

# AN ARMY OUTGUNNED



## Physics Demands A New Basic Combat Weapon

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**A**MERICA'S NATIONAL SECURITY strategy demands that our combat forces defeat enemy combatants across the full spectrum of battlefield environments, not just leafy jungles or the plains of Europe. Despite an increasing portfolio of enemies that are flexible, well armed, and robust, our Army, Marine Corps, and special operations forces have been stuck for decades hauling assault rifles firing NATO 5.56x45 millimeter (mm) (.223 caliber) varmint rounds over a half-century old. A decade into a new century, we need to adopt a more robust projectile and basic combat weapon (BCW) to meet current and emerging performance requirements. Despite incremental improvements, the M16 rifle and its 5.56 mm NATO round are unable to compete effectively in current and anticipated combat environments because of the physics of ballistic performance, combat terrain, and the nature and fighting characteristics of the enemy.

When the first official assault rifle appeared on the battlefield, the German MP-44, named the "Sturmgewehr" or assault rifle, its purpose was to provide German infantry with greater firepower by replacing the five-round, 8 mm, bolt-action K98 Mauser with the 30-round, 7.92 mm, fully automatic assault rifle. This development was a significant leap in firepower for the individual combat soldier in World War II. It is no accident that the highly rated and prolific Russian AK-47 looks very similar to the MP-44 that was introduced five years earlier. Hugo Schmeisser, the captured German designer of the MP-44, was working in the same Russian factory where Mikhail Kalashnikov was designing the AK-47, and Schmeisser obviously provided great influence in the design.

Considering the evolution in small arms technology and combat requirements, the United States had to upgrade its BCW firepower leading to a replacement for the powerful but heavy World War II-era, .30 caliber, M-1 Garand and Browning Automatic Rifles. Follow-on BCW development was influenced through an Army study by S.L.A. Marshall, *Men Against Fire*, and

*This article expresses the views of the author, not those of the U.S. Department of Defense or military services.*

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PHOTO: U.S. Army PVT Adam Eggers shoots his M4 rifle at a live-fire range on Camp Blessing, Afghanistan, 27 July 2009. (U.S. Army, SPC Evan D. Marcy)

subsequent Marshall articles indicating that only 15 to 25 percent of our soldiers actually fired at the enemy during World War II (50 percent in Korea). Marshall claimed this to be a “universal problem.” Although Marshall’s research came under broad criticism as significantly flawed, American weapons development continued to assume that we needed weapons that could discharge a large volume of “shoot and spray” fire—not well aimed and placed shots.

In the World War II Pacific Theater, shooting at the enemy was a major problem because camouflaged Japanese forces hid in jungle growth or in caves and fortifications and were difficult to target. Except for Japanese suicide attacks and occasional close encounters, soldiers fired in the general direction of the enemy. They had no other choice. The same issue arose in the jungles of Vietnam, where the enemy was frequently unseen. Today, the combat environment is very different, and the enemy is frequently quite visible at all ranges from close quarters to over 1,000 yards.

In 1957, the Army selected and issued the 20-round, automatic, 150 grain (gr.), 7.62x51 mm M14 rifle as the new American BCW. It was not enthusiastically embraced because it was too long, too heavy (11.5 lbs loaded), and had a powerful recoil (17.25 lbs). Despite these drawbacks, the M14’s maximum effective range was a respectable 460 meters with the sniper version having a range of 690 to 800 meters. Limited enthusiasm about the heavy M14 led to an immediate search for its replacement.

Eugene Stoner’s space-age design was the result. Stoner’s “plastic” 5.56x45 mm (.223 cal.) M16, with the M193 55 gr. projectile and a 30-round magazine was a light 8.79 pounds loaded. Unfortunately, it has a propensity to jam and fail due to its direct impingement method of operation that vents gas and residue directly into the internal action of the weapon. In both caliber and design, the M16 was a dramatic departure from any BCW previously adopted by the United States. The Army later adopted the improved 62 gr., M855, 5.56 mm cartridge that was less effective than the M193 against personnel under 200 yards, and more recently the 5.56 mm M855A1 “Enhanced Performance Round,” which is not yet fully assessed.



