Defense Standardization Program

Journal

April/June 2010

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Defense Standardization Program Journal

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Director's Forum

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

Individuals and teams are nominated for standardization awards, and we identified six as being particularly deserving of recognition. Through their efforts, sometimes taking several years, the six winners have played an integral part in keeping our men and women in uniform safe and in providing them the tools they need to get the job done.

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 FY09 award winners.

Congratulations to all of our award winners. I know that DoD leadership appreciates your work. These 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 money for the taxpayer. I hope that reading about their accomplishments will pique your interest and might even inspire you to submit an award nomination on the good work you are doing in standardization.

Gregory E. Saunders
Director
Defense Standardization Program Office

DPMP Defense Parts Management Portal

Defense Parts Management Portal–DPMP

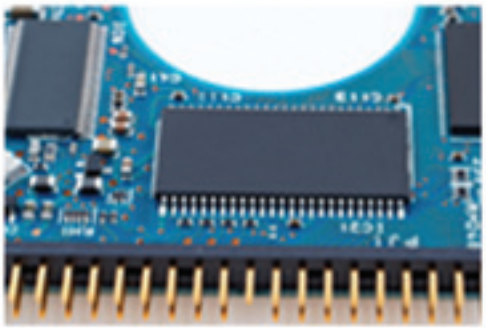
The DPMP is a new public website brought to you by the Parts Standardization and Management Committee (PSMC) to serve the defense parts management community.

The DPMP is a new resource, a new marketplace, and a "one-stop shop" for parts management resources. It is a navigation tool, a communication and collaboration resource, and an information exchange. It gives you quick and easy access to the resources you need, saves you time and money, connects you to new customers or suppliers, and assists you with finding the answers you need.

This dynamic website will grow and be shaped by its member organizations. A new and innovative feature of the DPMP is its use of "bridge pages." Organizations with interests in parts and components are invited to become DPMP members by taking control of a bridge page. Chances are good that your organization is already listed in the DPMP.

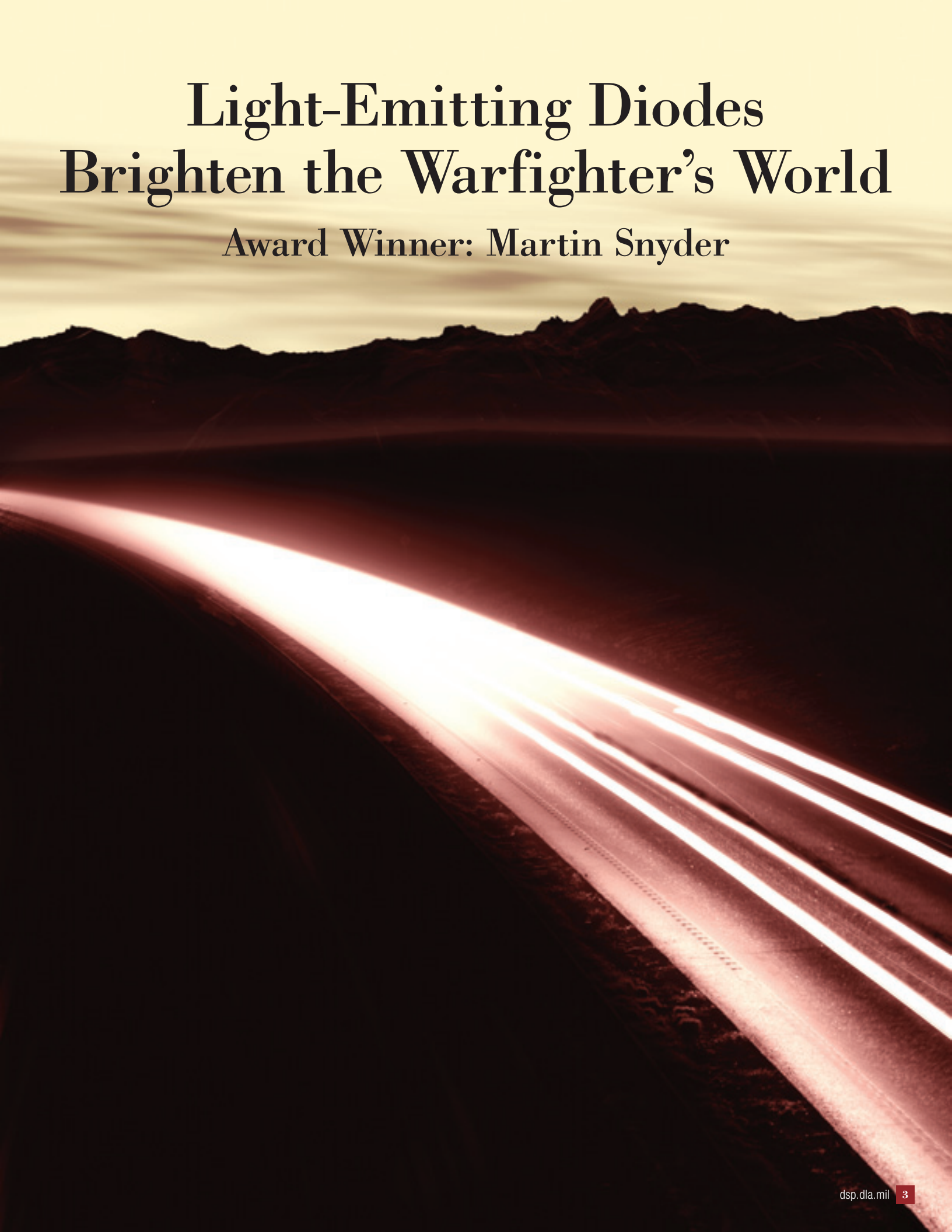
There is no cost.

Explore the DPMP at https://dpmp.lmi.org. For more information, look at the documents under "Learn more about the DPMP." Click "Contact Us" to send us your questions or comments.



Light-Emitting Diodes Brighten the Warfighter's World

Award Winner: Martin Snyder



Martin Snyder, from the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC), conceptualized, designed, developed, tested, and attained final production certification for the world's first 24-volt military vehicle headlamp using only light-emitting diodes (LEDs). The LED headlamp is a direct replacement (form, fit, function) of the standard 1930s-design 12-volt incandescent headlamp seen on military vehicles. The LED headlamps are much brighter than the old lamps, significantly reducing the danger to our warfighters; soldiers can clearly see—and avoid—obstacles like gullies and soft sand, as well as things like roadside bombs. The LED headlamps are designed to last the lifetime of the vehicle, in stark contrast to the older lamps, which have a short lifetime (nominally, 100 hours). Because vehicle systems are designed to last for 20 years or more, the recurring cost of the old lamps (about $12) outweighs the one-time cost of the LED lamps (about $150). Another benefit of Mr. Snyder's work is that the military will be able to eliminate the hybrid (12-/24-volt) electrical systems used on vehicles to power the 12-volt incandescent lamps. By standardizing on 24-volt components, the military can reduce the complexity of vehicle electrical systems and improve logistics supportability.

Background

Specifications call for 24-volt electrical systems on military vehicles for reasons of loads and electrical current. In addition, NATO has a 24-volt interoperability requirement for military vehicles. However, 24-volt incandescent lamps have short burn lives and are vibrationally fragile. The problem is exacerbated by the stiffness of military vehicle suspension systems and the varying terrain types that the vehicles may traverse.

To address the problem of continually failing 24-volt headlamps, military vehicle designers have, for the past 20 years, added 12-volt electrical systems just for lighting. With a multivolt (12/24) electrical system, vehicles can meet military and NATO requirements while having a more robust headlamp. A 12-volt lamp is much less susceptible to vibration failure, because its filament has a much thicker cross section than the 24-volt lamp filament.

The use of 12-volt lamps was the only technology-based solution available to improve lamp life. Still, they must be replaced frequently; nominally, every 100 hours. Moreover, the need for a hybrid electrical system—12-volt to power the lamps and 24-volt for all other vehicle power requirements—adds complexity to vehicle alternators, regulators, battery arrangements, and wiring. It also creates a difficult prob-

lem for the 24-volt trailer lighting hook-up (for NATO interoperability) for turn signals and brakes.

Problem/Opportunity

The military has long needed better and more reliable lighting for its vehicles. The introduction of LEDs—and the rapid and significant advancements in LED technology—offered an ideal technological solution. Properly engineered and constructed, LED external lighting is impervious to vibration failure.

In 2000, Product Manager, Heavy Tactical Vehicles (PM HTV), recognizing the potential of LEDs, selected Mr. Snyder as the lead engineer to develop, design, and qualify a whole new Army vehicle lighting system. Mr. Snyder began with the development of LED-based front turn/blackout, rear stop/turn/blackout, side markers in yellow/red, and blackout drive lights.

In 2002, Mr. Snyder turned his attention to the driving headlamp, which requires a very high-output white light. Developing such a headlamp using existing LEDs posed a formidable technical challenge, because at the time, no one had ever made an LED white-light driving lamp. There were no road maps to success.

Approach

PM HTV broke the development program into three separately funded stages: concept development (Phase 1), prototype/preproduction testing (Phases 2 and 3), and trial production (Phase 4). Funding for each subsequent stage depended on the successful completion of the previous stage.

CONCEPT DEVELOPMENT

As the base requirements standard for the military vehicle headlamps, Mr. Snyder selected Federal Motor Vehicle Safety Standard 108, backed by the testing requirements and enforcement of the National Highway Traffic Safety Administration, along with a few military-unique requirements for testing.

Initially, the goal was to make a 12-/24-volt LED driving lamp that would operate on multivolt vehicle electrical systems. Mr. Snyder created the scope of work with its detailed requirements and testing, obtained initial financing, and awarded a contract for concept lamps. After viewing the initial Phase 1 concept lamps, Mr. Snyder was convinced that making a 7-inch-round military LED driving lamp was a "definite maybe."

The initial testing found that the 12-/24-volt concept was not technically feasible with the then-current state-of-the-art electronics, but the single 24-volt driving lamp was thought to be technologically achievable.

PROTOTYPE/PREPRODUCTION TESTING

The contractor produced about 80 24-volt prototype lamps for Phase 2 testing and evaluation. Mr. Snyder insisted on having serial numbers and on keeping good records of test data, including driver comments.

Test lamps were installed on vehicles used at Yuma Proving Grounds, AZ, National Testing Center, NV, Cold Region Testing Center, AK, Aberdeen Test Center and Electromagnetic Interference (EMI) Laboratory, MD, and National Training Center, CA, as well as at the Oshkosh Truck Facility, WI. Mr. Snyder also sent test lamps to the U.S. embassy in Panama, which coordinated installation of the LED lamps on High Mobility Multipurpose Wheeled Vehicles (HMMWVs) and round-the-clock testing in the Panama jungles for 3 months. The purpose of testing the lamps in so many diverse environments was to make them fail, that is, to find every weakness in the Phase 2 design.

