. Klauenberg is mentoring a junior force member to assume the role of custodian, and for the near future, both will be leading a NATO Force Health Protection Working Group subgroup on EMF occupational safety and health. The subgroup will form the nucleus of the review group to meet the 2018 suspense. The 5-year contract to sponsor the IEEE "GET" program C95 series standards includes two new standards and all the updates for the contract period, thereby ensuring the currency of the guidance.

About the Award Winner

B. Jon Klauenberg was the initiator and lead for several EMF standardization efforts. His breadth of experience and varied skill sets have established him as a preeminent expert in EMF standardization. This recognition has provided him access to high-level international and national EMF standardization activities, some for the first time, such as the European Commission on Worker Safety (EC) wherein he serves as the sole non-European NATO stakeholder to the EC EMF Advisory Group. He was solely responsible for drafting language that led to multiple derogations of the militaries in EU Directive 2013/35/EU, which in turn enabled EU nations to ratify the STANAG. Dr. Klauenberg continues in the NATO stakeholder role providing science and technical watch to ensure that new guidelines and standards are militarily compatible. He chaired NATO Science and Technology Office RTG 189, which reviewed 50 years of literature on high-peak-power, ultra-short-pulsed electromagnetic fields, and he edited and wrote major chapters for the RTG report. The consensus he developed in the RTG provided a sound basis for revision of the standard covered by STANAG 2345. He established a STANAG review group that successfully worked as a team to obtain ratifications from dissenting nations, leading to promulgation of STANAG 2345. He spearheaded the search for funding for continued sponsorship of the IEEE “GET” program, briefed numerous groups, wrote two proposals, and, as a result of his persistence and recognition, obtained the necessary funding from DSPO Director Gregory Saunders.

DoD Aviation Fiber Optics Standardization

Award Winner: Defense Logistics Agency, Joint Fiber Optic Working Group



The Joint Fiber Optic Working Group (JFOWG) provides a forum dedicated to the standardization and commonality of fiber optic systems across DoD. JFOWG improves the safety, reliability, maintainability, supportability, cost-effectiveness, and overall readiness of DoD fiber optic systems. Military and civilian personnel provide lessons learned that are resolved via JFOWG action chits and addressed through technology development, evaluations, documentation (including standardization), and technical determinations. Civilian JFOWG participants include representatives from the Air Force Research Lab (AFRL), Army Aviation Applied Technology Directorate, Defense Logistics Agency (DLA), Ministry of Defense, Naval Air Systems Command (NAVAIR), and Naval Sea Systems Command (NAVSEA). DoD aviation prime and sub-prime contractors, and the DoD aviation acquisition and science and technology communities, also participate in JFOWG.

Over the past decade, JFOWG catalyzed the creation and update of a plethora of fiber optic standards and documents. This team effort used subject matter expertise from AFRL, Army, DLA, NAVAIR, and NAVSEA. Prior Navy shipboard fiber optic standards, documentation, and parts qualification expertise provided the framework for JFOWG standardization planning and execution. The primary payoffs for DoD are the life-cycle cost savings and cost avoidance via commonality across DoD and the elimination of proprietary and sole-source solution offerings from the prime contractors.

Background

In hindsight, the 1994 Perry Memorandum ("Specifications & Standards—A New Way of Doing Business"), combined with encouragement from DoD to rely on commercial-off-the-shelf and other industry standards, inhibited the flow of financial support to the DoD standards community to create and maintain standards for the benefit of the DoD aviation acquisition community. Beginning in 2001, the Navy Fiber Optic Working Group (now JFOWG) initiated work to determine exactly what military specifications and standards needed to be prepared for the benefit of DoD aviation fiber optics. This provided JFOWG with both a real problem to solve and a unique opportunity to significantly and positively impact DoD aviation via the creation, review/surveillance, and maintenance of aerospace, commercial, and DoD fiber optic standards.

