3 in 1 Portable Surface Preparation System

2023 Maintenance Innovation Challenge (MIC) Winner

Final Report

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Acronyms and Abbreviations

Term	Definition
APS	Atmospheric Plasma Solutions
CTMA	Commercial Technologies for Maintenance Activities
DOD	Department of Defense
LSV	Logistics Support Vessel
MEK	Methyl Ethyl Ketone
MIC	Maintenance Innovation Challenge
NAVSEA	Naval Sea Systems Command
NCMS	National Center for Manufacturing Sciences
NDI	Non-Destructive Inspection
ODASD-MR	Office of the Deputy Assistant Secretary of Defense, Materiel Readiness
R&D	Research and Development
REPTX	Repair Technology Exercise
TACOM	Tank-automotive and Armaments Command
U.S.	United States

1. Executive Summary

The Maintenance Innovation Challenge (MIC) Winner initiative, titled "3-in-1 Portable Surface Preparation System," addressed a critical gap in the Department of Defense (DOD) maintenance enterprise related to safe, rapid, and effective surface preparation in austere and operationally relevant environments. The problem stemmed from the need to reduce reliance on hazardous chemical processes and manual abrasion techniques that limit repair agility, pose health risks, and degrade efficiency in field and depot maintenance scenarios.

The need for a versatile, non-destructive, and mobile surface preparation system was evident across multiple DOD maintenance environments – particularly where corrosion, coating degradation, or weld preparation were limiting mission readiness. This collaborative effort focused on advancing and transitioning Atmospheric Plasma Solutions' (APS) patented PlasmaBlast 7000-M system, a portable atmospheric plasma device engineered to support corrosion mitigation, composite repair, weld prep, and coating removal in both shipboard and airframe applications.

The project team, supported under NCMS Project # 110453, conducted coordinated planning, hands-on demonstrations, and multi-service training sessions. The approach included participation in high-visibility DOD exercises such as Naval Sea Systems Command (NAVSEA) 05T's Repair Technology Exercise REPTX 2024 Salvage Exercise aboard USS Tarawa, live demonstrations for the 916th Support Brigade at the National Training Center, and field evaluation events at Hill Air Force Base. At these events, the PlasmaBlast 7000-M was utilized to perform targeted removal of corrosion, coatings, sealants, and other debris in mission-representative scenarios ranging from pipe flange repairs to composite bonding surface prep.

A significant milestone occurred on January 27, 2025, during a live demonstration hosted onboard the Army's Logistics Support Vessel LSV-1, involving personnel from Tank-automotive and Armaments Command (TACOM) and the 7th Transportation Brigade. The demonstration highlighted the efficiency of the PlasmaBlast 7000-M in removing corrosion and paint from shipboard surfaces in real-time applications. The event included a live operational walk-through of several maintenance scenarios requested by the ship's crew. Feedback from the demonstration was highly favorable. Attendees expressed strong interest in advancing procurement efforts for the Army's watercraft and ground vehicle fleets. Specific applications included corrosion prevention and mitigation, paint removal, and adhesion promotion for follow-on coatings.

Outcomes of the broader initiative demonstrated the PlasmaBlast 7000-M system's adaptability and effectiveness across diverse maintenance environments. Benefits achieved included:

- Accelerated surface prep times and improved coating/weld adhesion.
- Reduced exposure to hazardous materials and consumables.
- Increased mobility for in-field maintenance operations.
- Cross-platform applicability from shipyards to flight lines and watercraft operations.

Transition of the technology was actively pursued through onsite demonstrations and stakeholder engagements at key facilities. User training and field adoption were advanced at Norfolk Naval Shipyard, Hill Air Force Base, the National Training Center, and with Army watercraft personnel. Follow-up actions are in place with TACOM and Army commands to support broader adoption and field integration.

Partners involved in the project included APS, NCMS, and operational end-users from NAVSEA, U.S. Army, and U.S. Air Force organizations. Collaboration with the Commercial Technologies for Maintenance Activities (CTMA) Program enabled structured support, technical vetting, and deployment coordination.

No inventions were disclosed, and no negative findings were reported throughout the project duration.