Three days into the testing in Panama, Mr. Snyder received a report from one of the drivers: "stunning…this is the first time I drive a HMMWV at night in the jungle with confidence." Over the next 1½ years, Mr. Snyder talked with more than 60 drivers. Their unanimous opinion was that the very white, clean, crisp LED light output significantly enhanced night driving.

At the end of the 1½-year prototype testing period, Mr. Snyder recovered the Phase 2 lamps—nearly all of which had failed—and, over the next year, carefully evaluated them for failure modes and weaknesses. He then developed design solutions to address each weakness. At that point, he was confident that the LED headlamps were dependable and ready for testing and evaluation in Iraq.

Thirty-two Phase 3 driving headlamps were mailed to soldiers in Iraq for their important feedback. It took only 3 days. The soldiers submitted a field request for 500 LED lamps to equip all Army vehicles that nightly traverse the desert road from Kuwait to Baghdad. Because of their brightness, the new LED headlamps sped up road travel at night and gave great clarity to obstacles in the road.

PRODUCTION

To meet the field request, production of the new 24-volt LED lamps started immediately. Six months later, the 500 headlamps were on the contractor's shipping dock heading for

Iraq. During those 6 months of getting the production line set up, the Marines were seeing the 32 Phase 3 test lamps on vehicles driving around in Iraq. The Marines "acquired" most of the Army's 500 LED driving headlamps when they arrived in Iraq.

RELATED ACTIVITIES

To ensure standardization across all vehicle systems, Mr. Snyder co-authored and published five new performance specifications for exterior LED vehicle lighting. The last specification—MIL-PRF-32243, "Light Emitting Diode (LED) Military Driving Headlamp"—was published in March 2009.

Mr. Snyder continued working on a 12-volt LED driving headlamp and, due to advancements in LED technology, successfully completed its development in March 2009. This 12-volt headlamp, intended for Mine Resistant Ambush Protected (MRAP) Caiman vehicles and for medium tactical vehicles, will be in production in the near future.

Mr. Snyder also determined that LED headlamps could be used as flood, spot, and auxiliary lamps simply by changing the optics of the lamp lens cover. Such lamps—called "360 degree lighting," or route clearance lighting—have already been made available in a "kit" form for MRAP vehicles. These lamps are also used for road checkpoints and inspections.

Outcome

The successful development of the LED headlamp completes the suite of external LED lighting for military vehicles. The headlamp, available in either a 12-volt or 24-volt version, is a direct replacement (form, fit, function) for the 100-hour incandescent lamp. To date, more than 100,000 LED driving headlamps have been fielded in Iraq and Afghanistan.

The use of LED vehicle headlamps significantly reduces the danger to our warfighters. Because the color "temperature" of the LED lamp is near that of the sun's white light, soldiers have two to three times more viewing distance than they have with the old 100-hour lamps. More important, soldiers can clearly see—and avoid—obstacles like gullies and soft sand, as well as things like roadside bombs. With the old lamps, shadows make it difficult to see obstacles; for example, gullies may be lost in shadows that the old lamps cannot penetrate. In short, convoys can travel much faster, and far more safely, when the vehicles have LED headlamps.

The new headlamps also enable soldiers to see and then "blind" enemy soldiers in a firefight. Furthermore, because the LED headlamp is made up of 10 individual diodes

(lights), it is very difficult to disable the lamp by shooting all of the diodes; the record is seven lights hit with an AK-47 rifle.

Better logistics supportability and cost avoidance are other benefits of the new lamp. The LED headlamp is designed to last for the lifetime of the vehicle. In stark contrast, the old headlamp must be replaced about every 100 hours. It is difficult to quantify the cost avoidance. However, in the past, the Defense Logistics Agency was purchasing 80,000 100-hour headlamps per year. Since the LED headlamp was introduced, it is reasonable to assume that the number of old headlamps being purchased annually has declined considerably. To put it another way, 100-hour headlamps are a recurring cost (about $12 per lamp) for a vehicle system, while the LED headlamps (about $150 per lamp) are a one-time cost. Because vehicle systems are designed to last for 20 years or more, the recurring cost of the old lamps is significant, outweighing the one-time cost of the LED lamps.

With the availability of the 24-volt-only LED lamps, the military can eliminate the hybrid (12-/24-volt) electrical systems used on vehicles. To date, the electrical systems on two vehicle platforms—Heavy Expanded Mobility Tactical Truck (HEMTT) and Palletized Load System (PLS)—have been converted from 12-/24-volt to standard 24-volt-only systems. Moreover, the HEMTT and PLS platforms now have common shared 24-volt electrical parts. The conversion to a pure 24-volt system reduces complexity, and the use of standardized parts has innumerable benefits, including a reduced logistics footprint, increased interoperability, and reduced costs. The savings are incalculable.

Current Status

One by one, military vehicle platforms are adopting the full suite of TARDEC-engineered standard LED lighting solutions, including the LED headlamps.

Competition is expanding as more LED lighting suppliers are looking for opportunities in the "military lighting" business. Mr. Snyder is currently working with three new potential LED headlamp suppliers.

Challenges

During Phase 2 testing, Mr. Snyder faced five technical problems that needed to be addressed before Phase 3 lamps could be produced and tested:

- *Inaccurate light output color.* The light output color of the Phase 2 lamps lacked enough red (white light comprises *all* colors), which lets one see, for example, a stop sign at night. The diode manufacturer solved the problem by introducing more semiconductor doping (chemical mix) into the base white output diode.

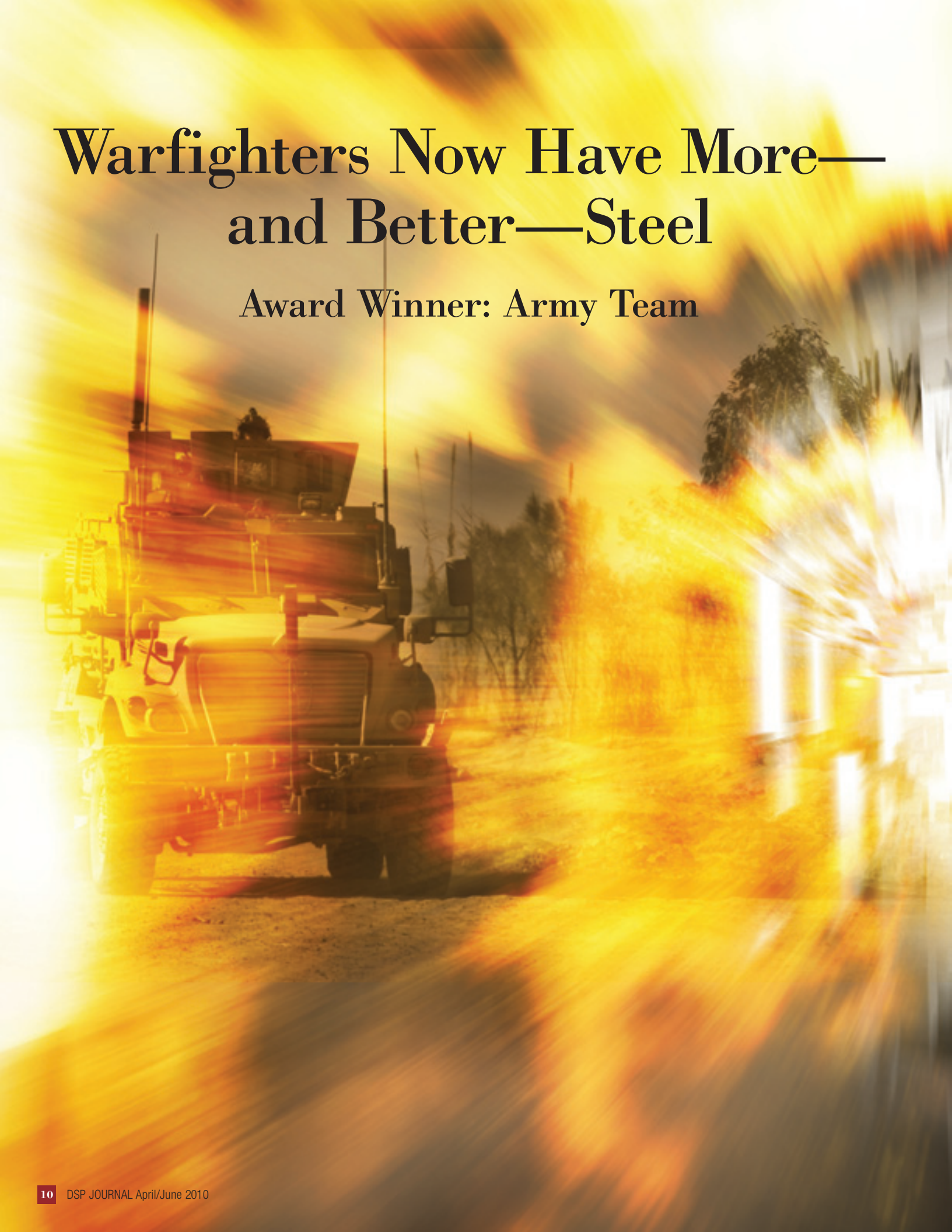
- *Thermal issues.* During the 1½ years of prototype testing, the LEDs often failed because of overheating. Hardening of thermal subcomponent electronics eliminated the problem. Furthermore, the potential for additional thermal problems was reduced when issues related to optical intensity and EMI were addressed.
- *Insufficient optical intensity or brightness.* Initially, the headlamps were built using 12 diodes at 28 lumens per diode. However, due to the rapid advances in diode technology—the light output rating for a given LED has doubled about every 9 months—the lamps now in production use 10 diodes at 190 lumens each. As the diode light output increases, less heat is produced and less electrical current is needed, making the lamp extremely efficient.
- *Electromagnetic interference.* EMI was an issue for LED lamps with a multivolt (12/24) operational range. The problem was resolved by giving up (at least temporarily) on having a multivolt operational range. Concentrating on only a 24-volt lamp fixed both the EMI and some thermal issues at the same time.
- *Lens fogging.* In some of the later Phase 2 tests, Mr. Snyder began seeing fogging or coating on the inside of the headlamp lens. Chemical analysis determined that the coating was caused by a fatty acid. The problem then became one of determining which of the 28 chemical compounds inside the light assembly was the source of the fatty acid. Any single or combination of compounds could cause this problem when heated by the lamp circuitry. After considerable testing, the coating was attributed to imperfectly mixed epoxy components.

