# Premature Battery Failure in Maintenance

## A Costly Battle Against Time

*By Chief Warrant Officer 2 Matthew Swift*

In the dynamic world of maintenance and operations, time is a nonrenewable resource that dictates the efficiency and effectiveness of processes. Among the numerous challenges that plague readiness, premature battery failure stands out as a significant contributor to operational inefficiencies, costing organizations over $75 million annually in lost time and resources. On average, the typical vehicle battery in the Army must be replaced every 12 months.

### The Value of Time in Maintenance

In maintenance, time equates to productivity and cost efficiency. Each minute saved in maintenance operations leads to substantial cost savings and increased operational uptime. Conversely, unplanned downtime due to equipment failure, such as batteries in critical equipment, results in a direct loss of mission accomplishment. This loss is not just measured in the immediate downtime but also in the ripple effect it causes, such as delayed schedules, increased workload, and the rush to catch up once the issue is resolved.

### Premature Battery Failure: A Core Issue

Batteries, often critical components in many pieces of equipment, are susceptible to a variety of failure modes. These range from manufacturing defects to improper usage (operator error) to underlying parasitic draws. When batteries fail prematurely, they not only necessitate immediate replacement but also cause unplanned downtime for repairs. This scenario is especially problematic in training and wartime scenarios that rely on combat platforms, transportation, or uninterrupted power supply systems, where battery failure can halt entire operations.

### Cost Implications of Battery Failures

The financial implications of premature battery failure are profound. It costs the DoD over $75 million per year,

confirming this issue's severity. This figure encapsulates not just the cost of replacing batteries but also the indirect expenses associated with downtime, such as lost production, labor costs for troubleshooting and repair, and potential penalties. In a world where time-sensitive operations such as logistics and sustainment are critical, the impact is even more pronounced.

## Loss of Man-Hours and Productivity

One of the most significant impacts of premature battery failure is the loss of valuable man-hours. Maintenance teams spend countless hours identifying, diagnosing, and resolving battery-related issues. This time could be used for preventive maintenance or other productive tasks. The diversion of resources to address battery failures also leads to a backlog of other maintenance activities, creating a cycle of inefficiency and decreasing overall productivity.

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The issue of premature battery failure in the maintenance world is a multifaceted problem with far-reaching implications. It is not just a matter of replacing a faulty component; it represents a substantial drain on both time and financial resources. So what can be done about it? Addressing this challenge requires a holistic approach that includes not only better training and maintenance practices but also the adoption of new technologies with longer lifespans and more robust performance. By tackling the root causes of premature battery failure, maintenance Soldiers can reclaim the valuable time and resources currently lost to this pervasive issue, ultimately enhancing operational efficiency.

## So Why Are Batteries Failing?

In military operations, the reliability of equipment is paramount. However, premature battery failure in military equipment is a recurring issue, compromising operational readiness and safety. This problem is predominantly attributed to parasitic draws, inadequate charging practices, and a lack of operator knowledge.

## Parasitic Draws: A Silent Culprit

Parasitic draws, or the small amounts of electric current that devices consume when they are switched off or in standby mode, are significant causes of battery drain in military equipment. These draws, although minimal in isolation, can cumulatively lead to substantial battery depletion, particularly in complex military systems with numerous electronic components. As a result, batteries can be drained unexpectedly, even when the equipment is not actively in use, leading to failure when the equipment is most needed.

## Inadequate Charging Practices

Proper charging is crucial for battery longevity. However, in the demanding and often unpredictable environment of military operations, charging protocols can be overlooked or improperly executed. Frequent partial charges, overcharging, or using incorrect chargers can significantly reduce a battery's lifespan. This situation is exacerbated in remote or harsh field conditions where access to appropriate charging facilities may be limited.

## Sulfation

Sulfation is a prevalent issue that occurs when batteries are left in a discharged state for an extended period. This process involves the accumulation of lead sulfate crystals on the battery plates, which can significantly hinder their performance and longevity. When a battery is not fully charged, sulfate crystals form and harden, making it difficult to dissolve back into the electrolyte. This crystallization reduces the battery's capacity and its ability to hold a charge, leading to weakened performance and,

ultimately, failure. Preventing sulfation involves regular charging and maintaining batteries at an optimal charge level to ensure longevity and efficiency.

## Lack of Operator Knowledge

The role of operator knowledge in preventing premature battery failure cannot be overstated. Often, operators may not be fully trained on the battery maintenance requirements of their equipment. This lack of knowledge can lead to mishandling, such as incorrect installation, exposure to extreme temperatures, or neglecting signs of battery wear, all which can precipitate early failure.

## How Do We Fix It?

Three things maintenance warrant officers will never have enough of are time, manpower, and money. In a perfect world, maintainers would come out of advanced individual training with all the knowledge needed to accurately troubleshoot battery issues. Tank-automotive and Armaments Command, Communications-Electronics Command, Aviation and Missile Command, etc., would incorporate battery and charging system checks into their Optimized Equipment Service Plans checklist. Operators would learn all the knowledge needed to properly perform operator-level maintenance before driving out of the motor pool. However, that may never be an attainable goal. So, what does that leave? Other than employing a rigorous battery maintenance management program, which in itself is a very time-consuming program when implemented properly, solar may be a solution.

Department of the Army Pamphlet 750-1, Army Materiel Maintenance Procedures, states, "Commanders will use approved solar maintainers for equipment in the LUP (low-usage program), NCOMP or in outdoor storage." Looking at what solar maintainers are approved, options are very limited: 6- to 12-watt panels with pulse-width modulation (PWM) controllers. Research shows PWM controllers max out at about 65% efficiency on a perfect day, converting energy gathered from the sun to your batteries. Maintainers are also only designed to maintain the current charge; they are not chargers. They are designed to maintain your battery's existing percentage of charge, and on a perfect day, they are only doing that with a maximum efficiency of 65%. A study published by Combat Capabilities Development Command in 2021 for four-battery vehicle systems indicated solar input wattage is recommended to be in the range of 25 to 60 watts to even put a dent in our battery failure problem.

Solar technology has improved substantially over the last 20 years and continues to evolve with green initiatives, reducing our carbon footprint. Civilian manufacturers make solar charging systems ranging from 20 to 80 watts using maximum power point tracking controllers that are about 90% efficient at converting energy gathered from the Sun to your batteries. We tested many of the systems at Fort Liberty from 2019 to 2022 on everything from Humvees to 3 kW generators and from M777 howitzers to Joint Light Tactical Vehicles. The average infantry division spends roughly $1.2 to $1.5 million annually on battery replacement; we were able to reduce that by 70% by testing alternative solar charging solutions. We conducted an electro-spectrum test to ensure the systems were not emitting any radio frequency signals and constantly monitored the voltage for spikes and drops. We found a 100% success rate over three years—zero batteries failed. We had batteries as old as seven years that were still in perfect working condition.

So that leads to the next questions: What is actually approved by the Army? Who dictates that? How can we make use of better technology than what is currently available within the Army supply system?

In a world where our enemy is rapidly evolving and adapting to technological advancements, it is naïve to think we can just continue to use what we have without evolving and adapting ourselves. There is so much available technology out there, continually pushing the limits of what we think is possible. It is up to us to take the initiative, do our homework, and develop solutions for problems.

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