Before It Breaks

Study Reviews Preventive Maintenance for Small Arms

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A Soldier may clean his weapon daily or even more, but he rarely changes out its internal components. That may rapidly change.

A recent study funded by Program Executive Office (PEO) Soldier, the proponent for Army small arm weapons, found methods to estimate when small arm components fail. The findings of the study provide the foundation for truly preventative maintenance doctrine. Rather than waiting for parts to break, these estimates recommend replacing small arm components likely to fail before they actually do so. This will lead to technical manuals that will direct replacing such items as firing pins, bolts, bolt carriers and hammer springs on a routine basis, especially when the Soldier's unit is preparing for an operational deployment. It will do so not on the basis of months, but instead based on the weapon's actual use — the number of shots the weapon fired. The result will be weapons that are more reliable and riflemen that are more effective during operational missions.

What is proposed in this article is adopting a set of parameters for preventative exchange of small arm components similar to that currently used for combat vehicles, aircraft, and other mission critical equipment. Analogous to the "change oil every 3,000 miles" metrics for a vehicle, these measures support the position that is better and less expensive to change a firing pin than replace a weapon. Even more, a Soldier that uses preventative maintenance on his weapon will be more confident in the performance of that weapon and will be more effective in his mission.

Current Policy — Replace When Broken

When a Soldier draws a weapon from the arms room, many times there is little — if any — historical information on that item. In many units, there are so many weapons that it is not feasible to track all the previous information or repair records in either paper or 5988-E forms. In those cases, a Soldier can only take the weapon, perform a functions check, clean it if necessary and then boresight it once on a range. Beyond the standard functions check, there were few pre- or post-operation checks a Soldier or his leaders could perform to determine if components in that weapon were expected to last through the next deployment, next mission, or next magazine.

That scenario may have been acceptable in the past, but the work of Soldier as a System, Land Warrior, Ground System Soldier, and other programs made the rifle and the rifleman a critical component in the global war on terrorism. The small arms rifle is now the core of a very complex weapon system that has day and night vision optics, thermal imagery, and battle command sensors. This modern system can have strategic importance, especially as Future Combat System spin-off systems become employed. What was once a simple weapon worth a few hundred dollars is now a system of systems worth several thousand dollars. This cost does not include the resources to train the Soldier to maximize that system's potential. Now, the previously low priority small arm is central to what the rifleman can do and his impact within a larger battlespace. This renewed importance requires improved maintenance techniques to keep the rifle in operation. Because of this, it is reasonable to utilize proactive, condition-based maintenance policies that

A Soldier with the 1st Battalion, 38th Infantry Regiment, 4th Brigade Combat Team, 2nd Infantry Division, provides security during a patrol in Iraq.

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are already in place for more costly systems. Imagine you are preparing for a 12-month deployment to Southwest Asia. You are rather new to your unit, and do not have all the information on your platoon or company's equipment that you wish to have. What if, with little extra effort, you could determine the "health" of your weapons with a rapid diagnosis of simple to measure components? If, with about 30 seconds of work, you could know that of the past 100 weapons going into a deployment with the same number of total shots as yours, 25 percent of them had a broken bolt during that deployment. That would put your weapon with a 25 percent chance of breaking its bolt, possibly during a critical moment. That bolt may look just fine, but a 1 in 4 chance of breaking in a fight might be more than you wish to risk. What if that same information could provide the same information regarding the bolt carrier, hammer spring, barrel, gas rings, and about a dozen other parts that commonly break in the M16 or M4. What if that type of information could also be tailored to your environment? Weapons were developed to function properly in an extreme spectrum of weather and environmental conditions. That does not necessarily mean that **they will** have common types of part failures or component breakdowns. The parts that wear out and break in an arid high altitude environment such as Afghanistan may not be the same as those that fail in a tropical climate such as the Horn of Africa. With the PEO Soldier study, it is possible to tailor the maintenance policies to accommodate such differences. This would be again analogous to the vehicle owner's manual that has a Schedule A for routine driving and Schedule B for city or rough-terrain use.

Previously, Risk Components Required Additional Equipment or Capabilities

There are certain to be skeptics and non-believers in adopting this new approach to maintenance. This is expected; most failures experienced with the M16 and M4 weapons are often prevented with proper cleaning. But even a clean weapon at some point will experience failure, and this should be expected since the weapon is in essence a machine. While any one Soldier's experience with any one weapon may last only a couple years at most, the experience of the durability test by Aberdeen Test Center did test each weapon out to 35,000 shots per rifle or carbine, and 50,000 rounds per automatic weapon. That experience, across all the weapons of different types and origins, demonstrated something that no one Soldier would see: parts break in a pattern that is both predictable and preventable. It is now possible to create a PMCS (preventive maintenance checks and services) policy around those tests that will do just that and lower the risk of small arms failing.