**SPC Stephen Battisto**, a cavalry scout and squad designated marksman with 2nd Brigade Combat Team, 1st Cavalry Division, steadies his aim while zeroing his M-14 rifle at a rifle range near Camp Buehring, Kuwait, 14 January 2005.

The advertised maximum effective range of both the M14 with a 150 gr., 7.62 mm NATO cartridge and the M16’s 62 gr., 5.56 mm M855 NATO cartridge was 460 meters. This equal classification is odd considering the dramatic difference in cartridges.

“Effective” is the key word. In this instance, it denotes the maximum range a projectile is expected to inflict casualties or damage. Both projectiles fired at a paper mache mannequin at 460 meters may sail the distance, but one will probably bounce off. As previous studies concluded, a truly *lethal* maximum effective range for an M855, 5.56 mm NATO projectile is about 200 to 250 meters (218-273 yards). Therefore, because half of our firefights occur well beyond 300 meters, our weapons are marginally effective.

An excellent 2009 U.S. Army Command and General Staff College study, *Increasing Small Arms Lethality in Afghanistan*, brilliantly summarized the problem, and it is not limited to Afghanistan. The study concluded that American military weapons, cartridge lethality, combat optics, doctrine, and marksmanship training are vastly inadequate, costing American soldiers their lives. After a mountain of operational evidence concluding that the American military’s BCW was vastly inadequate to address a broad array of battlefield dynamics,

the Army finally started to take steps to improve the M16's maximum effective range and lethality.

The M16's weight, range, and caliber proved good for leaf-penetrating jungle warfare, but less so when fighting in deserts, mountains, valleys, and close quarters combat. The Army itself demonstrated proof of the M16's obsolescence when the 101st Airborne and other units started using significantly enhanced 7.62 mm M14s in Afghanistan in mountain battles where the M16A4 and M249 proved basically useless. In the interim, the soldiers themselves used captured AK-47s to better compete in the mountainous terrain. As the title of this article emphasizes, we are clearly outgunned, and that situation will continue as we fight a geo-diverse global war on terrorism and face advanced new weapons, such as the AK-12, the 5th-generation Russian AK.

## A New BCW

The basic combat weapon requires a focused transfer of energy downrange sufficient to incapacitate the enemy across a broad spectrum of combat environments. Both a new cartridge and more reliable platform are long overdue to meet these requirements. The new cartridge and firing platform must not only prove effective at close quarters, but must also have the ballistic horsepower to effectively negotiate steep mountains, cross far ridges at mid-to-long range, and engage long-range targets across desert terrain. The new cartridge and firing platform must have the capability to penetrate through vehicles at a distance, excel at rooftop-to-rooftop fighting, double as a long-range sniper rifle if needed, and be highly reliable. If well designed, the cartridge could also replace the 5.56 mm squad automatic weapon (SAW) and possibly the 7.62 mm machineguns, providing a significant cost savings. Affordability requires that we attempt to reduce the current and stove-piped weapon systems for each type of fire, including direct assault, close quarters, suppression, sniper, and vehicle incapacitation.

In another attempt to address the significant shortfalls of our current BCW, the Army recently developed the lead-free, M855A1, 5.56 mm, 62 gr. Enhanced Performance Round, tipped with a steel arrow penetrator and more powerful propellant. According to an Army report, the "super round" has better armor-penetrating performance at 350 meters than both the 5.56 mm M855 and 7.62 mm M80,

as well as better hard-target performance than the 7.62 mm, and is highly accurate up to 600 meters. It also has better vehicle, glass, and structural penetration abilities, and snipers have reportedly killed enemy combatants up to 700 meters away using the new round. However, it is too early to assess the long-term performance of this new round in a broad range of combat scenarios and environments, including what adverse impact it may have on the M16, M4, or M249 platforms. The community of firearms and ballistic experts has not had an opportunity to independently test the ballistic and terminal performance of this new round. Although the Army increased the muzzle velocity to 3,150 fps. and added a steel penetrator, it is still only a 62 gr. projectile.

