

CTMA CONNECTOR

FALL 2022



Cutting the Fossil Fuel Tether

CTMA Project Works to Reduce US Fossil Fuel Reliance

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Due to ongoing travel uncertainties, some NCMS events have been rescheduled. Please check the NCMS events page (<https://www.ncms.org/events/>) for the latest updates. Don't hesitate to email eventsupport@ncms.org with any questions.

Fall 2022 – Spring 2023

[Airfield Autonomy Initiative: Burlington, NJ](#)

October 25, 2022, 1–3 p.m. EDT

[JTEG Technology Forum: Reverse Engineering, 3D Scanning & Prototyping](#)

November 29, 1–3 p.m. EDT

[JTEG Technology Forum: Digital Maintenance/Point of Maintenance](#)

December 12–15, 2022

[DOD Maintenance Symposium](#)

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About NCMS

The National Center for Manufacturing Sciences (NCMS) is a cross-industry technology development consortium, dedicated to improving the competitiveness and strength of the US industrial base. As a member-based organization, it leverages its network of industry, government, and academic partners to develop, demonstrate, and transition innovative technologies efficiently, with less risk and lower cost.

About CTMA

The CTMA Program offers a unique contracting vehicle for industry, academia, and the DOD sustainment community to work collaboratively. Through these efforts they promote the demonstration, evaluation, and validation of new and innovative technologies that enhance warfighter readiness at optimal value and lowest risk. This non-FAR based contracting vehicle is the only DOD-wide program focused solely on maintenance and sustainment.



Joint Intermittent Testing Working Group Announces Two New Military Performance Specifications (MIL-PRF) for Electronic Test Equipment

The Joint Intermittent Testing Working Group (JIT WG) announced that MIL-PRF-32516A and MIL-PRF-32516/1 were both published on August 4, 2022. These new specifications represent new standards for electronic test equipment that must be met by military personnel who work on diagnosing intermittent faults.

MIL-PRF-32516A "Electronic Test Equipment, Intermittent Fault Diagnostic (Electrical)" supersedes the March 2015 base document and covers the minimum performance requirements for equipment to detect and isolate nanosecond, microsecond and millisecond intermittent faults that can occur in conductive paths. These paths include line replaceable unit (LRU)/weapon replaceable assembly (WRA) chassis and backplane circuits and their wire harnesses; weapon system electrical wiring interconnect system (EWIS); and patch cables, electronic test cables and their connectors. The MIL-PRF-32516/1 specification covers "Intermittent Fault Diagnostic Equipment (Electrical), Depot Level" and provides the requirements for acquiring the equipment.

The JIT WG, which was first chartered in September 2012, is a joint services forum that works together to advance intermittent fault detection technology and address electronics intermittence across the DOD sustainment enterprise. Electronics maintenance is a leading driver of weapon systems non-availability, accounting for over \$10B in FY18 sustainment costs. It is not uncommon for up to fifty percent of the electronic components entering maintenance to be no-fault-found (NFF), exacerbating electronics availability issues and resulting in over 278,000 days of end-item systems non-availability and approximately \$3B in non-value-added sustainment costs annually. The JIT WG is championing a DOD initiative to rapidly promulgate intermittence detection and isolation capabilities.

For more information about the JIT WG, please visit: <https://jitg.ncms.org/>. Both specification documents can be found at <https://quicksearch.dla.mil/>. ■



Cold Spray Repair Technologies Reduce Navy's Supply Chain Delays

In March 2021, one of the largest-ever container ships became stuck in the Suez Canal for six days, bringing sustained public attention to the commercial maritime industry's importance. The crisis impacted already strained global supply chains and held up an estimated \$9.6 billion of trade each day. Because the US economy relies on maritime fleets to deliver vital finished goods and raw commodities to a multitude of industries, any disruption to these fleets causes shipping delays, resource scarcity, and increased prices.

Commercial maritime assets are globally deployed in demanding conditions—both extreme distances and harsh environments—which constrains technicians' abilities to perform maintenance and sustainment operations while underway. For this reason, maintenance experts, in both public and private sectors, are interested in technologies that can make repairs to vessels at sea. Such technologies would enable ships to continue towards port with critical cargo and to accomplish their missions without delay.