About the Award Winner

Martin Snyder is an electrical engineer on "Team TECS," a component of the Engineering Business Group at TARDEC. He has been dedicated to improving the soldier's safety and enhancing the night mission capabilities of military vehicles through improved lighting. His work on the LED headlamps is an outgrowth of his earlier work on other LED vehicle lighting systems. Through his engineering leadership, guidance, and persistence, Mr. Snyder succeeded in developing and testing LED vehicle headlamps and bringing them to production. Throughout the program, he provided requirements, specific design parameters, and vehicle/soldier testing environments.

Warfighters Now Have More—and Better—Steel

Award Winner: Army Team



An Army team from the Weapons and Materials Research Directorate (WMRD), U.S. Army Research Laboratory (ARL), undertook a project to increase the availability and capability of steel armor materials that could be used on military platforms. The reliance on outdated specifications using obsolete manufacturing technologies and inadequate requirements was hindering production and preventing the use of newer and better materials, such as armor as thin as 2.5 mm and a new class of air-cooled, auto-tempered high-hardness steels. Ballistic specifications also needed to be updated. To address these and other concerns, the team overhauled three major armor steel specifications and developed two new specifications (perforated homogeneous steel armor plate and ultra-high-hardness wrought-steel armor plate). The team's work made it possible to expedite the procurement of armor for more than 14,000 vehicles. Furthermore, the new specifications and new classes of materials better address current industrial practices, ensuring that the Army is getting an adequate supply of high-quality armor steel produced by the most effective processing available.

Background

Steel armor has been used by the U.S. armed forces for more than 100 years for numerous diverse applications ranging from the construction of main battle tanks to quality assurance testing of ammunition. Until standardization reform (1995), procurement documents were revised and updated continually. Since then, however, few documents have been updated due to the lack of funding, even though the technology for making steel evolved rapidly in the last 15 to 20 years. Three major armor steel specifications were of particular concern:

- MIL-DTL-12560, "Armor Plate, Steel, Wrought, Homogeneous (for Use in Combat-Vehicles and for Ammunition Testing)." Base document MIL-S-12560 was published in March 1953, with 19 subsequent revisions, amendments, or notices.
- MIL-DTL-46177, "Armor, Steel Plate and Sheet, Wrought, Homogeneous (1/8 to Less Than 1/4 Inch Thick)." Base document MIL-S-46177 was published in July 1978, with 8 subsequent revisions, amendments, or notices.
- MIL-DTL-46100, "Armor Plate, Steel, Wrought, High-Hardness." Base document MIL-S-46100 was published in August 1965, with 13 subsequent revisions, amendments, or notices.

In addition, new documents were needed to address new types of materials:

- Perforated homogeneous steel armor plate
- Ultra-high-hardness wrought-steel armor plate.

Problem/Opportunity

The lack of up-to-date specifications for armor steel became a problem when the Army and Marine Corps embarked on a priority program to field Mine Resistant Ambush Protected (MRAP) vehicles. Issuance of several production contracts led to an increase in demand for armor steel. However, the U.S. steel industry did not have the production capacity to meet the demand, particularly for quenched and tempered wrought plate, leading to a significant shortfall of metals for fabrication of the MRAP and MRAP II vehicles. The additional demand for perforated steel armor plates also strained steel production capacity.

Another problem was that the specifications contained outdated ballistic tables, putting our warfighters at risk. Specifically, the tables sometimes led testers to reach false conclusions about the performance of the materials being tested, potentially resulting in the rejection of good materials and the acceptance of poor materials.

Program Executive Office, Combat Support and Combat Service Support, recommended that ARL be brought in to DoD Priority Allocation of Industrial Resources meetings to assist with analyzing the shortfalls in the production capacity of U.S. steel facilities, mitigating some of the technical issues, and increasing the availability of metals for MRAP and MRAP II vehicles.

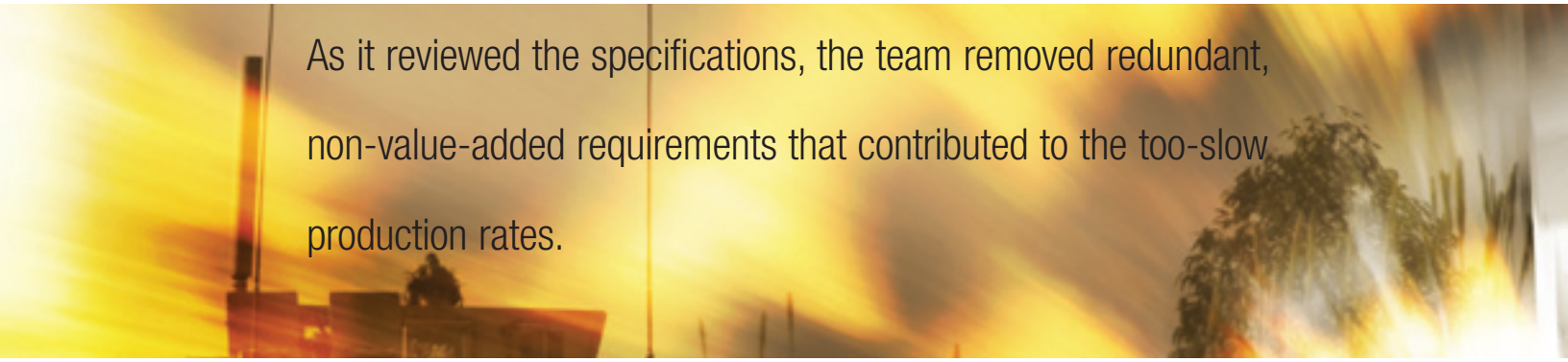
ARL recommended that the armor steel specifications be overhauled to include state-of-the-art materials, technologies, and capabilities, as well as to remove obsolete technology. Redundant, non-value-added requirements also needed to be removed so that a high-quality low-cost material can be produced at a high rate. In addition, ARL recommended the development of a specification for ultra-hard armor steel and for perforated homogeneous armor steel. Finally, ARL recommended the generation of new ballistic acceptance tables based on the use, in ballistic tests, of newer projectiles rather than World War II–era projectiles that are no longer available or are in short supply.

Approach

ARL formed a team within WMRD to address the problems with the armor steel specifications. The primary issue for MRAP metals procured under military specifications was the availability of U.S. quench-and-temper facilities that could produce military-specified wrought-steel armor plate. Related to this issue were procurement regulations that either limited or prioritized metal supplies. In particular, the "Berry amendment" places restrictions on the procurement of specialty metals, and the "DX" rating, which indicates "highest national defense urgency," prioritizes the use of metals.

Because of the critical need for expedited production of armor steel to support Army and Marine Corps operations, the team began by reviewing changes requested by industry in response to a DoD request to increase available steel production in support of the MRAP and other armored vehicles. After considering the requested changes, the team published interim amendments to MIL-DTL-12560 and MIL-DTL-46100 to meet the need in the short term. The interim amendments significantly increased the production of armor steel and thereby reduced the projected armor steel shortfall for MRAP and other armored vehicles. Steel production at Oregon Steel alone increased an estimated 30 percent. Because Oregon Steel represents a solid one-third of the U.S./Canada steel capacity, the changes addressed in the amendments were significant.

After publishing the interim amendments, the team undertook an in-depth review of the specifications and worked with industry to identify state-of-the-art materials, technologies, and capabilities that would better satisfy military requirements for armor steel. Among other things, that effort resulted in the development of a new class of air-cooled, auto-tempered high-hardness steel. The team incorporated this new class into the specifications as a Class 2 high-hardness armor steel. Inclusion of this new class in the specifications immediately reduced capacity issues with quench-and-temper facilities.



Another example of the team's work concerned the need for military-specification plate as thin as 2.5 mm. To address this need, the team incorporated changes in the specifications to allow production of thinner armor plate from coil versus flat plate. The team also modified the ballistic tables for thinner plate. These changes brought U.S. specifications in line with European specifications for thinner plate.

As it reviewed the specifications, the team removed redundant, non-value-added requirements that contributed to the too-slow production rates. For example, MIL-A-12560H required multiple hardness measurements on each steel plate, which often created a bottleneck for production. However, because a continuous plate-production process results in remarkably uniform plate, extra hardness measurements are redundant.

Therefore, the team revised the specification to require only one hardness measurement for continuous plate-production processes. This was one of many changes made to the armor steel specifications that allowed an increased production rate. That, in turn, allowed the MRAP vehicle production schedule to be met.

To the extent possible, the team replaced military standards with industrial standards such as those published by the American Society for Testing and Materials. Not only is this practice recommended by DoD, but is also preferable from a production standpoint, because steel producers are more familiar with the industrial standards than with military standards. The team also recognized the importance of making the armor steel specifications as similar as possible, so that they would be easier to understand, in turn, making it easier for a producer to shift from one type of armor steel to another.

In addition to overhauling the three major steel specifications, the team developed a new performance specification for perforated homogeneous steel armor, along with a purchase description for immediate use by the U.S. Army Training and Doctrine Command. It also developed a new specification for ultra-high-hardness armor plate.

The team fully coordinated the draft documents with all the armor steel producers. The priority review of the main specifications resulted in the need for additional testing to generate new ballistic velocity acceptance tables.

Outcome

The Army team completed its work on the three existing armor steel specifications in July 2009:

- MIL-DTL-12560. The team published an interim amendment (MIL-A-12560H Interim Amendment 4) in July 2007 and a revised version of the specification (MIL-DTL-12560J) in July 2009. The revised version incorporated changes from the interim amendment, new classes of material for additional applications, and pertinent requirements from MIL-DTL-46177.
- MIL-DTL-46177. The team published an inactivation notice (MIL-DTL-46177C Inactivation Notice 1) in July 2009. The inactivation notice allows this specification to be used for replacement purposes only.
- MIL-DTL-46100. The team published an interim amendment (MIL-A-46100D Interim Amendment 2) in July 2007, an amendment to Revision E (MIL-DTL-46100E Amendment 1) in October 2008, and an administrative notice (MIL-DTL-46100E, Administrative Notice 1) in February 2009.

The team also published two new specifications:

- MIL-PRF-32269, "Perforated Homogeneous Steel Armor," published in October 2007.

- MIL-DTL-32332, "Armor Plate, Steel, Wrought, Ultra-High-Hardness," published in July 2009. This specification can be used for lightweight armor applications as an appliqué and as a welded nonstructural plate, if welded by special techniques.