Funding was secured for the collaborative initiative through the National Center for Manufacturing Sciences (NCMS) CTMA Program and the Office of the Deputy Assistant Secretary of Defense, Materiel Readiness (ODASD-MR).

1.1 Results

The demonstration of the PlasmaBlast 7000-M system yielded significant outcomes, underscoring its potential to revolutionize maintenance operations within the DOD and offering broader benefits to the general public.

The PlasmaBlast 7000-M system demonstrated over 90% labor savings compared to traditional methods such as abrasive blasting and chemical stripping. Its quick setup time – operational in under 5 minutes – minimizes equipment downtime, enhancing overall maintenance efficiency. Key stakeholders expressed strong interest in adopting the system, recognizing its potential to improve maintenance operations. The system operates without hazardous chemicals or abrasive materials, reducing environmental impact and eliminating the need for extensive containment measures. Its ergonomic design and absence of harmful emissions enhance operator safety and comfort during prolonged use. The PlasmaBlast 7000-M was selected as the winner of the 2023 DOD MIC, affirming its value and effectiveness in military maintenance applications.

For the DOD, the system offers significant cost avoidance by reducing labor hours and eliminating the need for consumables like solvents and abrasive media. Faster maintenance turnaround times enhance the readiness and availability of military assets. For the general public, the eco-friendly nature of the PlasmaBlast 7000-M contributes to reduced environmental pollution and hazardous waste generation. The success and adoption of innovative technologies like the PlasmaBlast 7000-M can stimulate job creation and support small business growth within the defense industry.

In summary, the PlasmaBlast 7000-M system has demonstrated substantial benefits in terms of efficiency, safety, environmental impact, and cost savings, positioning it as a transformative tool in military maintenance operations with positive implications for broader public interests.

1.2 Benefits

The deployment of the PlasmaBlast 7000-M system has brought substantial advantages to both the DOD and the general public, enhancing operational efficiency, environmental safety, and economic growth.

Benefits to DOD

- **Enhanced Operational Readiness:** The PlasmaBlast 7000-M system accelerates maintenance processes by removing coatings at twice the rate of traditional methods such as

needle guns and wire brushes. This efficiency reduces equipment downtime, thereby improving the readiness of military assets.

- **Cost Savings:** By eliminating the need for consumables like blast media and hazardous chemicals, the system reduces material costs. Additionally, its quick setup time – operational in under five minutes – minimizes labor expenses associated with maintenance tasks.
- **Improved Safety:** The non-thermal plasma technology reduces operators' exposure to harmful noise and vibrations inherent in traditional mechanical methods, enhancing workplace safety.

Benefits to the General Public

- **Environmental Protection:** The PlasmaBlast 7000-M operates without the use of environmentally harmful chemicals, converting removed coatings into primarily carbon dioxide and water vapor. This process significantly reduces environmental pollution and hazardous waste generation.
- **Economic Growth:** The success and adoption of innovative technologies like the PlasmaBlast 7000-M stimulate job creation and support small business growth within the defense industry. APS, the developer of the system, exemplifies how small businesses can contribute to national defense capabilities while driving economic development.

In summary, the PlasmaBlast 7000-M system offers a transformative approach to maintenance operations, delivering significant benefits to the DOD through improved readiness, cost savings, and safety, while also contributing to environmental protection and economic growth for the public.

1.3 Recommendations

Following the successful demonstration and evaluation of the PlasmaBlast 7000-M system, several strategic actions are recommended to facilitate its integration into DOD maintenance operations and to maximize its benefits for both military and civilian applications:

- The development of comprehensive training programs is essential. Establishing standardized training modules for maintenance personnel will ensure proficient operation of the PlasmaBlast 7000-M system. Incorporating both theoretical instruction and practical application will build confidence and competence among users.
- Integrating the PlasmaBlast 7000-M system with existing predictive maintenance strategies can enhance equipment readiness and reduce unplanned downtime. Leveraging the system's capabilities in conjunction with predictive maintenance initiatives aligns with recommen–dations to organize, plan, and measure shifts to predictive maintenance for continued improvements.
- Establishing metrics for performance evaluation is crucial. Developing key performance indicators (KPIs) to monitor the system's effectiveness – including metrics on cost savings, labor efficiency, and environmental impact – will inform decision-making and continuous improvement efforts.
- Engaging with industry and public stakeholders is recommended. Collaborating with industry partners and public agencies to explore broader applications of the PlasmaBlast

7000-M technology can foster innovation, drive economic growth, and enhance public-private partnerships.