To develop these technologies, in 2020 NCMS brought together a collaboration—Advancing Additive Repair Technologies and Cold Spray for Sustainment of Maritime Assets—that is conducting research and development into additive repair technologies, including cold spray, to reduce maintenance costs, dramatically extend the life of commercial maritime assets, and help keep global supply chains intact to serve the general public. The project combines the expertise of Naval Sea Systems Command (NAVSEA), Naval Air Systems Command (NAVAIR), and the US Marine Corps, along with two industry partners:

VRC Metal Systems and Solvus Global, and two academic partners: Kostas Research Institute (KRI) at Northeastern University and Temple University.

Cold spray is a solid-state coating deposition technology that has recently been applied as an additive manufacturing process to fabricate components and to repair damaged components. Its capability to add new metal onto worn surfaces enables critical features to be re-machined back to tolerance, allowing parts previously destined for scrap to be reused. Cold spray provides an incredibly powerful tool for the commercial maritime industry to quickly refurbish an existing damaged or out of tolerance part and simply reuse it, rather than waiting weeks, months, or years in some cases, for a replacement part.

"In the last three to four years, cold spray has become commercially viable," said Kiley Plooster, Motion Systems Engineering Program Manager at VRC Metal Systems, LLC, where she specializes in setting up facilities to integrate cold spray. She works on preparing equipment, robotics, dust collection, and more.

This project's first phase demonstrated a variety of cold spray technologies in three Navy shipyards. Additionally, the collaboration's highly skilled engineers and technicians developed qualified spray procedures (QSPs) to efficiently repair NAVSEA impellers using the KRI Cold Spray Additive Manufacturing Laboratory's advanced equipment. The team also created a software tool for cold spray professionals that enables them to select cold spray operating conditions and manufacturing costs



for a variety of materials used by NAVSEA. Finally, the team developed a cold spray technician training module, which includes information on the fundamentals of cold spray, robotic operation, interactive tests, and more.

Building on these successes, Phase II expanded the demonstration of cold spray technologies into a fourth Navy shipyard to validate the technologies across a wider range of applications. The team also added portable and hatchable cold spray technology to provide in-situ repairs on ships that are underway. Moreover, they investigated the technologies for applicability in coatings while maturing the testing criteria and design for use in structural repairs. The collaboration also developed a workflow for QSP development, including creating digital twins of the damaged parts. Using digital twins before and after repairs reduces the time and effort required inspect the outcome.

"This project and the work that we're all doing benefits the Navy because the cold spray is quick and effective," said Plooster. "The Navy is now able to repair parts a lot faster and

for a lot less money. Cold spray is especially useful for obsolete parts on everything from helicopters to aircraft carriers, where the original OEMs no longer exist. Instead of having to completely remake the part, we can now repair it."

The customer is pleased with the results so far and Phase III is in process. This initiative, which is scheduled to wrap up in 2023, will provide a road map for the successful adoption of cold spray and other additive repair technology in the Navy, and will ultimately enable its transition throughout the DOD, onward to commercial maritime companies and fleet maintenance organizations. While the initiative focuses on ships, the results will be applicable to many other industries, such as truck transport, train, aircraft, and other situations where repairs adversely affect deliverables and time schedules.

"A lot of commercial entities are having problems with parts being unavailable, due to COVID-19 and the supply chain issues," said Plooster. "Having the ability to repair a part that normally would be thrown away is huge." ■

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NCMS Hosts Sold-Out Technology Showcase at Corpus Christi Army Depot

NCMS's July Technology Showcase at Corpus Christi Army Depot (CCAD)—the first showcase NCMS has held at this depot—was a huge success, attracting nearly 50 world-class exhibitors to demonstrate their maintenance and sustainment technologies to a sold-out crowd.

"We could not be more pleased with the outcome of this technology showcase," said Debbie Lilu, NCMS Vice President of Maintenance & Sustainment and Business Development. "We're especially honored that the CCAD depot's commander, Col. Parker (existing), and Col. Hogan (incoming), attended, along with the depot's senior leadership. I'm very confident that this showcase introduced talented CCAD M&S leaders and artisans to technologies that will advance the Army's strategic readiness."

This event gave industry and academia a special opportunity to display and demonstrate novel capabilities that address the DOD's most pressing maintenance issues. DOD leadership, maintenance managers, and artisans met face-to-face with industry and academic experts to learn about the latest processes and technologies that can best solve their maintenance and sustainment (M&S) challenges.