Problem/Opportunity

As fiber optic technology insertion began to ramp up on DoD aviation programs—that is, Air Force F-22 (Lockheed Martin), Navy F/A-18 (Boeing), and Navy E-2 (Northrop Grumman)—the only "practical" alternative at the time was to rely on aerospace prime contractor proprietary standards, a few industry standards, and conversion of military fiber optic standards to SAE fiber optic standards. In actuality, no military fiber optic standards were converted to SAE fiber optic standards. Some commercial standards were modified to accommodate military application, but the standards were difficult to call out and enforce on acquisition contracts. This situation created a major standards

void in DoD as the Air Force and Navy increased acquisition activities to incorporate fiber optics technology on aviation platforms and various unmanned aircraft systems ground control stations.

Until the Navy Fiber Optic Working Group recognized this standards void problem in 2001, no MIL-DTL or MIL-PRF standards were created or updated to address DoD aviation fiber optic requirements. Although two new standards were created in SAE (SAE AS5382 for aerospace fiber optic cables and AS5990 for aerospace fiber optic connectors), even to this day AS5382 and AS5590 cable and connector parts have not been qualified by SAE. Also in 2001, SAE AS50881 was in Revision A and thus had little relevant language relating to fiber optic installation on aerospace platforms. Legacy DoD aviation platforms had not yet included AS50881 as a contractual requirement, and instead they applied the outdated MIL-W-5088. In addition, during this time period European Union (EU) aerospace fiber optic standards and ARINC, the primary commercial aviation standards body supported by the commercial airplane industry, did not collaborate with DoD aviation or SAE aerospace standardization communities. In short, until JFOWG engagement occurred via the Navy Fiber Optic Working Group in 2001, DoD was effectively left "orphaned" with respect to state-of-the-art military aviation fiber optic standards.

Approach

Six things were done within JFOWG to fill the aforementioned standards void:

1. JFOWG first began discussions to determine what military specifications, standards, and documents needed to be prepared. Some JFOWG participants also initiated work within the SAE Avionics Systems Division–Fiber Optics and Applied Photonics committees to identify what SAE standards and documents needed to be modified or prepared.

2. JFOWG participants completely revamped and modernized the **NAVAIR 01-1A-505-4 to 1-1A-14-4 TM 1-1500-323-24-4** "Installation and Repair Practice Aircraft Fiber Optic Cabling" technical manual for the benefit of the military field/fleet maintainer.

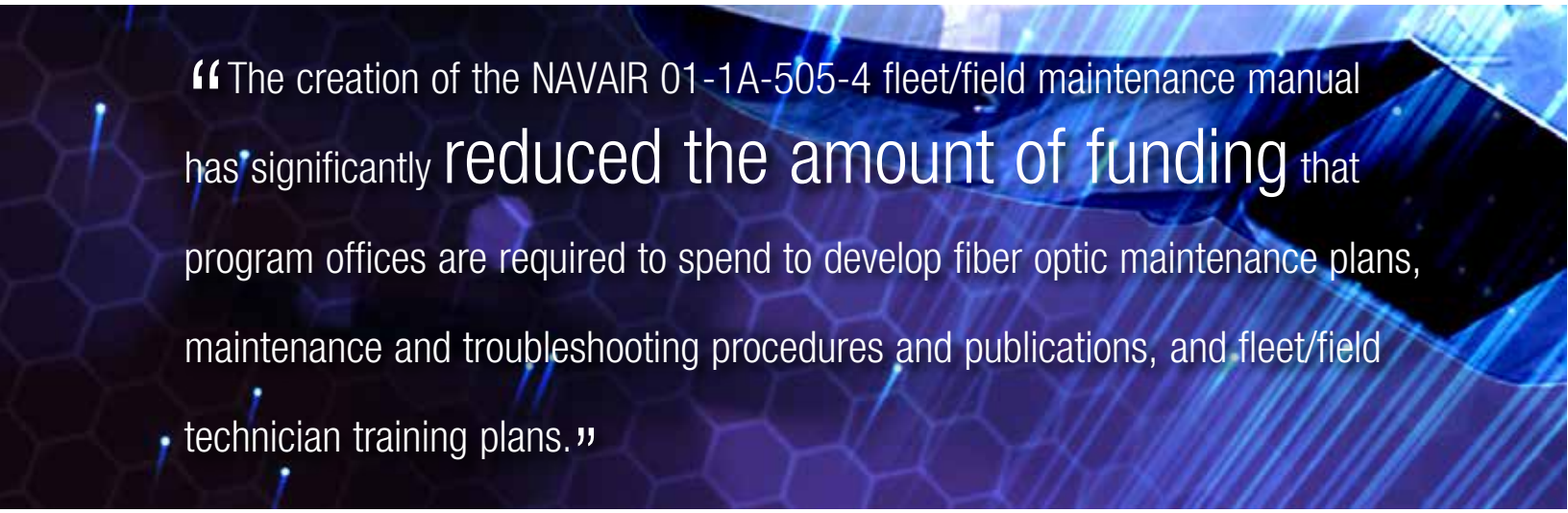
3. JFOWG participants completely revamped and modernized MIL-STD-1678, "DoD Standard Practice Fiber Optic Cabling Systems Requirements and Measurements," for the benefit of the DoD acquisition community. This was a major task that created five new parts to the standard while keeping the legacy information in a sixth part.