Shot Counters and Odometers

A weapon does not have a device that tracks usage like a vehicle's odometer. Without one, a Soldier can only make an estimated guess as to how many shots he has fired since the last maintenance was completed. (The Army has requirements for such a shot counter in future small arms, but there is no requirement for a shot counter capability on current weapons. The U.S. Special Operations Command has developed such a device for its rifles and carbines and has started fielding it.) This is again analogous

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to a person performing maintenance on a vehicle without an odometer. He can guess — but not know — which parts are oldest and in most need of replacement. The Soldier, however, can still perform preventative maintenance. The PEO Soldier study provided a unique method to estimate how many shots a weapon has fired, and then correlates these to the replacement recommendations. When the testers conducted the test out to 35,000 or 50,000 shots, they conducted Bore Erosion gauging every 3,600 rounds. This standard test, currently conducted once a year on Army weapons, is the means to determine when a weapon's barrel has reached its maximum effective life. The gage used to perform this test typically provides an "Accept" or "Reject" outcome on whether to maintain or replace the barrel. The same gage can also serve as a pseudo-odometer for a weapon. The PEO Soldier test provides a method to translate the gage results into the number of shots the weapon has performed.

For example, a Soldier or his leaders measure his weapon with the Bore Erosion gauge. On a new weapon, there would typically be 14/32" of space between the "Reject" line and the back of the upper receiver. This measurement is possible with the "insert the ruler NSN in the small arm repair kit" or any other tape measure or ruler with 1/32" marks on it. In this case, the Soldier's weapon shows 7/32" remaining to the "Reject" line. This corresponds to roughly 7,500 rounds through the barrel. (The actual conversions are sensitive and not used in this document. The full report is available to U.S. Government personnel at the Defense Technical Information Center Web site: www.dtic.mil.) Next, the Soldier would refer to the technical manual that lists the preventative replacements that should take place at 7,500 shots. It recommends replacing the bolt and the firing pin. The Soldier requests those items. If those items are available in unit benchstock, the replacement takes place immediately. If not, the parts must be requested as with other equipment. The weapon, in the mean time, is still operational. The Soldier can use it for training or missions, while the logistic system moves the necessary components to him. The Soldier and his weapon are now part of the condition-based maintenance system that pushes required components to the field units, preserving the units combat effectiveness. This supports the sustainability of the equipment without removing it from the operator. At the same time, the Soldier acts with the knowledge that his weapon is within the window of maintenance and that the 'system' is working to replace the key components. The result is that the unit can continue its combat training with its full arsenal of equipment and begins it deployment with weapons that are measurably more reliable and fully prepared for the deployment

ahead. The leaders and commanders at every level have more weapons and more reliable weapons at their disposal to complete the mission.

Organizational Impact

There will understandably be a materiel impact on the brigade combat team to support such a policy of preventative maintenance. The size of such an impact is not expected to be as large as the impact already in place to perform the same type of policy for wheeled, track, and flying weapon systems. The impact should ultimately improve and not necessarily increase the effort to maintain weapons. Instead of fixing weapons wherever they are positioned and whenever they break, the unit has the choice of replacing parts on a scheduled, predictable routine. The unit can choose to conduct this type of maintenance prior to deploying, which in turn reduces the likelihood and number of weapon failures once deployed. This leaves the unit less occupied with weapon sustainment and more occupied with weapons training and use during a deployment.

The full impact is still being investigated by the Tank-automotive & Armament Command (TACOM), the organization that creates the technical manuals and maintenance policies for small arms and its supporting components. The final changes will ultimately be nested not only in what the Army feels is best for its weapons and mission requirements, but will also need to complement what the other services and federal agencies desire in their rifle and carbine capabilities. This may be a long time coming and could outlast this author in its gestation. The motivation, however, to implement such a policy is there, and could be improved with a grassroots call from operational units for such a change to be published with haste.

Path Ahead

There is a good deal more to the background and analysis of the study than what is discussed in this article. The full report is available from the Defense Technical Information Center and is available to all U.S. Government agencies. The risk analysis that relates number shots on a weapon to the likelihood of a part breaking is another subject all together. What is important though is the understanding that this type of maintenance policy is more than just possible, it is what is currently in place for most other systems. The PEO Soldier study has only brought it to the small arms arena. It is what already takes place for other systems the nation decided are critical and simply applies them to the Soldier and his personal weapon.

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A Soldier with the 82nd Airborne Division fires his weapon during a live-fire exercise in Ad Diwaniyah, Iraq, in December 2006.

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