The M16 has had two problems in the past: a cartridge with a projectile that is far too small (62 gr.) and underpowered, and a weapon platform that is unreliable and prone to jamming because of basic design flaws. It appears the military will go to any length to continue to nibble around the edges to keep this half-century old, 5.56 mm Cold War-relic cartridge operational. If the Army wanted to enhance a cartridge, it should have enhanced a cartridge of greater substance and redesigned a reliable platform around it.

In terms of short-range and close quarters combat requirements, our forces are facing enemy characteristics similar to those of the Moro guerrillas during the Philippine-American War and Japanese during World War II. The Philippine-American War combat environment led to development of



The new M855A1 Enhanced Performance Round offers better performance than the M855 against all targets likely to be engaged with small arms. (DOD)

the Model 1911 230 gr., .45-caliber pistol. Similar to today's Al-Qaeda Muslim extremists, Moros had high battlefield morale and often used drugs to heighten courage and inhibit the sensation of pain. Ammunition with significant stopping power was required to repulse their fanatical attacks. During World War II, the .45 caliber, automatic Colt pistol (ACP) 230 gr., full metal jacket round at 850 ft/s also passed the test against the fanatical Japanese forces and frequent suicide attacks.

By contrast, there have been many instances, especially in close quarters, house-to-house combat in Iraq, when the small 5.56 mm projectile, with a high velocity of 3,000 ft/s, would zip through an enemy combatant center mass without causing effective incapacitation, allowing further attacks on our forces. The projectile's entrance and exit occurred so quickly (the ice pick effect) that the enemy combatant did not realize he had been shot until later when either additional rounds or internal blood loss finally downed him.

Soldiers have been clamoring for a new caliber (and more reliable) weapon to ensure single-shot knockdowns at close range and to effectively address the diverse, longer-range shooting environments current and future combat forces experience as they face significantly heavier caliber weapons of significant range and energy.

## Meeting the Challenge

The enemy is well aware of the M16's weaknesses. New calibers and platforms have been developed in the United States and tested by firearms experts in an attempt to meet the aforementioned challenges.

Two examples are the Barrett 6.8 SPC (Special Purpose Cartridge) Remington and the Alexander Arms 6.5 mm Grendel. Both were extensively tested and appear to well outperform the M885 5.56 mm NATO round. In Afghanistan, a *Jane's Defense Weekly* posting in the *Pakistan Defence Forum* claims that more than half of Taliban small-arms attacks on British patrols took place between 300 and 900 meters, well outside the 5.56 mm NATO round's effective range. The enemy is well aware of this and positions his forces accordingly. It is not certain what additional range the 5.56 mm Enhanced Performance Round will realize in a mountainous environment, nor what its terminal effectiveness is at any range.

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When U.S. forces are fighting mountain battles firing uphill or across mountain ridges with such a small caliber BCW, heavier enemy AK-47, 7.62x39 mm and larger caliber rounds rain down on them. Worse, the enemy's AK-47 has a significantly higher reliability rate than the 5.56 mm M4, M16, or SAW family, regardless of the cartridges we adopt.

Although every serious comparative assessment by a broad range of national and international weapon experts has concluded that our current BCW is operationally timeworn and has been for decades, our half-century old 5.56 mm family of weapons remains in use. The M16 appears to have taken on the mantle of the "Holy Grail" of the American military, never to be criticized or challenged. After decades of dissatisfaction with the BCW platform, the Army finally managed to squeak out the aforementioned enhanced 5.56 mm cartridge (the M855A1). Weapons development and procurement normally follow the dictates of technology and the battlefield, so it is surprising that it took over 50 years to make any significant improvement to our BCW.