"This Technology Showcase has probably been the best that we've seen," said Rob Harrill, Vice President of Lone Star Analysis. "It gave more of an intimate setting with the other vendors, and it allowed us to interact directly with the leadership and artisans who can actually benefit from the capabilities that we have to offer."

Participating in this event can jump-start new collaborations that deliver advantages to all by

enabling industry to gain a deeper understanding of DOD M&S needs.

Chris Root of Sharp Vision Software found a lot of value in his interactions with the DOD. "We were able to ask them specifically what they do, what their pain points are, and explain what our software solution could do for them."

"It gave more of an intimate setting with the other vendors, and it allowed us to interact directly with the leadership and artisans who can actually benefit from the capabilities that we have to offer."

Benefits for the DOD include a firsthand look at successfully deployed and emerging commercial technologies that may solve maintenance issues such as lengthy repair times, high overhaul costs, parts obsolescence, hazardous processes, and variable results. This knowledge will help planners prioritize their maintenance technology investments.

A unique feature of this showcase was that both Army and Navy representatives were able to attend, because CCAD is located

on the site of the Corpus Christi Naval Air Station (NAS). Corpus Christi NAS serves primarily as an aviator training facility, and provides pilot training for the Navy, Marines, and Coast Guard.

Most exhibitors had technology solutions suitable for both Army and Navy M&S needs. For instance, for nearly 75 years, ZOLLER Inc. has been developing innovative tool presetting and inspection machines, as well as tool management solutions software, for optimal management of cutting tools. The company offers a portfolio of solutions that have multiple applications for M&S personnel in all the services.

For more information about the other exhibitors, please visit: <https://www.ncms.org/events/ncms-technology-showcase-corpus-christi-army-depot/#exhibitor-directory>. ■

Navy REPTX Event Tested Ship Maintenance Technologies Aboard Decommissioned Destroyer

At the time this issue of the *CTMA Connector* went to press, the first-ever Repair Technology Exercise (REPTX) had just wrapped up in Port Hueneme, CA. NCMS was pleased to assist the US Navy with this successful exercise focused on keeping ships in top shape while at sea.

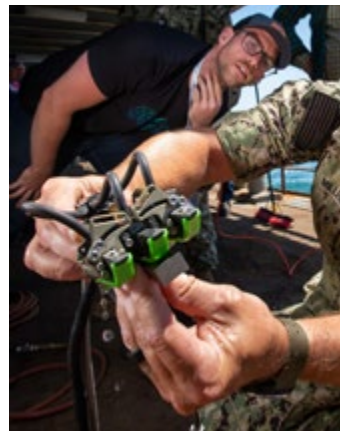
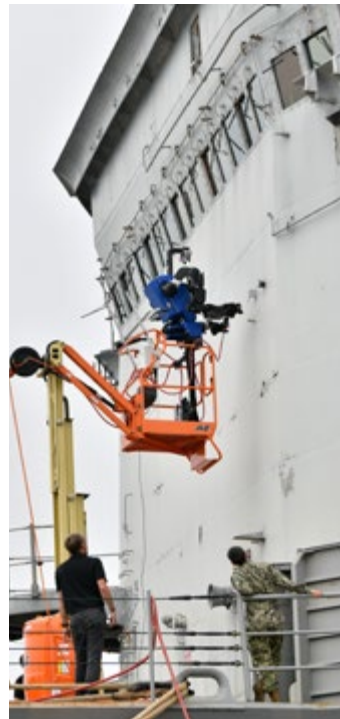
REPTX was designed for government, academia, and industry participants to demonstrate and evaluate the viability and efficacy of products and services that expand the Navy's ability to perform expeditionary maintenance operations. NCMS assisted with identifying and vetting industry and academic participants via its network of hundreds of innovative technology solutions providers.

From August 22 through September 2, more than sixty technology suppliers substantiated their products' capacity to tackle real-world fleet maintenance challenges, including assessing and repairing potential battle damage aboard the Navy's self defense test ship, an asset of Naval Surface Warfare Center, Port Hueneme Division (NSWC PHD). REPTX participants addressed four focus areas: visualization, command and control aids, forward manufacturing, and expeditionary maintenance.

Visualization refers to dynamic inspection methods that enable a ship to see itself and the world around it, above and below the water line. Command and control aids help naval commanders make rapid, data-driven decisions and real-time situational assessments. Forward manufacturing hubs, such as additive manufacturing or 3D printing systems, reduce ships' reliance on long-distance supply chains, increasing readiness in theater. Expeditionary maintenance refers to the Navy's ability to perform maintenance operations and battle damage assessment and repair while a ship is forward-deployed.