Upgrading and developing new specifications—including modified and new classes of armor steel materials, as well as improved ballistic specifications—made it possible to expedite the procurement of armor for more than 14,000 vehicles. Furthermore, the new specifications and new classes of materials better address current industrial practices, ensuring that the Army is getting an adequate supply of high-quality armor steel produced by the most effective processing available.

Three of the top 10 winners of the U.S. Army Greatest Inventions Program for 2008 used these armor steel specifications. The three winners were Overhead Cover for Objective Gunner Protection Kit, Mine Resistant Ambush Protected Armor Weight Reduction Spiral Program, and Mine Resistant Ambush Protected Expedient Armor Program Add-On Armor Kit. The steel specifications were also critical in the U.S. Army Greatest Inventions Program for 2006 for the Interim Fragment Kit 5 for the M1114/M1151 High Mobility Multipurpose Wheeled Vehicle tactical trucks.

The bottom line? Our warfighters are safer.

Current Status

The steel armor plate produced using the upgraded and new specifications (more than 600 tons of perforated plate alone) has been applied on more than 14,000 vehicles. The vehicles include the following:

- MRAP Expedient Armor Program (RG-33, Cougar) and MRAP II vehicles
- Route-clearing vehicles (Cougar, Joint EOD Rapid Response Vehicle, Buffalo)
- Legacy combat vehicles (Stryker, M1A2 Abrams)
- Up-armored tactical trucks with add-on armor capability (M1151, M915A5, Family of Medium Tactical Vehicles A1P2, Heavy Expanded Mobility Tactical Truck A4)
- Future production vehicles (Joint Light Tactical Vehicle, MRAP All Terrain Vehicle).

Challenges

Funding was the biggest problem associated with revising and developing new steel armor plate specifications. ARL requested, but did not receive, standardization funds in FY08 and FY09. Ultimately, ARL reprogrammed its FY08 and FY09 standardization funds to support this critical effort. In addition, ARL received funding from the MRAP Program for the purchase of armor material and the development of the mechanical and ballistic data required for each of the documents.

About the Award Winner

The Army team consisted of Richard Squillacioti, William Gooch, Matthew Burkins, Jonathan Montgomery, and Kirk Stoffel, all from the U.S. Army Research Laboratory's Weapons and Materials Research Directorate.

Richard Squillacioti, a material engineer from the WMRD Specifications and Standards Office, led the standardization effort, which included initiating standardization projects for each of the required actions through to the final publication of each document. Mr. Squillacioti coordinated multiple drafts of the documents with industry and government representatives. He also reviewed and documented all the comments about the drafts and presented each comment to the team, which jointly determined whether to accept or reject it.

William Gooch, a materials engineer, took the lead to obtain funding from the MRAP Program, and he developed the communication link between ARL, program managers, original equipment manufacturers, and industry. Mr. Gooch conducted first-article ballistic testing and certification for new steel armor producers and participated in the inspection of new steel production facilities in the United States and overseas.

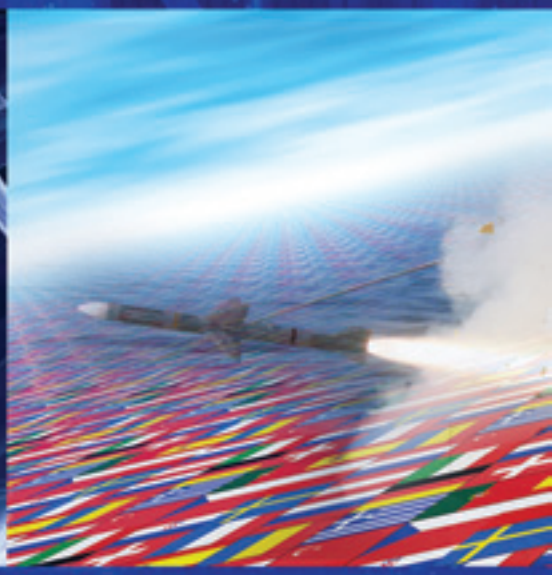
Matthew Burkins is a mechanical engineer. He took the lead and was responsible for developing all of the ballistic performance data and calculating the ballistic acceptance requirements for each of the documents. Mr. Burkins participated in all of the working group meetings that took place to review and evaluate the comments received during the coordination of the specifications.

Jonathan Montgomery, a materials engineer, was responsible for the process control requirements and metallurgical properties of each specification, including the chemistry limits, carbon equivalence, hardness and toughness requirements for each class of material, minimum tempering temperatures, and product tolerances. Dr. Montgomery also inspected new steel armor production facilities in the United States and overseas.

Kirk Stoffel, a mechanical engineer, was the main motivator in the development of the purchase description and, ultimately, the performance specification for perforated homogeneous steel armor (MIL-PRF-32269) needed by the U.S. Army Tank Automotive Research, Development and Engineering Center for use in MRAP and other armored vehicles. Mr. Stoffel was instrumental in the review and evaluation of the comments received during the coordination of this specification.

"Flex" Factory Improves Missile Production

Award Winner: Navy Team



A Navy team from the NATO SEASPARROW Project Office (NSPO) has created a common set of test equipment that can be used by all missile testing facilities, including the Raytheon Missile Systems factory, intermediate-level maintenance facilities (ILMFs), and the all-up-round (AUR) facility. The team consolidated AUR and guidance-section testing into one test set for the entire portfolio of surface weapons, including all variants of the Standard Missile, the Evolved SEASPARROW Missile (ESSM), and the Rolling Airframe Missile (RAM). By using common test equipment and common procedures across the U.S. Navy missile family, the team was able to create a "flex" factory in which all Navy surface-to-air missiles can be processed on the same equipment base for subassembly, guidance-section, AUR, and intermediate-level recertification. The result has been a doubling of final test yields, a demonstrated doubling of maximum surge capacity, and a 50 percent increase in steady-state throughput. The team's work resulted in an immediate $40 million cost avoidance and approximately $8 million in annual recurring costs. In the long term, the savings to the missile community are almost immeasurable.

Background

Missile test sets have long been the Achilles' heel of production. Consisting of banks of equipment filling entire rooms, these specialized equipment suites are subject to obsolescence, are largely custom built, and drive a significant portion of production costs through floor space, manning, and maintenance requirements, as well as their limited throughput.

As a result of decreasing test-set availability and increasing costs, the ESSM production and sustainment management teams embarked on a campaign to consolidate common processes and equipment across the family of U.S. Navy self-defense missiles. The strategy was to eliminate all unique test equipment from the program and to consolidate as many functions as possible into a single flexible and maintainable test suite capable of testing the Navy's family of missiles from the AUR level to the subcomponent level. This approach would also allow for the standardization of testing procedures, work instructions, and failure data to aid in reliability improvement efforts.

Problem/Opportunity

As the production levels of missiles have decreased in the past decade, numerous programs have struggled to maintain the right level of missile production in order to maximize the benefit of volume purchases. As quantities have decreased, unit costs have risen and investments in infrastructure have become more difficult to justify and fund. The result has been an aging infrastructure that has begun to fail repeatedly, interrupting production. At the same time, the prime contractor and maintenance facilities have been unable to retain sufficient "legacy" skill sets to maintain the equipment.

The ESSM program is no exception. After falling behind production goals for 2 years, due largely to test equipment limitations, the ESSM suffered a significant production stop in spring 2008. Lacking sufficient funding, the program was required to exercise considerable creativity to restore production.

Without a major change to infrastructure and processes, the ESSM program, and potentially other missile programs, will be unable to meet fleet deployment requirements. The Program Executive Office (PEO), Integrated Warfare Systems (IWS), proposed a solution: establish a common missile factory. This factory would have one common missile production process and infrastructure, three base missile product lines, and a family of six missiles under production. All would be supported by a common infrastructure to create "virtual" production volume and common processes to improve worker performance and the transfer of learning.

Approach

NSPO established a team, including production and sustainment personnel, to implement the common missile factory initiative spearheaded by PEO IWS. Specifically, NSPO charged the team with establishing, at Raytheon Missile Systems (the major missile manufacturer in the United States), common processes and common components to ensure that minimum sustainability levels can be met, while also minimizing cost across the spectrum of missile programs.

The team began by leveraging Standard Missile and Japanese Maritime Self-Defense Force investments, with nonrecurring engineering funding from Turkey, to create a common ESSM test set (a combination of the Mk 698 and TE7698), allowing the old unreliable test sets to be eliminated. The immediate result of the team's work was an increase in test-set availability. The team also standardized the test set for the guidance section and AUR onto a common core. The team then further consolidated vibration, "burn-in," and software load functions into the suite, eliminating additional single points of failure in production. The efforts of the team meant that for the first time, a standardized test set was available for deployment worldwide.

The production team quickly placed orders for the Mk 698 and its associated guidance-section test station (TE7698) for deployment to Camden, AR; Tucson, AZ; Seal Beach, CA; Canakkale, Turkey; and Orchard Hills, Australia. (Test sets may also be procured for deployment to El Ferrol, Spain, and Den Helder, The Netherlands.) With this worldwide network of standardized test sets, the family of allied self-defense missiles can be supported based on availability of the nearest test set rather than the nearest test set capable of testing the equipment.

All test sets that have been procured are capable of testing any configuration of ESSM. The test set configuration was contracted for the Camden, AR, AUR assembly facility, creating a flex factory that allows workers to build ESSMs or Standard Missiles using the same equipment based on demand, with the same work instruction systems and the same data systems. Common modal reliability analyses are now being conducted across the missile lines.

The team then turned its attention to subassembly testing. It coordinated with the Advanced Medium-Range Air-to-Air Missile (AMRAAM) program to consolidate fuse testing and radio-frequency component testing onto a single automated line pioneered by the Standard Missile. The payoff for that effort, an increase in throughput of up to 50 percent, was so impressive that the prime contractor agreed to consolidate remaining subassemblies using its own funds, with recovery of costs expected through accelerated delivery of production missiles.

Outcome

The payoff to the U.S. government has been immediate. The team's successful procurement and installation of the standardized test sets, which eliminated the need for test-set redesign due to obsolescence, resulted in an immediate $40 million cost avoidance. In addition, because of the deployment of the standardized test sets, seven obsolescent test suites were retired, recovering factory floor space and yielding approximately $8 million in annual recurring savings due to reduced operating and certification costs.

In May 2009, 45 ESSMs were delivered, doubling the previous monthly high. Guidance-section yields have increased to over 90 percent (and are still rising), and AUR test yields have improved from under 40 percent to over 80 percent. Steady-state throughput has been maintained for more than 6 months at 50 percent above the previous monthly high.

The savings that the team has passed on to the future leaders of the missile community are almost immeasurable.