## Ballistic Performance

The physics of external ballistics and current and future combat environments appear to demand a new caliber of weapons—whether or not based on the M16 chassis. Many firearm experts, combat users, and studies have recommended the heavier and modernized 123 gr., 6.5x39 mm Grendel Lapua Scenar cartridge as a replacement for the current 5.56 mm NATO and possibly the 7.62 mm NATO as well. With double the mass of the 5.56 mm NATO, the ballistics of a 6.5 mm 123 gr. Lapua Scenar projectile far outperforms the M16's 5.56 mm, the AK-47's 7.62x39 mm, the Barrett 6.8 mm SPC (110-115 gr.), and it flies faster, farther, and with significantly less recoil (9.23 lbs vs. 17.24 lbs) than the 7.62 mm NATO round. The superior ballistic performance (Ballistic Coefficient [BC] = .547), low recoil, higher accuracy,

longer range, and superior reliability of a 6.5 mm basic combat weapon against the 5.56 mm M16 and AK-47's 7.62x39 mm should at least raise the possibility of replacing the 5.56 mm family of weapons with a new platform and cartridge. The ballistic coefficient measures the ability of the projectile to retain velocity and resist wind to target, and the higher the ballistic coefficient, the more efficient the round. A 5.56 mm M885 NATO has a ballistic coefficient of approximately .250 versus .547 for the 6.5 mm. It also appears that the Grendel 6.5 mm or similar cartridge with its higher sectional density, heavier and flatter shooting projectiles (90 gr. to 144 gr.), and effective long-range killing power proven on animals up to 500 pounds in mountain environments, offers a solution that deserves consideration.

The figure below compares the performance of the three calibers fired from a 24-inch barrel at 600 yards, with environmental conditions of 70° F, 50 percent humidity, at an elevation of 50 feet above sea level, using a Grendel 6.5 mm, 123 gr. Lapua Scenar round against M885 and M80 NATO projectiles. There are heavier projectiles available for the 6.5 mm that would change the performance below, but the 123 gr. weight projectile provides the optimal performance.

Although additional testing of both external and terminal ballistics of various projectile configurations is necessary to attain an optimal effectiveness over a broad spectrum of combat environments, one can deduce that a more robust and heavier alternative to the 5.56 mm NATO is needed. That alternative would be compatible with the U.S. military's historical desire and battlefield experience to keep BCW ballistic performance around a .30 caliber package (M1903 Springfield 30-06 cal., M1 Garand 30-06 cal., and M14 7.72x51 mm NATO—a shorter 30-06 cartridge), and with its history of using a 6 mm cartridge (112 gr.-135 gr.) in combat.

## **The American 6 mm Cartridge Proven in Combat**

In 1895, prior to introduction of the 1903 30-06 Springfield, the Navy and Marine Corps adopted the Lee Navy Rifle Model 1895 as their basic combat weapon, using the Lee rifle 6 mm cartridge, the first cartridge designed for use in both rifles and machine-guns (Colt-Browning Model 1895 machinegun). The 6 mm cartridge was lighter, more accurate, and demonstrated better penetrating power than the military's previous .30-40 Krag cartridge, and had been used successfully in many battles. Although

<b>(At 600 yards)</b>	<b>NATO 5.56 OTM</b>	<b>NATO 7.62 OTM</b>	<b>Grendel 6.5 OTM</b>
<b>Velocity (fps.)</b>	<b>1,558</b>	<b>1,666</b>	<b>1,861</b>
<b>Energy (Ft/lbs.)</b>	<b>415</b>	<b>1,079</b>	<b>946</b>
<b>Drop (inches)</b>	<b>- 91.08</b>	<b>- 96.95</b>	<b>-81.10</b>
<b>Max Yds. Supersonic</b>	<b>875</b>	<b>1,075</b>	<b>1,275</b>
<b>Recoil (lbs.)</b>	<b>5.40</b>	<b>17.24</b>	<b>9.23</b>

Note: OTM = Open Tip Match Projectile

the current 6.5 mm is a more powerful and modern cartridge, the 6 mm Lee Model 1895 with a 135 gr. projectile at 2,469 fps is the closest technical cousin that the American military has fielded effectively in harsh combat conditions. It was first used during the Spanish American War of 1898.