Implementing these recommendations will facilitate the effective adoption of the PlasmaBlast 7000-M system, yielding significant benefits in maintenance efficiency, cost savings, and environmental sustainability for both the DOD and the general public.

1.4 Invention Disclosure

☐ Yes Inventions ☒ No Inventions

DD882 Invention Report sent to NCMS ☒

1.5 Project Partners

- Atmospheric Plasma Solutions, Inc. (APS)
- National Center for Manufacturing Sciences (NCMS)

2. Introduction

2.1 Background

The DOD continues to prioritize technologies that enhance readiness, reduce sustainment costs, and improve the safety and efficiency of maintenance operations across diverse platforms. One persistent challenge across land, air, and sea-based assets is the time-consuming and hazardous nature of surface preparation processes required for corrosion mitigation, coating removal, and bonding preparation. Traditional methods often involve abrasive blasting, chemical stripping, or manual grinding, each of which introduces safety, environmental, or logistical drawbacks – particularly in operational environments and confined spaces.

2.2 Purpose

The purpose of this project was to evaluate, demonstrate, and accelerate the transition of the PlasmaBlast 7000-M, a portable atmospheric plasma surface preparation system, into operational use across the DOD maintenance enterprise. The initiative aimed to validate the system's effectiveness in replacing or supplementing traditional surface preparation methods – such as chemical stripping, abrasive blasting, and mechanical abrasion – while improving safety, reducing hazardous waste, and enhancing maintenance efficiency.

2.3 Scope/Approach

The project was structured to methodically evaluate and demonstrate the capabilities of the PlasmaBlast 7000-M developed by APS. The approach encompassed collaborative engagements with various DOD maintenance entities to assess the system's effectiveness across diverse operational environments.

Key phases of the project included:

1. **Stakeholder Engagement and Planning**: Identifying and coordinating with key military maintenance facilities and personnel to establish demonstration sites and objectives.
2. **On-Site Demonstrations and Training**: Deploying the PlasmaBlast 7000-M system to selected sites, providing hands-on training to maintenance personnel, and conducting live demonstrations on actual equipment and surfaces.
3. **Performance Evaluation**: Collecting feedback from end-users regarding the system's efficiency, safety, and integration into existing maintenance workflows.
4. **Data Analysis and Reporting**: Analyzing collected data to assess the system's performance metrics and compiling comprehensive reports for stakeholders.
5. **Transition Planning**: Collaborating with stakeholders to develop strategies for the potential adoption and procurement of the PlasmaBlast 7000-M system within their respective maintenance operations.
6. **Target Solution**

The primary objective was to introduce a portable, efficient, and safe surface preparation system capable of addressing common maintenance challenges such as corrosion removal, paint stripping,

and surface cleaning without the drawbacks of traditional methods. The PlasmaBlast 7000-M system offers:

- **Portability**: Weighing less than 40 lbs, the system is designed for single-person transport and quick deployment in various settings, including confined spaces and field environments.
- **Efficiency**: Demonstrated over 90% labor savings compared to traditional methods, with setup times under 5 minutes and no need for adjustments during operation.
- **Safety and Environmental Benefits**: Eliminates the use of hazardous chemicals and abrasive materials, reducing health risks and environmental impact.
- **Versatility**: Effective on a wide range of materials and coatings, suitable for applications across naval, ground, and aerospace maintenance operations.

The project aimed at achieving the following goals and deliverables:

- **Demonstrate System Capabilities**: Showcase the PlasmaBlast 7000-M's effectiveness in real-world maintenance scenarios across various DOD facilities.
- **Train Maintenance Personnel**: Provide comprehensive training to end-users to ensure proficient and safe operation of the system.
- **Collect Performance Data**: Gather quantitative and qualitative data on the system's performance, user feedback, and potential areas for improvement.
- **Develop Transition Strategies**: Collaborate with stakeholders to outline procurement processes, integration plans, and potential scaling of the technology within their operations.
- **Produce Comprehensive Reports**: Compile detailed documentation of findings, including performance metrics, user testimonials, and recommendations for future adoption.