Current Status

The NSPO team is continuing to manage the deployment of test equipment, which should be completed by 2012. It is also developing maintenance and infrastructure requirements for ESSM Block 2, an improved version of the Evolved SEASPARROW Missile.

A new configuration management model and a new business model are being implemented. The business model envisions that missile development efforts will fund produc-

tion test equipment modifications and that those modifications will be implemented automatically in all user suites. Installation in each suite will be funded by a modest annual service fee, obviating the need for expensive suite-specific modification and qualification efforts.

Challenges

The Navy team was challenged by the nature of the U.S. Navy's missile family, specifically, the existence of multiple, variably managed missile programs. As an example, the Standard Missile program is generally considered a U.S.-run program, while the ESSM and RAM programs are cooperative programs with different management structures. Although the Standard Missile program can implement unilateral decisions, the ESSM and RAM programs must reach consensus before implementing any decision.

Funding stability was another challenge, because the consolidation of test equipment was supported by multiple funding streams. Funding came from the Standard Missile, ESSM, and RAM programs, which were themselves facing unstable funding streams. This effort also took into account the AMRAAM program, which is managed by an Air Force–led Joint Systems Program Office, with the Navy component located in a different systems command.

About the Award Winner

The Navy team consisted of Don Hoffman, Jon Pieti, John Plews, Bruce Tuskey, and Fernando Omega.

Don Hoffman, the ESSM production director, oversaw and managed the team responsible for consolidating the test equipment and transitioning the resulting test set into a multiprogram test set capable of testing missiles at the AUR level, as well as at the component and subcomponent levels.

Jon Pieti, the ESSM production manager, was directly responsible for developing and implementing the plan to transition the Raytheon factory in Tucson, AZ, from numerous variable test sets (over 10 in all) to the standardized test set combining the Mk 698 (AUR) and the TE7698 (guidance section).

John Plews is the ESSM in-service support director. He developed and implemented the plan to transition the Raytheon ILMFs to the standardized test set.

Bruce Tuskey is the PEO IWS technical representative for ESSM in Tucson, AZ. He ensured the seamless transition to the new test equipment and managed the development and installation of the Mk 698 test set.

Fernando Omega, the production manager for the Navy's Standard Missile program, provided expert knowledge of ongoing infrastructure initiatives. Also, he was responsible for the alignment of ESSM efforts with those of the Standard Missile program.

Revolutionary pRFID System Improves Asset Visibility

Award Winner: Navy Team

A team from the Navy Automatic Information Technology Program Office (NAIT PO), a component of the Naval Supply Systems Command (NAVSUP), designed and is implementing a Passive Radio Frequency Identification (pRFID)-based system to support receipt-and-issue transactions for the entire Navy Department. The system consists of a centralized server repository at the Navy enterprise level and standardized equipment at the field activity level, along with standardized business and reporting processes. In addition, the Navy's pRFID system is integrated with DoD asset visibility systems. When fully implemented, the Navy's system will provide real-time visibility over assets as they move through the supply chain, enabling managers to make more informed operational decisions, as well as to expedite critical repair parts to the end user. The new system also will reduce the logistics footprint by, for example, eliminating the requirement for servers at hundreds of field activities. In addition, it will increase operational readiness as the time to deliver high-priority requisitions to the warfighter will be reduced. Finally, by implementing the new system, the Navy will cut supply chain logistics costs by at least $70 million and potentially nearly $1.8 billion over a 6-year period, according to the Government Accountability Office (GAO).

Background

The military services have limited access (let alone in real time) to basic information required for effective decision making concerning the end-to-end DoD supply chain. In fact, service supply chain data are scattered throughout myriad DoD databases, which are rarely integrated and not always accessible. Therefore, the Office of the Secretary of Defense, the U.S. Transportation Command (USTRANSCOM), and DoD agencies embarked on a joint program to implement pRFID technologies at asset receipt-and-issue operations throughout DoD. The primary purpose of this program is to improve visibility of DoD-owned assets as they move through the supply chain.

Problem/Opportunity

In support of the joint program, the Chief of Naval Operations tasked NAIT PO with designing and implementing a cost-effective and sustainable pRFID program that improves asset visibility across key components of the Department of the Navy's supply chain. As part of this effort, NAIT PO undertook the integration of all pRFID transactions into the variety of Navy warehouse automated information systems (AISs), along with the AIT enablement of 26 warehouse and inventory business processes at pending Navy enterprise resource planning (N-ERP) sites,

thereby generating even greater savings within the Navy supply chain. The specific goals were as follows:

- Enable pRFID at all Navy and Marine Corps receipt-and-issue operations, ashore and afloat
- Standardize pRFID integrations with 15 Navy AISs, including the new N-ERP program.

Approach

Considering that the Navy has more than 1,000 receipt-and-issue sites, which generate a huge volume of transactions, the Navy team quickly realized that only an enterprise approach to enabling pRFID would be cost-effective and sustainable over the long term. Moreover, an enterprise approach would significantly reduce the burden of complying with ever-changing information assurance (IA) requirements. In effect, NAIT PO concluded that it had to build the world's largest pRFID enterprise system.

With several successful Navy pRFID and AIT prototype efforts upon which to build, the Navy team designed a standardized three-tiered, real-time enterprise system that can accommodate pRFID transactions for the entire Navy Department and is interoperable with other DoD systems. The system has the following key features:

- *Centralized server repository at the Navy enterprise level.* The team's approach requires only a couple of servers at the enterprise level and eliminates the need for hundreds of servers and software licenses at the field activity level. This feature also supports a NAVSUP goal to reduce the overall number of servers. In addition, this feature completely removes the IA compliance burden from the field activities. Instead of pushing software patches to and conducting annual security scans on hundreds of field activity servers, meeting IA security requirements is reduced to a single event, thereby greatly reducing annual operating and sustainment costs.
- *Standardized equipment—both handheld scanners and fixed pRFID portals—at the field activity level.* After establishing required performance criteria, the team conducted extensive market research into a wide range of commercial devices. Ultimately, the team selected the Intermec CN3e/CN4e wireless handheld device and the Alien-ALR-9900 fixed portal. By using standard equipment at the field activity level, the Navy can leverage economies of scale to obtain optimal pricing through bulk procurements. This feature also reduces the burden and costs of associated life-cycle sustainment and maintenance, and it eliminates the need for a local support staff or a help desk. When a device breaks, the repair is as simple as the overnight delivery of a new device.
- *Standardized communications between the Navy and the DoD enterprise level.* The Navy team designed the system to feed all pRFID transactions directly to the Defense

Automatic Addressing System Center (DAASC). By creating pRFID transactions that DAASC can accept, DAASC can then automatically feed any of the DoD enterprise asset visibility systems such as the Logistics Online Tracking System, the Global Transportation Network, and the Defense Logistics Information Service Asset Visibility Web Program. This feature eliminates the need to integrate the Navy's central repository directly with each individual DoD enterprise-level asset visibility system—a costly reprogramming effort that would also require the agreement of system owners to make the connections. The Navy team used the same DAASC reporting mechanism to pass pRFID asset visibility transactions to the N-ERP program, as well as to the Navy's legacy AISs.

In addition to designing the three-tier pRFID infrastructure, the Navy team standardized business and reporting processes. Notably, the team championed the establishment of an "NL" status code for pRFID transactions to standardize the process of reporting on those transactions. When any pRFID-tagged asset passes through a portal or is read by a handheld device anywhere in the world, information about the asset, including the date, time, and location in which the asset was positioned, will be automatically populated in DAASC and other systems supporting asset visibility.

After designing the pRFID enterprise system, the Navy team developed a plan for implementing the system at 700 ashore activities and, in FY08, executed a prototype implementation at the Naval Base Kitsap warehouse in Bangor, WA. The team revised the implementation plan, based on issues and lessons learned during the prototype implementation. The team also began developing an enterprise architecture approach to pRFID and AIT implementation and data collection.

Concurrent with the prototype implementation at Bangor, the Navy team participated in a DoD regionalized pRFID implementation prototype effort. Specifically, the team implemented pRFID technologies at a dozen Navy and Marine Corps sites on Oahu, HI, using an interim architectural approach. Subsequently, the team finalized the enterprise architecture.

Outcome

Implementing pRFID to enable asset visibility will have numerous benefits generally related to reductions in the logistics footprint and increases in operational readiness:

- *Reduced infrastructure.* The new system will eliminate the requirement for servers at hundreds of field activities, significantly reducing maintenance and support requirements. Similarly, the use of common, standard equipment at the field activity level will eliminate the need for maintenance and support of multiple varieties of equipment now used at individual sites.

- *Reduced inventory.* With AIT and pRFID enablement of N-ERP warehouse and inventory sites, the Navy will be able to reduce inventories, annual procurements, and annual carrying costs.
- *Productivity gains.* The deployment of wireless handheld scanners will improve productivity. During the Bangor prototype implementation, productivity increased more than 25 percent.
- *Reduced logistics response time.* Response time will improve significantly with pRFID implementation. Various sites on Oahu dramatically reduced the time it takes to deliver high-priority requisitions from the supply system to the end user. The time to deliver critical requisitions (Priority Group 1) went from an average of 12.2 days to 3.7 days over a 12-month period. Priority Group 2 requisitions went from 40.2 days to 8.9 days during the same period. In short, warfighters will get their critical parts sooner, thus increasing readiness levels.
- *Reduced average customer wait time.* Customers will receive material faster. At Bangor, wait time was reduced by 3 days, thus making it faster to resupply a nuclear submarine for its next deployment.
- *Increased monthly material movements.* The use of wireless AIT and pRFID scanners will increase warehouse material movements. The Bangor warehouse operations went from 4,000 to 13,000 material movements per month, thus increasing overall inventory accuracy and better supporting the warfighter.
- *Increased asset visibility.* Managers will know exactly where their material is located within the supply chain, allowing them to make faster and more informed operational decisions, as well as to expedite critical repair parts to the end user.

The reduced logistics footprint and increased operational readiness contribute to substantial cost savings and avoidance, notably the following:

- Enterprise-wide implementation of the pRFID system will result in reductions in shipping costs, inventory losses, duplicate orders, and labor expenses, representing savings, over a 6-year period, of at least $70 million and potentially as much as $1.8 billion, according to a GAO audit (GAO-05-1040R).
- Two business case analyses of the Bangor prototype implementation calculated a return on investment of 3 years and 3.6 years. However, using an enterprise architecture implementation approach, the Navy team expects to recoup all implementation costs at each site within 1 year.
- By using DAASC to provide asset visibility transactions to the N-ERP program and legacy AISs, the Navy team avoided the cost of programming AIS configuration changes, estimated at up to $100,000 per system, which translates to a cost avoidance of some $1.5 million.