4. JFOWG participants updated the following MIL-PRF specifications to make the standards applicable to aviation:

   - MIL-PRF-64266 was created to define performance requirements for the next-generation fiber optic connector.
   - MIL-PRF-29504 was updated with new slash sheets to accommodate MIL-PRF-64266 fiber optic termini for shipboard and aerospace applications.
   - MIL-PRF-49291 was updated with new slash sheets to accommodate modern single-mode and multimode aerospace fiber optics technology.

- MIL-PRF-85045 was updated with a new slash sheet to accommodate modern single-mode and multimode aerospace fiber optic cable technology.
- MIL-PRF-24623 was updated with a new slash sheet to accommodate modern aerospace mechanical splice technology.

5. NAVAIR JFOWG participants attended SAE AS-3 meetings and played major roles to create the following SAE aerospace standards and one SAE recommended practice:
   - AS5675, "Characterization and Requirements for New Avionic Fiber Optic Cable Assemblies—Jumpers, End Face Geometry, Link Loss Measurement, and Inspection"
   - AS6021, "Aerospace Fiber Optic Cable Assembly Drawing Specification"
   - AS5603A, "Digital Fiber Optic Link Loss Budget Methodology for Aerospace Platforms"
   - AS5750A, "Loss Budget Specification for Fiber Optic Links"
   - AS5659, "Aerospace Wave Division Multiplex Local Area Network Standard"



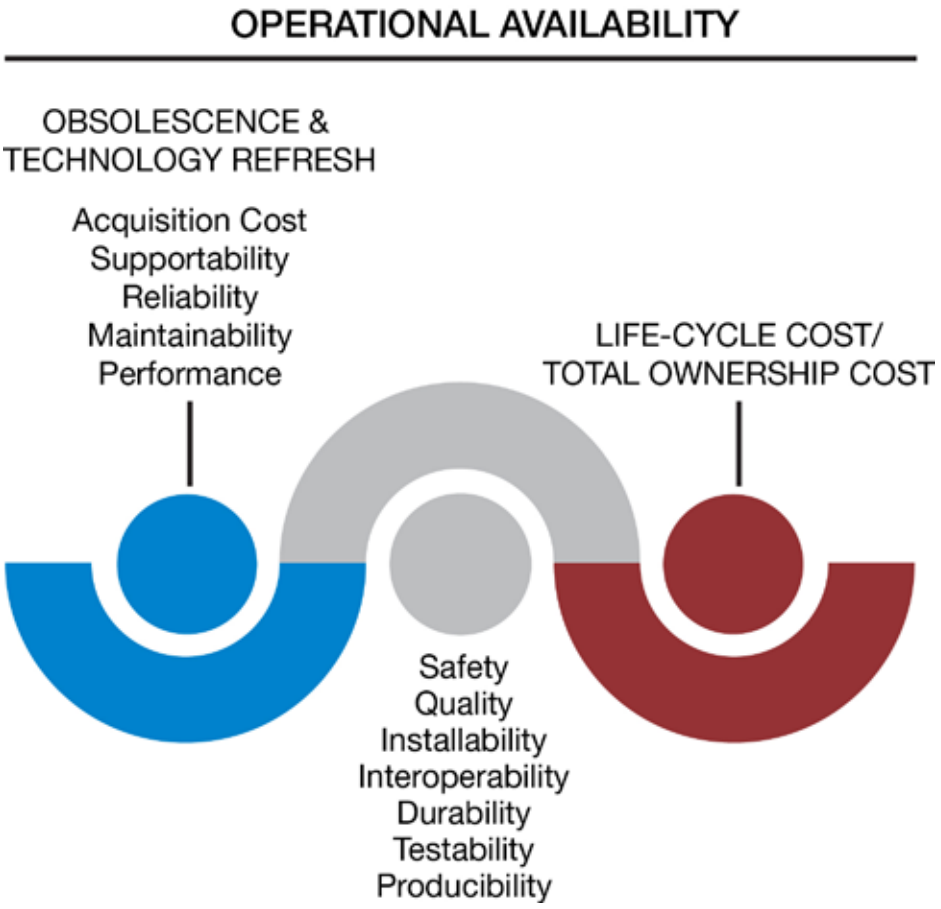
   - ARP6017, Supplement to AS50881, "Recommended Practices for Aerospace Fiber Optic Cable Plant Installation Design."