By systematically addressing these objectives, the project sought to validate the PlasmaBlast 7000-M as a viable solution for enhancing maintenance efficiency, safety, and effectiveness across the DOD's diverse operational environments.

3. Project Narrative

DOD continues to prioritize technologies that enhance readiness, reduce sustainment costs, and improve the safety and efficiency of maintenance operations across diverse platforms.

APS previously developed and validated its PlasmaBlast technology under multiple government-funded programs aimed at evaluating plasma-based solutions for surface decontamination, coating removal, and functional surface modification. These prior efforts demonstrated the safety, effec–tiveness, and versatility of the PlasmaBlast platform in non-traditional environments and formed the foundation for further development into ruggedized, portable formats.

The need was driven by a growing demand for a multi-functional, mobile surface preparation solution that could address a wide range of military maintenance needs. Specifically, the aim was to deliver a tool that could operate safely in field and depot conditions, minimize secondary waste, eliminate the use of hazardous chemicals, and integrate into existing repair workflows with minimal training or infrastructure requirements.

In response to a persistent challenge across the DOD maintenance community – namely the need for safer, more efficient surface preparation methods – APS embarked on a collaborative initiative under NCMS Project #110453 awarded through the MIC, marking it as a priority candidate for accelerated development and transition to demonstrate and transition its patented PlasmaBlast 7000-M technology.

The purpose of this project was to evaluate, demonstrate, and accelerate the transition of the PlasmaBlast 7000-M, a portable atmospheric plasma surface preparation system, into operational use across the DOD maintenance enterprise (Figure 1). The initiative aimed to validate the system's effectiveness in replacing or supplementing traditional surface preparation methods – such as chemical stripping, abrasive blasting, and mechanical abrasion – advancing a capability that addresses critical performance, safety, and operational readiness gaps in existing surface preparation methods in corrosion prevention, coating removal, and surface prep in both field and depot-level maintenance activities.

Figure 1. Image of PlasmaBlast 7000-Mobile System

Specifically, the project was designed to achieve the following objectives:

- Demonstrate the PlasmaBlast 7000-M system across representative maintenance environments including shipyards, air bases, and field support units.
- Train end-users and maintenance personnel to evaluate usability, effectiveness, and potential integration.
- Assess performance in corrosion mitigation, paint and coating removal, adhesion promotion, and weld preparation.
- Support technology transition efforts by engaging operational stakeholders, gathering user feedback, and refining deployment strategies for both maritime and ground-based applications.

This effort was aligned with the broader goals of improving mission readiness, reducing sustainment costs, and equipping military maintenance teams with modern, versatile, and safe technologies that can be deployed at the tactical edge.

3.1 What Was Done

The PlasmaBlast 7000-M system was introduced and tested in real-world scenarios across multiple services and environments. The following summarizes key project phases and events.

3.1.1 Kickoff and Early Planning (Q2 2024)

The project officially launched in May 2024. APS collaborated with NCMS to develop a project execution plan outlining key demonstration sites, stakeholders, and evaluation criteria. Coordination began for upcoming field demonstrations at Navy, Army, and Air Force maintenance sites.

3.1.2 NAVSEA REPTX 2024 Salvage Exercise – Pearl Harbor (May-June 2024)

The first major demonstration took place during the NAVSEA 05T REPTX 2024 Salvage Exercise aboard the decommissioned USS *Tarawa*. APS engineers conducted onsite user training for approximately 250 Sailors and participated in multiple repair scenarios involving simulated battle damage (Figure 2).

The PlasmaBlast 7000-M was originally slated for use in two of the eight scenarios, but due to its effectiveness, it was requested for nearly all scenarios. Applications included:

- Corrosion and gasket removal from pipe flanges
- Coating removal for composite patching and sealant application
- Cleaning brass fittings and threaded surfaces
- Preparing gouged metal surfaces for composite bonding or fastener repair

3.1.3 Norfolk Naval Shipyard Training (August 2024)

Following REPTX, APS conducted a weeklong training course for maintenance personnel from Shops 71 and 56 at Norfolk Naval Shipyard. A total of 35 workers received hands-on experience with the system, preparing them for future adoption in shipyard workflows.