Eliminating the requirement for hundreds of site servers results in a one-time infrastructure savings of $2 million over the 5-year implementation plan and $200,000 in annual IA compliance savings.

Current Status

The Navy team has submitted the IA documents required to obtain the Authority to Operate (ATO) and expects ATO approval in spring 2010.

Once the ATO is approved, the Navy team will retrofit the sites implemented using the interim enterprise architecture and will then begin pRFID deployments at new sites. The team expects to implement pRFID at approximately 100 sites per year. Initially, the Navy team will focus its efforts in two key areas:

- *Repairables supply chain*. Although individual sites will benefit immediately from cost savings and process efficiencies, the benefits will be maximized when entire end-to-end supply chains have been pRFID enabled. The team will begin with the repairables supply chain, with its $11 billion inventory of operationally critical repair parts.
- *Navy warehouse operations.* The Navy will use its Bangor pRFID evaluation model as the template for AIT support at N-ERP sites, such as Naval Air Station warehouse operations. Once deployed, this effort will fully integrate AIT and wireless pRFID technologies, as well as standardize warehouse and inventory business processes at all Navy warehouse operations. According to an N-ERP economic assessment, these AIT and pRFID implementation efforts will contribute toward $600 million in Navy-wide savings.

In a related effort, the Navy team has embarked on a program to feed auto-generated receipts into the financial system of record once an item reaches its destination and has been scanned by a pRFID reader. This integration will require resources to program legacy AISs, but the cost will be largely offset by the immediate savings generated by a reduction in workload. For example, during the prototype implementation at Bangor, the warehouse was able to reduce the number of warehouse floor personnel associated with warehouse receipts, from four to two full-time equivalents. Automatically generating receipts also eliminated the risk of errors due to manual data entry.

The Navy team's ongoing support of the pRFID program includes the following activities:

- Supporting the DoD AIT concept of operations and implementation plans. That support includes participating in bimonthly meetings of the DoD AIT Global Working

Group. The team is seen by the DoD AIT deputy process owner as the service leader in pRFID implementation efforts.

- Engaging actively in USTRANSCOM's in-theatre and retail pRFID implementation tasks.
- Coordinating with the Marine Corps on pRFID implementations at Marine Corps aviation receipt-and-issue sites. The team also coordinates its IA and deployment planning with the Marine Corps Systems Command and Marine Corps Headquarters to ensure a standardized approach to business processes and IT systems.
- Coordinating directly with the Defense Logistics Agency (DLA) as pRFID is implemented at each Navy and Marine Corps site to ensure that all DLA depot material earmarked for those sites is labeled with pRFID tags.
- Coordinating with the Navy Central Processing Office on the procurement of all AIT and pRFID equipment for the entire Navy. This allows the Navy to standardize and combine procurement requirements via the omnibus DoD Product Manager for Joint-Automatic Identification contract, DoD's primary source of AIT-related material.

Challenges

The Navy team faced several challenges:

- This is a DoD first. A pRFID enterprise of this magnitude has never been developed before. In fact, once deployments are completed, it could very well become the largest pRFID enterprise in the world today.
- Navigating IA compliancy is a lengthy and bureaucratic process, sometimes taking longer than it takes industry to make technological changes.
- In developing a cost-effective, IA-approved, wireless pRFID and AIT handheld solution, the team had no previous Navy efforts to build upon.
- The team had to obtain explosive safety (Hazards of Electromagnetic Radiation to Ordnance, or HERO) approvals for each piece of enterprise equipment.
- In addition to navigating accreditation processes to use the Navy Marine Corps Intranet (NMCI) network and certifying AIT-related equipment, the team had to develop alternative pathways, like commercial broadband networking (cell based), when NMCI was unable to provide a cost-effective solution for a given task.

About the Award Winner

The Navy team consisted of the following people:

- Robert Bacon, Navy AIT program director
- Lorrey Bentzel, deputy director, who is a Navy AIT technical authority
- Gary Bruner, who provided pRFID technical, sustainment, and life-cycle support
- Helen Wonders, who provided AIT requirements definition, financial and contracting management, and ordnance support
- Pat Blakney, who worked with the Navy Central Processing Office and provided AIT hardware and software procurement support, as well as financial and contracting support
- Jerry Zamer, who provided operations research and unique identification support.

Improved Rubber Keeps Our Submarines Safer

Award Winner: Navy Team

A Navy team simultaneously revised five specifications affecting critical end-use submarine components—rubber gaskets, seals, and other rubber parts—identified by the Navy as being used in "SUBSAFE" applications. Failure of a SUBSAFE component can result in the loss of a ship. The team corrected first-article and conformance testing discrepancies that jeopardized delivery of high-quality, safety-critical rubber parts. As part of this effort, the team developed, and incorporated in all five specifications, a standard process for testing rubber products; this process can serve as a broadly applicable template for similar Navy and DoD molded rubber parts specifications. The revised specifications ensure the quality of vital rubber components and thus the safety of our submarines. Also, they reduce production costs by eliminating redundant tests, eliminating complicated and expensive tests from quality conformance testing, specifying the tests to be conducted under first-article evaluation (so they need to be performed only once), and significantly streamlining lot conformance tests to speed production and reduce delivery time.

Background

Following the loss of the USS *Thresher* (SSN-593) in 1963, the U.S. Navy implemented a program to help maintain the safety of the nuclear submarine fleet by providing maximum reasonable assurance that a submarine's hull will stay watertight. One of the critical contributors to the safety of submarines is rubber.

The Portsmouth Naval Shipyard (PNSY) is the U.S. Navy's center of excellence for the production of critical rubber components used aboard Navy ships. PNSY manufactures and tests a wide array of molded rubber gaskets, seals, and sheet material for the Navy. In an internal review, PNSY determined that five specifications for rubber components contained testing discrepancies that potentially could affect the quality of the components and, therefore, jeopardize the safety of submarines.

Due to PNSY's findings, production of the affected rubber components was stopped, leaving the Navy without a source for these key components and, more important, potentially affecting operational readiness.

Problem/Opportunity

The five specifications of concern to PNSY were deficient in two key respects:

- They structured first-article and quality conformance testing differently.
- They invoked different standards and test protocols for evaluating the suitability of components that had different shapes and end uses but were all made from rubber.

Specifically, PNSY found that some quality conformance tests were more appropriate for first-article evaluation. PNSY also found that the specifications were deficient in

not always requiring key conformance tests to ensure proper performance of rubber products. In addition, four of the specifications, which were last revised between 14 and 32 years ago, contained outdated tests, as well as tests requiring equipment that is no longer available. PNSY also determined that not all vendors were meeting specification requirements.

Addressing these deficiencies meant that the five specifications would have to be extensively revised. Safety was the paramount concern. At the same time, however, the Navy was under significant pressure to expedite the revision of these documents. Without the ability to positively ensure that rubber components meet the requirements, new submarine construction and repair of active fleet ships would be jeopardized, affecting readiness and potentially resulting in submarines that could not perform their missions.

Approach

The Naval Surface Warfare Center Carderock Division (NSWCCD) and the Naval Sea Systems Command (NAVSEA) formed a team to undertake the extensive revisions needed to standardize key rubber conformance tests and to revise or replace archaic first-article test procedures.

The NAVSEA team standardized the conformance requirements of all five specifications to include the same key conformance tests. The team placed the most complicated tests, which were appropriate only to demonstrate a manufacturer's ability to fabricate the parts, under first-article testing. After identifying obsolete tests and investigating candidate replacement tests, the team selected the most suitable tests for incorporation into each of the specifications. The team also standardized the structure of the quality assurance sections (conformance test procedure, lot and batch acceptance criteria, rejection criteria, and rework requirements).

The five draft specifications were distributed to entities with a vested interest, including manufacturers, shipyards (commercial and government), technical authorities, and Navy design and repair activities. The NAVSEA team adjudicated the comments from these activities and incorporated the changes to ensure that the specifications were complete, correct, and usable. These changes succeeded in capturing all of the needed requirements and were accepted by key Navy experts, including PNSY, Navy laboratories, NAVSEA technical authorities, and user-community representatives.

The NAVSEA team not only successfully accomplished the revisions, but completed these standardization document updates ahead of schedule.

Outcome

The primary payoff of this effort was the successful implementation of the new requirements in time to ensure the safety and functionality of these critical components. This prevented impacts to the operational availability of the fleet and prevented delays in new construction. Savings will be realized by avoiding construction delays for new ships, as well as minimizing dry-dock times for fleet ships. Cost savings are estimated to be in the millions of dollars.

Implementation of the new standardized test procedures and protocols has significantly reduced the time needed to complete conformance testing, thereby decreasing lead-times and production schedules. Approximately one labor-year of effort was required to implement the changes, but the changes will reduce production time by 80 percent and save at least $1 million per year.

The Navy expects this deceptively small change to return significant improvements in component delivery time by preventing testing delays caused by ambient temperature swings and by reducing costs associated with more rigid climate control.

An unanticipated benefit of the technical effort was the broadening of the acceptable temperature range in which the conformance tests may be conducted. PNSY presented this possibility to the specification development team. The team assessed test data and verified the technical acceptability of this approach. The temperature range for conducting the tests was broadened beyond standard test requirements to a point where virtually all tests may now be conducted at prevailing ambient conditions. The Navy expects this deceptively small change to return significant improvements in component delivery time by preventing testing delays caused by ambient temperature swings and by reducing costs associated with more rigid climate control.

PNSY has now implemented a standard procedure for conducting its conformance tests. This has not only reduced labor costs, but allows more uniform monitoring of product quality. This is expected to result in long-term gains in product consistency and in the maintenance of product safety and performance.

Unique and outdated test procedures were eliminated, and conformance testing was standardized. This will ensure that the manufacture of these products conforms to indus-

try practices, and it should increase competition. These changes are expected to lower overall acquisition costs.

The standardized approach to rubber conformance testing incorporated in the five specifications will serve as a template for a much broader range of rubber products used by the Navy, as well as DoD. Efforts are already under way to revise a number of additional rubber specifications. These efforts will be less costly because of the groundwork accomplished for the SUBSAFE application specifications and will further augment the efficiencies and cost-reduction benefits already achieved.

Current Status

All five specifications have been approved and published.