6. JFOWG sponsored a government-industry workshop that resulted in a 2010 conference publication at the 30th AIAA/IEEE Digital Avionics Systems Conference, *Military and Aerospace Standards for Digital Avionics Fiber Optic Systems*. This workshop and publication included input from all relevant aerospace fiber optics standards bodies responsible for writing military, SAE, EU, and ARINC aerospace fiber optic standards.

Outcome

JFOWG routinely uses the chart shown in Figure 1 to summarize how JFOWG impacts the DoD aviation platform life-cycle cost. The military standards and specifications for *fiber, cable, connector, termini, and splice* and SAE standards for *cable assemblies* are expected to help, or have helped, to reduce DoD aviation platform life-cycle cost by reducing program office exposure to parts obsolescence and increasing parts supportability, maintainability, reliability, performance (for the splice and cables), durability, quality, installation, testability, and interoperability.

Figure 1. JFOWG-Derived Life-Cycle Cost, Total Ownership Cost Avoidance, and Savings Summary



The SAE standards for loss budget methodology and specification are helping to reduce the DoD aviation platform life-cycle cost via increased fiber optic system performance and reliability. The fiber, cable, connector, termini, and splice parts specified in the military specifications are also intended to reduce the logistics footprint by minimizing the number and type of parts to maintain in the fleet. This also affects other logistics resource costs such as fleet training costs and support equipment costs.

Finally, the creation of the NAVAIR 01-1A-505-4 fleet/field maintenance manual has significantly reduced the amount of funding that program offices are required to spend to develop fiber optic maintenance plans, maintenance and troubleshooting procedures and publications, and fleet/field technician training plans. This existence of the NAVAIR 01-1A-505-4 maintenance manual, and the fiber, cable, connector, termini, and splice parts specified in the military specifications, has significantly reduced the ability of prime contractors to insert expensive proprietary, sole-source, and non-obsolescence-proof solutions into the DoD aviation acquisition infrastructure.

Current Status

The military fleet/field maintainer routinely uses the NAVAIR 01-1A-505-4 to 1-1A-14-4 TM 1-1500-323-24-4 "Installation and Repair Practice Aircraft Fiber Optic Cabling" technical manual. Prime contractors are now fully aware of this publication and no longer lobby to create and sell their own proprietary manuals. MIL-STD-1678 is now being applied as a requirement on new DoD aviation acquisition programs. Fiber optic cable, connector, and termini suppliers are now engaged to qualify their parts against the new military specifications. Prime contractors have accepted the new military splice standard and SAE loss budget methodology and specification standards. AS5675 and AS6021 have harmonized DoD aviation fiber optic cable assembly requirements.

Challenges

A lack of funding and support via a Congressional budget line item to JFOWG has been and continues to be the largest barrier to completing the standards and verifying or validating the standards through laboratory testing and parts qualification. This has been overcome within JFOWG via the individual services and agencies providing their own support to individual civilian subject matter expert employees at Air Force, DLA, and Navy (NAVAIR and NAVSEA).

About the Award Winner

The team included Mark Beranek (representing the Joint Fiber Optic Working Group) and Mary McWilliams (representing the Defense Logistics Agency), who acknowledge the leadership and management support from their service and agency; for without this support, their participation in the JFOWG fiber optic standardization process would not have been possible. They also acknowledge technical support from suppliers and contractors. Many DoD and non-service/agency people and organizations have supported the aviation standardization work initiated by JFOWG.