The 6 mm Lee Rifle was carried by the First Marine Battalion (Reinforced) in various battles to capture Guantanamo Bay, Cuba, in 1898. According to a 15 June 1898 report by Captain George Elliott, commander of the expedition of 225 marines to capture Cuzco Wells from an enemy force of approximately 500 Spanish, the marine battalion used the new 6 mm Lee Rifle effectively at ranges of 800 yards. In addition, Private Frank Keeler reported that his Company D set their sights at 1,200 yards and effectively fired well-aimed shots at the enemy. Most fire during the mountainous campaign ranged from 600 to 1,200 yards.

According to reports, the marines used deliberate, well-aimed volley fire in an environment of high mountains, ridges, valleys and dense chaparral. A 29 June 1898 *New York Sun* article written from the war zone on the rifle's performance reported that despite periodic issues with the extracting mechanism and the bolt stop, the weapon performed well, as did the 6 mm cartridge. According to the field report, the enemy suffered severe wounds "due to the enormous velocity of the projectile, which caused an explosive effect." The decimated enemy thought they were under machinegun fire due to the weapon's range and rapid fire.

Marine sharpshooters also effectively used the flat shooting and accurate cartridge of the 6 mm Lee Rifle during the Chinese Boxer Rebellion of 1900 to knockout artillery battery crews at long range. Although the Lee Model 1895 rifle was not the ideal BCW and was soon replaced by the superior 1903 Springfield 30-06 cal., the 6 mm cartridge performed well under diverse and harsh combat conditions at both short and long range. One benefit was that the 6 mm was a lighter cartridge to carry than .30 cal ammunition, and that was important in the mountainous and jungle terrain.

Using an M16A4/M4 equivalent chassis to save cost, the powerful, highly accurate, and flat-shooting 6.5 mm round is capable of incapacitating the enemy

at five as well as 1,000 yards with far greater penetration against vehicles and other hard targets than the standard 5.56 mm NATO. You can fire inside buildings single-shot or full automatic with a sound suppressor. Place *effective* optics on the weapon, and it will knock the enemy off mountain and building tops at over 1,000 yards (1,300 fps @ 462ft/lbs.) without calling in a special sniper team. A five-shot grouping will easily fall within a 4.5-inch square at 600 meters. A belt-fed 6.5 mm SAW variant could potentially replace current light and medium machine guns, and give excellent performance across-the-board. Additional lab, field, and operational testing would have to be performed to optimize cartridge configuration and weapon design. Snipers or belt-fed machinegunners may desire a heavier load than the 123 gr. and may opt for a 130 gr. or 140 gr. 6.5 mm projectile. There is also a possibility that a 6.5 mm cartridge, which fits into the 5.56 mm magazine, could also be "enhanced" with a steel penetrator and more powerful propellant. That would provide the 123 gr. package with theoretically double the devastation and longer range than the M855A1 Enhanced Performance Round, giving our forces the edge in any combat environment and at any range. However, a big question and possible drawback with the "enhanced" version of any caliber cartridge is its terminal effects at very close range with a possibility of severe "ice picking," a problem with the current M885 5.56 mm.

## A Versatile and Reliable BCW

United States combat forces require a versatile and reliable BCW with the ability to incapacitate the enemy at close quarters with sufficient ballistic energy to smack-down enemy forces with authoritative force at long distance. We can either analyze the newly developed and currently existing 6.5 mm cartridges, or attempt an expensive development of a new family of ammunition. Assessing the recently developed 123 gr. Lapua Scenar 6.5 mm, with its high velocity, flat trajectories, and greater knockdown power than the 5.56 mm well beyond 600 meters, may be a place to start. The new family of 6.5 mm projectiles has over twice the lethality of the 5.56 mm, M885 NATO round, and regardless of the configuration, with a 123 gr. projectile that does not go subsonic until 1,275 yards, if you can see a target, you can theoretically hit it.