Challenges

The team faced challenges in three areas:

- *Schedule.* The short timeline for completing the documents was perhaps the most significant challenge of this effort. The Navy had an urgent need for the revised specifications, but the extensive changes required, the fundamental restructuring of the conformance testing, and the identification of replacement tests for outdated procedures presented tremendous challenges.
- *Technical.* The test procedures were cumbersome and outmoded. Therefore, the team needed to identify acceptable, efficient, and contemporary test procedures to replace the old procedures.
- *Adjudication.* The comprehensive changes made to quality conformance testing represented a streamlined and fundamentally different approach. This resulted in a large number of very detailed comments from industry, the technical community, and Navy clients. Resolving those comments within a condensed timetable required exceptional effort. Moreover, the changes significantly affected the "normal way of doing business," requiring the team to convince all involved that the new approach would ensure the adequacy of the end-use items.

About the Award Winner

The Navy team consisted of Forrest Pilgrim, Steve Lutgen, Mark Lattner, Roland Lemieux, and Richard Dempsey. All team members jointly assessed test data, cooperated in preparing review packages for the specifications, adjudicated all comments, and ensured timely publication of the documents.

Forrest Pilgrim, an NSWCCD chemical engineer, led the technical revision of the documents, coordinated with PNSY to ensure the adequacy of the conformance and first-article test changes, and coordinated other technical and administrative support. Mr. Pilgrim also led a challenging effort to

convert one of the documents to primary Navy cognizance to permit tailoring to meet critical Navy needs.

Steve Lutgen, an NSWCCD materials engineer, led the program management of the revision effort, accelerating the schedule by identifying revision efforts that could be conducted in parallel, and he coordinated key support to ensure compliance with command and technical authority requirements. In addition, Mr. Lutgen prepared a standardized template for the structure of the five specifications, including conformance test procedures, lot and batch acceptance criteria, rejection criteria, and rework requirements.

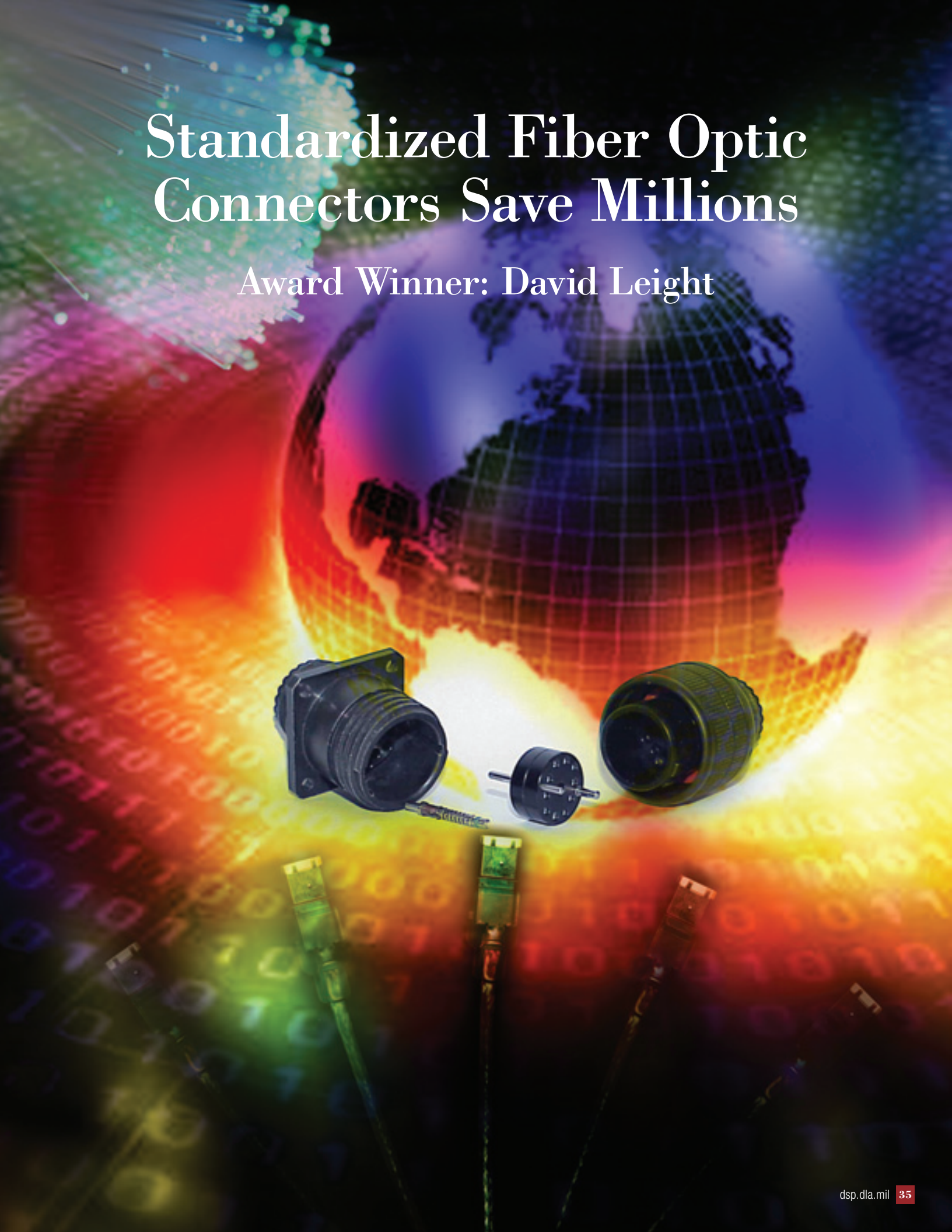
Mark Lattner, from NAVSEA's Naval Systems Engineering Directorate, Ship Integrity and Performance, represented the technical authority responsible for the specifications. Mr. Lattner was instrumental in the timely specification review within the command and the resolution of key technical concerns, and he was responsible for the technical approval of the documents.

Roland Lemieux is a materials engineer at the PNSY Materials Test Laboratory. He provided key technical inputs that helped determine which quality assurance tests were most critical, which tests were no longer needed, and what updates were required for the more complex first-article tests. Mr. Lemieux also led the effort to manufacture and test molded rubber samples in order to develop the data needed to support his recommendation to broaden the temperature range under which quality assurance tests could be conducted.

Richard Dempsey, a chemist with The Columbia Group, Inc., executed significant technical revisions of four of the five specifications and recommended organizational improvements to all of the specifications. Mr. Dempsey also provided key historical background on previous revisions of these documents, which served as a basis for understanding and assessing the need for and utility of the existing tests and requirements.

Standardized Fiber Optic Connectors Save Millions

Award Winner: David Leight



David Leight, from Defense Logistics Agency (DLA) Land and Maritime, led the development of a new specification for next-generation connectors, specifically, fiber optic connectors using the latest technology. The new specification—MIL-PRF-64266, "Connectors, Fiber Optic, Circular, Plug and Receptacle Style, Multiple Removable Genderless Termini, Environment Resisting, General Specification for"—was the culmination of a 6-year effort. The fiber optic connectors covered by the new specification have diverse uses in hundreds of shipboard, submarine, and avionic military applications, greatly reducing the logistics footprint. In addition, the connectors are more reliable, more maintainable, and easier to clean, and they have tighter mechanical tolerances than older connectors. Moreover, costs will be substantially reduced. For example, the availability of a standard connector will eliminate the need to procure multiple types of nonstandard ones, resulting in a cost avoidance, for surface ships alone, of about $21 million over 5 years. Maintenance time also will be greatly reduced, resulting in significant cost savings—an estimated $4 million over the next 5 years for one major aircraft alone. When all applications are considered, the savings will likely reach tens of millions of dollars.

Background

The number of new programs or systems requiring the transfer of data signals at high rates is increasing rapidly. Optimal high-rate data transfer requires the use of fiber optics. However, DoD did not have a specification for fiber optic connectors that use up-to-date technology. Instead, the military document covering fiber optic connectors was originally developed from an electrical connector specification.

Lacking a specification for state-of-the-art fiber optic connectors, system designers have introduced nonstandard parts in an attempt to achieve many of the desirable aspects of fiber optics. The piecemeal introduction of nonstandard parts has, in turn, resulted in less-than-optimal performance and high life-cycle costs due, among other things, to the need to procure and maintain an inventory of multiple system-unique connectors. Moreover, as more nonstandard parts were introduced, logistics supportability became problematic. For example, older connectors required extensive cleaning during routine maintenance because of the many internal piece parts used.

Problem/Opportunity

The U.S. Navy, which is a large user of fiber optic systems, expressed the need for a new military specification for a standard, heavy-duty, multifiber connector. The Navy envisioned a connector that uses the latest fiber optic technology and is applicable to ships, submarines, and aircraft. DLA Land and Maritime, DoD's specification preparing activity, has the key role of resolving standardization problems and issues related to standardization documents. It therefore undertook what turned out to be a 6-year effort to develop the needed specification.

Approach

In November 2002, DLA Land and Maritime formed a working group of stakeholders to aid in the development of a new specification for a standard fiber optic connector. The working group consisted of personnel from DLA Land and Maritime, the Naval Sea Systems Command (NAVSEA), the Naval Air Systems Command, manufacturers, communication system designers, and original equipment manufacturers representing ship, submarine, and aircraft builders. DLA Land and Maritime charged the group with generating a single specification, for both sea and air applications, with improved optical performance, improved repeatability and reliability, higher density, improved availability, and reduced procurement and maintenance costs.

Mr. Leight was a key participant on the design selection committee. The committee, which consisted of DoD personnel, began by establishing criteria for the design of a standard fiber optic connector. The following are among the types of design criteria selected:

- Quality and reliability (features that would substantially reduce risk of failure that could be catastrophic to mission, equipment, safety, or life)
- Field maintenance (ease of field service and repair, common tools required, containment of small parts)
- Manufacturing cost (number of parts, assembly required)
- Performance in harsh conditions (10g vibration, over 1,000g shock, temperature excursions ranging from −55°C to +165°C).

The committee used the criteria as the basis for evaluating numerous prototype designs for the termini, as well as for connectors and backshells, from various manufacturers. The committee then selected the design that would best meet customer needs and developed qualification requirements.

Drafting the specification for the selected design was the responsibility of Mr. Leight. He also coordinated many drafts, sorted through and consolidated more than 500 comments, and recommended their dispositions. Resolving comments and developing consensus required a significant effort to ensure that the connectors covered by the new specification would be usable in multiple shipboard, submarine, and avionic applications and to ensure that the connectors made by multiple different manufacturers would be interoperable. Mr. Leight also worked with a manufacturer and lawyers to obtain a royalty-free license for a patented part of the connector.

To resolve outstanding issues and gain consensus on the final draft of the new specification, as well as associated documents, Mr. Leight chaired a 3-day coordination meeting with military and industry stakeholders. Once the final drafts were ready, Mr. Leight sent them to the DLA Departmental Standardization Office for final approval. This step was

required, because the specification and its associated documents were new and because they contained qualification requirements. He wrote justifications as to why the documents should be categorized as performance documents and why qualification was required.