NAVAIR's Mark Beranek has chaired or co-chaired JFOWG since 2009. His JFOWG chairman predecessor from 2003 to 2009 was Michael Hackert. Mr. Beranek has participated in Fiber Optic Working Group meetings since 2002. Also since 2002, he has served as fiber optics engineering lead on the F/A-18 program and the E-2D program. From 2002 to 2008 he chaired the SAE AS-3 Fiber Optic Components Committee. He specifically initiated the creation of SAE AS5675, AS6021, and AS5750A standards, and the initial update to NAVAIR 01-1A-505-4. Mr. Beranek also provided technical inputs to MIL-STD-1678, MIL-PRF-24623, and SAE AS5603A. He continues to actively advocate qualification of the new military standardized fiber optic parts (cables, connectors, splice, and termini) on behalf of DoD aviation.

DLA's Mary McWilliams has participated in JFOWG since joining the fiber optics group in November 2012. Her DLA predecessors were Eugene Ebert and David Leight (both now retired). Ms. McWilliams is responsible for developing and maintaining fiber optic standardization documents as well as providing technical guidance for the fiber optic documents and non-government standards. She is the preparing activity for more than 130 fiber optic documents. She interfaces closely with the Navy, Army, Air Force, and NASA in efforts to establish new specifications and maintain existing specifications. Her contributions have been impressive in her short tenure as the DLA fiber optic standardization professional. She continues to create new fiber optic standardization documents as well as revise current documents.

Program News

Topical Information on Standardization Programs

Spring PSMC Meeting Held in DC

The Spring Parts Standardization and Management Committee (PSMC) meeting was held April 25–27, 2017, in the Washington, DC, area, with 50 participants from government and industry attending.

Rob Gold, the director of engineering enterprise, gave the keynote address. During the plenary session, presentations were given on a variety of parts management-related topics, such as industry standards affecting parts management, counterfeit parts, obsolescence, lead-free solder, use of automotive parts in military and aerospace applications, copper wire bonds, and semantic web for interoperable specifications and standards.

During the breakout sessions, the PSMC subcommittees worked on tasks related to parts management procedures and contracts, parts management implementation guidance, counterfeit parts and risk mitigation, and parts management tools and data.

The Fall PSMC meeting will be held October 31 to November 2, 2017.

Events

Upcoming Events and Information

June 5–9, 2017, Denver, CO

AIAA Aviation Forum

The AIAA Aviation and Aeronautics Forum and Exposition is the only aviation event that covers the entire integrated spectrum of aviation business and technology. Twelve technical conferences and a new demand for an UAS symposium in one location make this a must-attend event in 2017! Industry, academia, and government leaders will share their perspectives on the new challenges, future opportunities, and emerging trends in the global aviation industry. Plenary sessions examine some of the most critical issues in aviation today. The Forum 360 panel discussions build on the themes and discussions of each day's opening plenary session, adding a layer of content and context that enhances the value of your forum experience. An innovative and extensive technical program provides the latest in innovative research and developments that will drive advancements in aviation. For more information, go to http://www.aiaa-aviation.org/program/.

December 4–7, 2017, Tampa, FL

DMSMS 2017 Conference: Managing Obsolescence Risk—How to Optimize Budget, Schedule, and Readiness

You are invited to attend the Diminishing Manufacturing Sources and Material Shortages (DMSMS). Qualified attendees (active U.S. military, government, or current DD2354 on file) also will be able to attend the concurrent Defense Manufacturing Conference (DMC) at no additional expense, giving you access to more technical information for the same travel cost. The expanded Exhibit Hall will include all of the leading organizations from both the DMC and DMSMS communities. More information can be found at http://www.dmsmsmeeting.com.