Figure 2. Navy Maintainer Performing Coating Removal Aboard Decommissioned USS Tarawa

3.1.4 Hill Air Force Base & National Training Center Demonstrations (December 2024)

APS demonstrated the PlasmaBlast 7000-M to maintenance teams at Hill Air Force Base and the 916th Support Brigade at the National Training Center. Focus areas included:

- Coating removal from aerospace-grade aluminum and composites
- Replacing use of Methyl Ethyl Ketone (MEK) solvents and chemical strippers
- Weld prep for structures requiring non-destructive inspection (NDI)

Strong interest was expressed in using the system on ground support equipment and in flight line maintenance, particularly for final-stage precision cleaning following laser paint removal.

3.1.5 Army Watercraft Fleet and Ground Vehicle Evaluation – LSV-1 (January 2025)

APS demonstrated the PlasmaBlast 7000-M onboard LSV-1 to key decision-makers from TACOM and the 7th Transportation Brigade. The demonstration began with a training aid, then moved to several live-use cases onboard the ship (Figure 3). The team simulated actual shipboard maintenance tasks using the system, including corrosion and paint removal. Feedback was strongly positive, and follow-up actions were initiated to explore Army-wide adoption, both for watercraft and ground vehicle fleets.

Figure 3. Demonstration of PlasmaBlast 7000-M Technology to Army Personnel (left); Removal of Coating and Light-Corrosion Aboard LSV-1 (right)
Red circle shows surface preparation down to base metal

3.2 How Was It Done

The project followed a systematic approach involving:

1. **Planning and Stakeholder Coordination –** Identification of suitable sites and alignment with user priorities across services.
2. **Onsite Demonstrations and Training –** APS engineers deployed the system and trained end users at each location.
3. **Performance Evaluation –** Maintenance teams used the system in real-world repair scenarios. Feedback was documented.
4. **Technology Refinement –** User input was used to improve operational procedures and determine logistics support needs.
5. **Transition Strategy Development –** Based on performance and stakeholder interest, APS and NCMS supported planning for procurement and broader deployment.

The PlasmaBlast 7000-M proved to be an effective, adaptable solution to meet the DOD's surface preparation needs across diverse platforms. The project successfully demonstrated that the technology could reduce hazardous material use, improve maintenance efficiency, and support cross-service maintenance modernization goals (Table 1). Based on the results of this project, discussions for procurement and continued testing are now underway with Army, Navy, and Air Force stakeholders.

Table 1. Overview of Demonstration Sites with Key Outcomes

Demonstration Site	Date	Key Applications	Result
NAVSEA REPTX – Pearl Harbor	May–June 2024	Coating removal, weld prep, corrosion mitigation	Used in 6 of 8 scenarios; deemed highly effective
Norfolk Naval Shipyard	August 2024	Shipyard training	35 workers trained across 2 shops
Hill Air Force Base	December 2024	Aerospace composite prep, NDI surface cleaning	Identified for flight line deployment
NTC/916th Support Brigade	December 2024	Ground vehicle corrosion and surface prep	Positioned for use in future rotations
LSV-1/TACOM Evaluation	January 2025	Watercraft corrosion & paint removal, adhesion promotion	Strong Army interest in procurement

4. Conclusions

The PlasmaBlast 7000-M system has demonstrated significant advancements in military maintenance operations through a series of successful demonstrations and training sessions across various DOD facilities.

On January 27, 2025, the system was showcased aboard LSV-1, effectively removing paint and corrosion from ship components. Key stakeholders, including Tim Pike from TACOM and Kenneth Brown from the Army's Watercraft Fleet, observed the demonstration and expressed interest in adopting the technology within their respective domains, recognizing its potential to enhance maintenance efficiency and reduce environmental impact.