REPTX was part of the broader Advanced Naval Technology Exercise-Coastal Trident 2022, which began in June and ran to September. The initiative, organized by NSWC PHD, was designed to bolster port and maritime security through field experiments involving emerging technologies and training events with law enforcement and other first responders.

For more information on REPTX, including a photo gallery of activities at the event, go to www.ncms.org/events/2022-reptx. We look forward to offering a more in-depth view of this successful exercise in the Winter issue of the *CTMA Connector*. ■





Cutting the Fossil Fuel Tether

Rising gas prices, along with environmental concerns and governmental regulations, have amplified interest in reducing fossil fuel consumption, in part by transitioning to electric vehicles. A CTMA collaboration has helped America move closer to accomplishing this goal.

Launched in 2021 and scheduled to wrap up in early 2023, the collaboration—Electric Propulsion and Storage Technologies to Increase Reliability and Reduce Reliance on Fossil Fuels—analyzed the costs and logistical hurdles involved with transitioning entire fleets to partially or fully electric-powered vehicles. It brought together the expertise of several research and development and acquisition units within the US Army, Marine Corps, and Special Operations Command, along with industry partner QinetiQ, Inc.

The project focused on vehicle electrification, defined as the use of electrical power for the primary operation of automotive drive trains, auxiliary systems, turret motors and drives, and other mechanical subsystems using either hybrid-electric (HE) or all-electric (AE) solutions. With the objective of advancing vehicle electrification technologies in both commercial industry and in the military, the project team conducted a feasibility study that investigated technical aspects of electrification and potential crossovers between the civilian and military domains.

The team's primary researcher, Greg Lee, a program manager at QinetiQ, has twenty years of experience as an Army armor officer. After writing an Army Futures Command white paper, "Electrification of U.S. Army Ground Force (An Evolutionary Revolution)," he began working with QinetiQ on this CTMA project. Along with a small team of engineers and researchers, Lee created a

campaign plan to transition the Army to AE vehicles.

"Both industry and policy are driving the Army towards electrification," said Lee. "No later than 2035, the Army wants to have its entire non-tactical vehicle (NTV) fleet be all electric and should have fielded its first purpose-built HE tactical vehicles."

Lee and his collaborators conducted a feasibility study to determine the operational and maintenance benefits associated with electric propulsion and energy storage systems for medium-duty and heavy-duty vehicles. By using the Army's tactical wheeled vehicle (TWV) and combat vehicle (CV) fleets as a surrogate, the team demonstrated how it could be possible to transition to electric propulsion and energy storage systems within the medium- and heavy-equipment commercial sectors.

Through a market survey and a trade study, the team completed a comprehensive investigation into twenty-one companies that build, supply, and support electric vehicles (EVs). This research focused on vehicle architecture trade-offs, supply chain capabilities, and access to strategic materials. The initiative examined the process of transforming the Army's TWV and CV fleets to HE or AE platforms. Ultimately, the team produced a campaign plan for electrification of the Army's TWV and CV fleets.

Because HEs are well-positioned to be the transition point from internal combustion engines (ICE) to AE, the team recommended that the Army acquire its next TWVs and CVs purpose-built as parallel hybrid-electrics (P-HEs) with an upgradable configuration to AEs. The collaborators determined that P-HE vehicles would produce the most benefit for TWVs and CVs, because P-HE vehicles can use either the ICE or the motor/generator to power the vehicle if

one of the systems is damaged. This can save future funding dollars with near-term investment and provide the ability to ease the transition from fossil fuels to electric.

“My mantra is ‘cut the fossil fuel tether,’” Lee said. “The Army is focused on the tactical benefits of electrification. But electrification also provides operational and strategic-level benefits. I built a plan focused on readiness and logistics. We had to shape the logistics trains [for TWVs] before we could focus on electrifying combat vehicles.”

The study further recommended that the purpose-built P-HEs contain a super capacitor (SCAP) hybrid system where super capacitors are used to store energy and then disburse it to electrical components. Super capacitors are best when used with kinetic energy recapture systems (KERS) and provide redundancy for emergency maneuvering or battlefield damage assessment and repair (BDAR). SCAP hybrid systems, when paired with KERS, have the capability to self-charge in austere environments.