Upcoming Issues
Call for Contributors

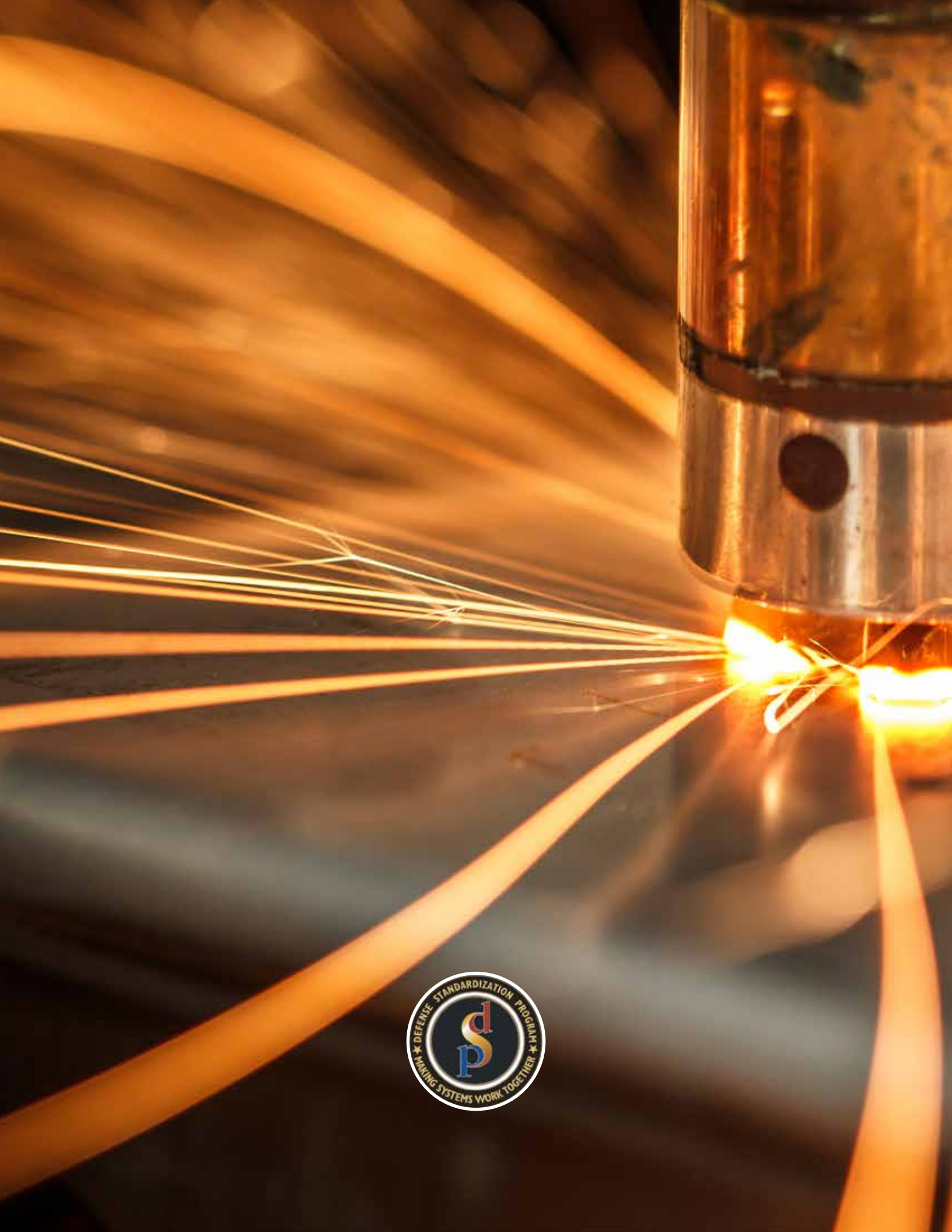
We are always seeking articles that relate to our themes or other standardization topics. We invite anyone involved in standardization—government employees, military personnel, industry leaders, members of academia, and others—to submit proposed articles for use in the *DSP Journal*. Please let us know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

Following are our themes for upcoming issues:

Issue	Theme
July/September 2017	Warfighter Support
October/December 2017	Diminishing Manufacturing Sources and Material Shortages

If you have ideas for articles or want more information, contact Nicole Dumm, Editor, *DSP Journal*, Defense Standardization Program Office, 8725 John J. Kingman Road, STOP 5100, Fort Belvoir, VA 22060-6220 or e-mail DSP-Editor@dla.mil.

Our office reserves the right to modify or reject any submission as deemed appropriate. We will be glad to send out our editorial guidelines and work with any author to get his or her material shaped into an article.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