Earlier, during the NAVSEA 05T REPTX 2024 Salvage Exercise held in May-June 2024 aboard the decommissioned USS Tarawa, the PlasmaBlast 7000-M was initially slated for use in two of eight repair scenarios. However, due to its effectiveness, it was requested for nearly all scenarios, including corrosion and gasket removal from pipe flanges, coating removal for composite patching, cleaning brass fittings, and preparing gouged metal surfaces for composite bonding. Approximately 250 Sailors, civilians, and contractors collaborated in these scenarios, evaluating simulated battle damage and developing repair solutions using emerging technologies.

Following REPTX, in August 2024, a weeklong training course was conducted at Norfolk Naval Shipyard for maintenance personnel from Shops 71 and 56. A total of 35 workers received hands-on experience with the PlasmaBlast 7000-M system, preparing them for future adoption in shipyard workflows.

In December 2024, demonstrations were held at Hill Air Force Base and the National Training Center, focusing on coating removal from aerospace-grade aluminum and composites, replacing the use of MEK solvents and chemical strippers, and weld preparation for structures requiring non-destructive inspection. Maintenance teams expressed strong interest in utilizing the system for ground support equipment and flight line maintenance, particularly for final-stage precision cleaning following laser paint removal.

Collectively, these demonstrations and training sessions underscore the PlasmaBlast 7000-M system's versatility and effectiveness in various maintenance scenarios, highlighting its potential to enhance operational readiness, reduce environmental impact, and improve maintenance efficiency across multiple branches of the DOD.

4.1 Key Outcomes

- **Effective Demonstration:** The PlasmaBlast 7000-M effectively removed paint and corrosion from various ship components, demonstrating its efficiency and precision in real-world scenarios.
- **Positive Stakeholder Feedback:** Attendees were impressed by the system's performance, highlighting its potential to enhance maintenance operations.
- **Interest in Procurement:** Both Tim Pike and Kenneth Brown expressed interest in adopting the system within their respective domains, recognizing its value in improving maintenance efficiency and reducing environmental impact.

4.2 Impact and Next Steps

The successful demonstration has paved the way for potential procurement and integration of the PlasmaBlast 7000-M system into the Army's maintenance operations. Follow-up discussions are planned with NAVSEA to determine procurement quantities and implementation strategies for the watercraft fleet. Similarly, ARMY/TACOM is coordinating with R&D and Futures Command to explore testing opportunities for ground vehicle applications.

In summary, the project has effectively demonstrated the PlasmaBlast 7000-M's capabilities, garnering strong interest from key stakeholders and setting the stage for its potential adoption across various Army maintenance sectors.

5. Project Benefits

The deployment of the PlasmaBlast 7000-M system has yielded substantial advantages for both the DOD and the general public. These benefits encompass cost savings, enhanced productivity, business growth, and improved readiness.

5.1 Benefits for the General Public

- Environmental Impact
  - Eco-Friendly Operation: The solvent-free process reduces environmental pollution and eliminates the generation of hazardous waste.
  - Reduced Noise and Emissions: The system operates quietly and without harmful emissions, contributing to a safer and cleaner environment
- Economic Growth
  - Support for Small Businesses: The success of APS, a small business, in developing and deploying this technology exemplifies the positive impact of DOD investments in innovation.
  - Job Creation: The adoption of advanced maintenance technologies can lead to the creation of specialized jobs in manufacturing, training, and support services.

5.2 Benefits for DOD

- Cost Avoidance and Operational Savings
  - Labor Efficiency: The PlasmaBlast 7000-M has demonstrated over 90% labor savings compared to traditional methods like abrasive blasting and chemical stripping.
  - Reduced Material Costs: By eliminating the need for consumables such as solvents and abrasive media, the system lowers both procurement and disposal expenses.
  - Minimal Setup Requirements: The system's rapid deployment – operational in under 5 minutes – reduces downtime and associated costs.
- Enhanced Productivity
  - Versatility: Effective on various substrates and coatings, the system streamlines maintenance processes across different platforms.
  - Safety and Ergonomics: The ergonomic design and elimination of hazardous emissions improve operator safety and reduce fatigue.
- Readiness Improvements
  - Rapid Maintenance: Accelerated coating removal and surface preparation enhance the turnaround time for equipment maintenance, directly impacting operational readiness.
- Field Deployability
  - Portable nature of the system allows for onsite maintenance, reducing the need to transport equipment to specialized facilities.