While electrification has many benefits, this process also presents challenges and risks. At the top of the list, the ability to recharge a fleet of vehicles in austere regions will require access to a substantial amount of power. Until higher capacity batteries that can last substantially longer are developed, AE combat vehicles would be restricted to regions with an established power-grid. Beyond the power issue, when the team examined the supply chain for EVs, they emphasized a strategic vulnerability: America effectively relies on imports for 70 percent of its strategic metals, including those used in HE and AE batteries, as indicated by a 2017 USGS report. Moreover, China is home to at least 90% of the world’s capacity to process rare earth ores into material that manufacturers can use for EV batteries, according to research firm Adamas Intelligence. The US must adjust regulations to secure its electric battery supply chain.

“The big risk of going all electric,” Lee said, “is that we need to solve the production of rare earth minerals, and its manufacture into products, in order to close a major strategic vulnerability to China.”

Additionally, software is a critical component in EVs, so the code and embedded code on microchips must be protected from cyberattacks and hacking.

The team concluded their work by making six recommendations. First, the US should increase its

investment in advanced electrification technologies immediately. Second, the Army must lobby the DOD to assist the Department of Energy and the Environmental Protection Agency with modifying regulations and securing the electric supply chain and rare earth materials. Third, the team produced a campaign plan to tie the modernization of non-tactical vehicle, TWV, and CV fleets together. Fourth, the Army should aim at producing HE and HE upgradable to AE (HE-AE) TWVs within the next ten years. Fifth, the Army must invest in battery storage technology development. Finally, the Army should invest R&D into KERS to provide backup or emergency recharging methods.

The findings from this project will help crystallize the approaches needed to advance vehicle electrification in the auto industry. The average EV in the US today produces the emissions equivalent of a gasoline car that gets 73 miles per gallon, and the emissions performance of EVs will only improve over time. Electric vehicles can save commercial industry and consumers on maintenance costs—an estimated \$1,500 over the life of the vehicle, compared to a gasoline-powered version of their vehicle. Increased use of EVs in the medium- and heavy-equipment commercial sectors will produce far fewer emissions than traditional gasoline/diesel-powered vehicles, decrease noise pollution, improve air quality, and reduce public health impacts. Overall, EVs are estimated to cut US oil use by 1.5 million barrels a day by 2035.

The team’s research found that if the Army converted its light wheel fleet of 110,913 vehicles to HE it could save in fuel, parts, and maintenance at between \$3.19 billion and \$5.40 billion annually. If the light wheeled fleet is upgraded to AE, then the savings increase to between \$6.43 billion and \$7.39 billion annually. These savings will not be unique to the military and industry potentially will find a higher cost-benefit.

The Army can use the fossil fuel savings and reinvest them into AE vehicle development and acquisition. Electrification brings the Army in line with reducing its carbon footprint and potentially achieving a net zero garrison footprint in the US. In addition to cost savings and reduced reliance on fossil fuels, major benefits of modernizing to AE TWV and CV fleets include increasing strategic and operational flexibility, achieving tactical silent capabilities, reducing logistical convoys and personnel, and requiring smaller fuel depots. Electrification has the potential to unlock strategic, operational, and tactical advantages for decades to come. ■

NCMS Investigates Best Practices for Technology Transition



The term “valley of death” is used throughout the business world to describe the difficulty of developing, demonstrating, and scaling promising new inventions into sustained use. The term is ubiquitous because only a tiny percentage makes the journey. Many have tried, but most have failed.

In the summer of 2022, two NCMS interns, Katie Wells and Braden Crimmins, worked on cracking the code of technology transition through an internship program run by the University of Michigan’s Tauber Institute for Global Operations.

Their research focused on two main questions. How do industry, academia, and government technologists bridge the “valley of death”? And what separates the technologies that fail from those that succeed? Their goal was to identify common criteria and to build a model that predicts which technologies are most likely to successfully transition. While this work was done primarily in the Department of Defense (DOD) technology space, the research could be applicable and adaptable in the private sector.

“I’ve always been interested in technology innovation,” said Crimmins, who is working on a master’s degree in computer science. “Since I’ve been an undergraduate, I’ve researched various technologies that I believe will make the world a better place. This internship focused on how to make technologies like those a reality, and I knew it would give me some valuable insights.”