Using a standard M16A4 rifle, the 5.56 mm (M855) performance with a 62 gr. bullet at 500 yards (457 meters) attains 1,739 to 1,884 fps velocity with 489 to 517 ft/lbs of knockdown energy. In contrast, a standard 6.5 mm 123 gr. Lapua Scenar bullet using a 24-inch barrel performs at 1,875 fps with 961ft/lbs of energy. For a more eye-opening comparison, a large 230 gr., .45 cal. automatic Colt pistol full metal jacket Model 1911 automatic, fired at *point-blank range*, has a *muzzle velocity* of 835 ft/sec with 414 ft/lbs of knockdown energy. As described in the previous chart, the 6.5 mm 123 gr. Lapua *far exceeds* this kill capability *at over 600 yards*. This performance helps keep friendly forces outside the enemy's effective kill radius by outranging enemy forces with a greater reach and knockdown capability.

## Current 6.5 mm BCW Contenders

Tactical Rifles, Inc. developed an M40 6.5x47 mm sniper rifle that produced shot groups between .025" to .05" at 100 yards, and 1.5" at 350 yards with an effective range of over 1,000 meters (1,093 yards). This means that every unit can have light weight organic sniper support without waiting for limited and highly specialized sniper teams. These are significant improvements in firepower capability that we have today, not 10 years from now. A 6.5 mm magazine with the same dimensions as a 30-round, 5.56 mm magazine will hold 26 rounds. Although each magazine will hold four rounds less, each round is far more powerful and flexible. The key is to match the 6.5 mm cartridge with an improved weapon platform.

The Alexander Arms 6.5 mm ultra-light Grendel is another well designed 6.5 mm assault rifle that outperforms the current M16A4 in power and reliability. The Grendel uses a more reliable piston gas system that is difficult to jam, even after firing hundreds of rounds and being exposed to water, mud, and sand.

Although not a 6.5 mm, another competitor that outperforms the M16 is the Barrett 6.8 SPC REC7. Unlike the Lee Navy Rifle example of an entirely new weapon, both the Alexander Arms 6.5 mm

Grendel and the Barrett 6.8 mm REC7 are compatible with the current M16A4 and M4 configurations, reducing training and orientation requirements, yet the Grendel has superior performance improvements over the M16A4 and M4, such as a gas-piston operated design for high reliability in combat, the ability to resist jams, and a more powerful cartridge. The important difference between the two is the weapon caliber, 6.5 mm versus 6.8 mm. The 6.5 mm gives better performance over longer ranges and fits in the 5.56 mm magazine.

Additional testing is required, and there is always the option of designing an entirely new platform around the current or an enhanced 6.5 mm cartridge. It may be prudent to release a group of 6.5 mm, M16-chassis weapons for operational field testing in Afghanistan by deployed forces to test against the 5.56 mm M885, M885A1 Enhanced Performance Round, and AK47. Research should look into possible enhancement of an even more powerful 6.5 mm Enhanced Performance Round, but the enhanced round may not be ideal under all combat conditions.

Training would be modified to teach personnel to take advantage of such a powerful weapon through use of more controlled aim-and-fire operations versus point and spray. The ammunition carry weight is slightly increased, but the gain in soldier confidence and combat power, range, reliability, and accuracy may be worth the tradeoff. A basic load of 210 rounds of 6.5 mm, 123 gr. Lapua Scenar ammunition will weigh about 2.4 pounds over the current 5.56 mm combat load. Each round weighs more, but each contains far more kill capability at all ranges.

Does another half-century have to pass before American forces shoulder a basic combat weapon that is reliable and can match the full-spectrum combat environments faced by current and future American combat forces? Do we really need another major study to bury this issue when good replacement systems already exist?

The time has arrived for our military forces to have a basic weapon that can effectively compete against the capabilities of our adversaries. **MR**