DLA Land and Maritime published the new fiber optic connector specification (MIL-PRF-64266) in November 2008. At the same time, it also published 14 connector specification sheets, 11 covering connectors and 3 covering connector termini. MIL-PRF-64266 is a strong foundation to which additional connectors can be added as needs arise.

Outcome

The new specification enables the procurement of thousands of new state-of-the-art fiber optic connectors for use in hundreds of demanding military applications. The connectors are more reliable, more maintainable, and easier to clean than the connectors they replace, and they have tighter mechanical tolerances. Not only does the availability of such connectors result in better support of military missions in terms of reliability and reduced risk, but it has many other benefits as well:

- *Improved logistics supportability.* The new connectors are easier to maintain and repair than the connectors they replace. For example, the new connectors have fewer removable parts and faster standard termination procedures between different manufacturers' products. Therefore, systems using those connectors gain hours in the field versus downtime in the repair shop.
- *Reduced procurement and inventory costs.* A major goal of this project was not only to improve the products covered in the military specification, but to reduce the cost to the customer by making the connectors applicable to more systems. Therefore, as usage and sales of the standard connector increase, customers can benefit from economies of scale. They also can benefit from reduced inventory costs; for example, with the availability of genderless termini parts, customers do not need to keep as many items in stock. The ability to obtain compatible connectors from multiple sources also contributes to reduced life-cycle costs, because standardization helps preclude the risk of conflicting design elements.
- *Reduced maintenance costs.* Navy repair and maintenance personnel conservatively estimate that on average, routine maintenance per connector will take at least 1 hour less than it takes for the older connectors. Therefore, routine maintenance on a system using multiple connectors will be substantially reduced. For example, replacement of the many different types of older connectors on a major aircraft fleet with connectors built using the new design will save at least 16,000 hours in maintenance time, which translates to an estimated savings of $4 million over the next 5 years for that aircraft

alone. When the new connectors have been applied to all weapons systems, the savings in maintenance costs will most likely reach into the tens of millions of dollars.

- *Increased cost avoidance.* Instead of procuring multiple types of nonstandard parts for system-specific uses, customers can procure a single type for multiple uses. Considering NAVSEA estimates for usage on surface ships alone, customers can avoid purchasing an estimated 1,000 nonstandard parts over the next 5 years. On the basis of the DoD parts management cost avoidance factor of $20,904 for each nonstandard electrical connector, NAVSEA can avoid costs of about $4.2 million annually—or nearly $21 million over the next 5 years—by using the standard connector covered in MIL-PRF-64266.

An added benefit of this new military specification is that multiple manufacturers will be qualified for these connectors, ensuring supply availability for years to come.

Current Status

DLA Land and Maritime has procurement and inventory control responsibilities for the new connectors. The new connectors are planned to support various systems both on ship and submarine platforms and on air platforms.

Mr. Leight continues to support the DLA Land and Maritime Sourcing and Qualifications Division and the six manufacturers interested in qualifying to the new specifications. He also is working on an additional five new specification sheets to cover backshells for the new connector to support further user needs. Another of Mr. Leight's continuing responsibilities is to provide test and evaluation criteria related to Telecommunications Industry Association (TIA) test methods and procedures. He is working with TIA to revise test procedures as needed, such as procedures for fluid immersion tests, fungus evaluation tests, and vibration tests for random and sinusoidal vibration requirements. Mr. Leight also has responsibility for DoD voting on TIA fiber optic industry test procedures used for qualification testing in the new fiber optic specification.

Challenges

Development of a new specification to cover fiber optic connectors was a significant engineering standardization project. During this project, Mr. Leight overcame many challenges, such as the following:

- Worked with a manufacturer and lawyers to obtain a royalty-free license for a patented part of the connector
- Worked with the many different manufacturers and users to, among other things, ensure interoperability

- Resolved hundreds of official comments on draft documents to achieve consensus among stakeholders
- Worked with the DLA Departmental Standardization Office to obtain final approval for the specification.

About the Award Winner

David Leight is an electronics technician at DLA Land and Maritime. He was the primary focal point for this significant standardization project from its inception. Not only was he an integral member of the working group of stakeholders, but, as a DLA Land and Maritime representative, he was responsible for preparing the new documents (the specification and its associated specification sheets), which included generating and coordinating drafts, consolidating comments and recommending dispositions, resolving comments, and obtaining final approval for documents, as well as answering the many questions along the way. Mr. Leight was also a key participant in the design selection committee of DoD personnel. As part of this committee, he evaluated numerous prototype designs of the terminus system, as well as connectors and backshells from various manufacturers, to identify the best designs. From project inception to publication of the new specification for fiber optic connectors, Mr. Leight demonstrated outstanding leadership.

Program News

Topical Information on Standardization Programs

Qualified Products Database Users Group Meets at Northrop Grumman

DSPO hosted a qualified products database (QPD) users group session at Northrop Grumman in Chantilly, VA, on May 12, 2010. The event, attended by qualification personnel from the services and the Defense Logistics Agency, focused on the QPD software updates that have been released over the past year. The event provided participants with a forum to ask questions and suggest enhancements. The database, which went live in 2006, is the official repository of qualified products and suppliers that meet technical requirements stipulated in specifications. To date, 88 percent of the 744 qualified products lists and qualified manufacturers lists have been published. The use of qualified products or suppliers eliminates the need for first-article testing and thus can shorten acquisition lead-times and reduce costs. Attendees provided positive feedback and requested that users group sessions be held annually.

Parts Standardization and Management Committee Holds Spring Conference

DSPO chaired the spring 2010 Parts Standardization and Management Committee (PSMC) meeting. The theme was "Parts Management: A Systems Engineering Discipline." Mr. Nicholas Torelli, from Systems Engineering/Mission Assurance within the Office of the Director, Defense Research and Engineering, provided the keynote speech, and Mr. Greg Saunders, DSPO's director, provided the DSPO perspective. The agenda consisted of briefings and subcommittee breakout sessions on parts management. PSMC was chartered to reengineer the DoD parts management program, to implement best practices, and to share information regarding parts management. Parts management primarily concerns part selection. Selecting preferred (standard) parts early in a system's design reduces costs; mitigates issues related to diminishing manufacturing sources, material shortages, and counterfeits; reduces parts proliferation; and improves system reliability, availability, and maintainability. For more information about PSMC, please contact Donna McMurry at 703-767-6874 or donna.mcmurry@dla.mil.

PQM 103 Gets a New Look

PQM 103, Defense Specification Management, is a course sponsored by DSPO and delivered through the Defense Acquisition University (DAU). The course covers DoD policies and procedures for developing, managing, and using nongovernment standards, commercial item descriptions, and specifications and standards. PQM 103 emphasizes interoperability, market research, use of commercial and nondevelopmental item alternatives, use of performance specifications, international standardization agreements, and the single-process initiative.

Currently, PQM 103 is a 2-week course that is offered on site as a resident delivery method class. In response to feedback received from many of the field activities about the length of the class, DSPO has been working in conjunction with DAU to redesign the course into one that is more "time friendly."

The redesigned course will consist of two online modules followed by a 2- to 3-day workshop. The course, with its new look and feel, will be deployed in the first quarter of FY11. The course will be offered multiple times throughout the year.

For more information, please go to http://www.dau.mil.

ANSI Offers a Member Discount on Some Standards

The American National Standards Institute (ANSI) is offering DoD a discount on the single-user purchase of standards from certain collections in the ANSI eStandards Store (http://webstore.ansi.org/). (DoD's ANSI membership is funded by DSPO.) The typical discount is about 20 percent off the list price and applies to standards in the following collections: ISO, International Electrotechnical Commission, American Gear Manufacturers Association, and Outdoor Power Equipment Institute. The ANSI eStandards Store provides purchased documents only in PDF format.

To obtain the discount, the purchaser must enter his or her government purchase card number and, on the subsequent screen, must enter discount code 478. The discount will be applied only if the purchaser has an e-mail address ending in ".mil." Before the purchase is finalized, the website will display a document-specific end-user license agreement that explains the terms of use. The purchaser must accept the terms before he or she may download the document.

Events

Upcoming Events and Information

September 23, 2010, Washington, DC

2010 World Standards Day

The U.S. Celebration of World Standards Day will take place on September 23, 2010, at the U.S. Chamber of Commerce, in Washington, DC. This year's theme is "Standards through Accessibility." For more information about the 2010 World Standards Day celebration, exhibition, reception, and dinner, please go to http://www.wsd-us.org.

October 25–28, 2010, Las Vegas, NV

DMSMS and Standardization 2010 Conference

Mark your calendars now and plan to attend the 2010 Diminishing Manufacturing Sources and Material Shortages (DMSMS) and Standardization Conference at the Rio All-Suite Hotel in Las Vegas, NV. Once again, the conference will include multiple tracks of topics, including one featuring topics relating to the Defense Standardization Program and another on the Government-Industry Data Exchange Program. As the conference planning develops, key information will be posted on the DMSMS and Standardization 2010 website. For more information, please contact Alex Melnikow at Alex.Melnikow@DLA.mil or 703-767-1415.

People

People in the Standardization Community

Welcome

On October 13, 2009, **Eric Steensen** joined the Defense Logistics Agency (DLA) Land and Maritime as part of the standardization community and hazardous materials program. Mr. Steensen brings with him experience from the telecommunications industry and from an Air Force repair depot and program office. We welcome him to the standardization community.

Leah Aleman, a food technologist, joined the Subsistence Directorate at DLA Troop Support some 8 years ago. She has been promoted to chief of the Technical Branch, Supplier Support Division, for subsistence cataloging and standardization.

John Woloszyn, former chief of the Technical Branch, Supplier Support Division, at DLA Troop Support for the last 13 years, has been promoted to deputy of the Supplier Support Division.

Farewell

Likow (Simon) Chang has retired after 18 years of federal service. Dr. Chang was a key contributor to the DLA Land and Maritime standardization community and hazardous materials program. His integration of standardization concepts and hazardous materials knowledge was integral to DLA Land and Maritime being awarded the 2009 Green Products and Services Award in the Defense Logistics Agency.

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 2010	Systems Engineering
October/December 2010	Science and Technology
January/March 2011	Materiel Readiness

If you have ideas for articles or want more information, contact Tim Koczanski, Editor, *DSP Journal*, Defense Standardization Program Office, 8725 John J. Kingman Road, STP 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.


DEFENSE STANDARDIZATION PROGRAM
MAKING SYSTEMS WORK TOGETHER