Wells, who is completing an MBA, said, “I wanted to work for NCMS because I was looking for an

operations and process experience. I have a background in HR and the NCMS project enabled me to look at processes solving for success. I was able to take the work I’ve done in my former HR career and bring it into the technology sector.”

Throughout the summer, Wells and Crimmins gathered input from industry, DOD, and academic leaders who are active in technology transition. They interviewed individuals, conducted surveys, attended technology conferences, and completed facility tours to gain as many perspectives and insights as possible.

After completing interviews and surveys—from across government, industry, academia, and NCMS—the team compiled their data and made some key findings. Among them were the following:

There are many different perspectives on what constitutes successful technology transition. Oftentimes one of the roadblocks to technology transition is that the DOD, OEMs, start-ups, and academia have different definitions of what is required for success. After interviews elicited a wide range of answers, the interns asked survey respondents to choose among four main definitions: a prototype has been created; a finished product has been piloted or demonstrated; a product has been integrated into a local facility; or a product has been adopted enterprise-wide. Among those choices, a plurality defined technology transition as “local integration of a new tool.”

Successful transitions require different factors, depending on the type of technology. For example,

software transitions require different considerations than hardware. Regardless, one common theme emerged among interviewees and two-thirds of survey respondents: transition partnerships should be initiated when the technology has reached a specific range in technology readiness levels (TRL)—typically TRL 3 to 6.

Adopter need was identified as the most important factor for technology transition success—i.e., there must be “user pull,” rather than “technology push.” However, high-level stakeholder buy-in is also critical for gaining momentum throughout organizations in support of transition.

Most new technologies that offer major benefits also involve major disruption. On a spectrum between 1 and 100, where 1 means a technology with very little change or benefit and 100 means large benefits but substantial difficulties involved, a small range was expected to be identified for optimal technology transition. Instead, responses were clustered around two different marks, at 25 and 75. This means some respondents tend to think it's easier to make incremental changes with small benefits, while others tend to think major improvements are worth the difficulties that come with them.

Based on their research, the team built an adaptable model that systematizes seven key dimensions of preparedness required for successful technology transitions. The interns found two things about this model to be surprising: that technology maturity is only one dimension, and that not all factors will apply the same way for each transition.

The team pressure-tested their model with various vendors and confirmed that they captured the key attributes of the process. Additionally, they built the model generically enough so that it can be adjusted to meet the specific needs of the vendor, adopter, and transitioning technology. This work advances NCMS's mission to develop, demonstrate, and transition innovative technologies efficiently, with less risk and lower cost.

“A concerted effort is underway within the defense enterprise to bridge the ‘valley of death,’” said Christopher Fick, Strategic Communications Project Manager at NCMS, who led the effort. “Understanding the issues from all perspectives and eliminating the roadblocks significantly impacts warfighter readiness. This work is vital for NCMS. The result of this research will enable NCMS to increase the value we deliver to our members, partners, and customers.” ■



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THROUGH INNOVATION AND MANUFACTURING EXCELLENCE.

Meet Globe Tech

Over the last twenty years, what was once a one-room tool and die shop has grown to a world-class facility with more than 70 diverse and dynamic employees. Globe Tech was founded in 2003, and although its core business has evolved, its primary principle remains unchanged: Globe Tech serves those who serve. As a woman-owned small business (WOSB), Globe Tech manufactures world-class systems and components to serve a broad array of customers, ranging from all military branches, to tier-one automotive suppliers for tooling and production, to commercial markets. The company has invested in solutions and technologies to ensure the safety and security of this country and, ultimately, to save lives.

From design, to machining, to welding, Globe Tech's extensive list of capabilities are all done in-house. Globe Tech serves a variety of industries, including aerospace, for which they provide machining, assembly, and welding. The company also offers stamped and fabricated products, prototypes, tools, gauges, and designs, as well as worldwide program management and procurement, all while maintaining the highest quality and safety standards that include: IATF 16949:2016, VDA 6.3, ISO 9001:2015, A2LA 17025, AS 9100, and CMMC compliance. Globe Tech has experience in effective project execution under tight timelines and inconsistent source availability. With over 176,000 square feet of prime manufacturing space, Globe Tech is vertically integrated to provide its customers with a multi-faceted experience.

Globe Tech's skilled associates define the organization's culture of continuous innovation. With this, Globe Tech continues to strive and meet the ever-changing needs of tomorrow and to execute its mission: serving those who serve, safely and sustainably, through innovation and manufacturing excellence. ■