PROFESSIONAL FORUM

Is 6mm the Optimum Caliber?

A Common Cartridge for Rifle and Machinegun

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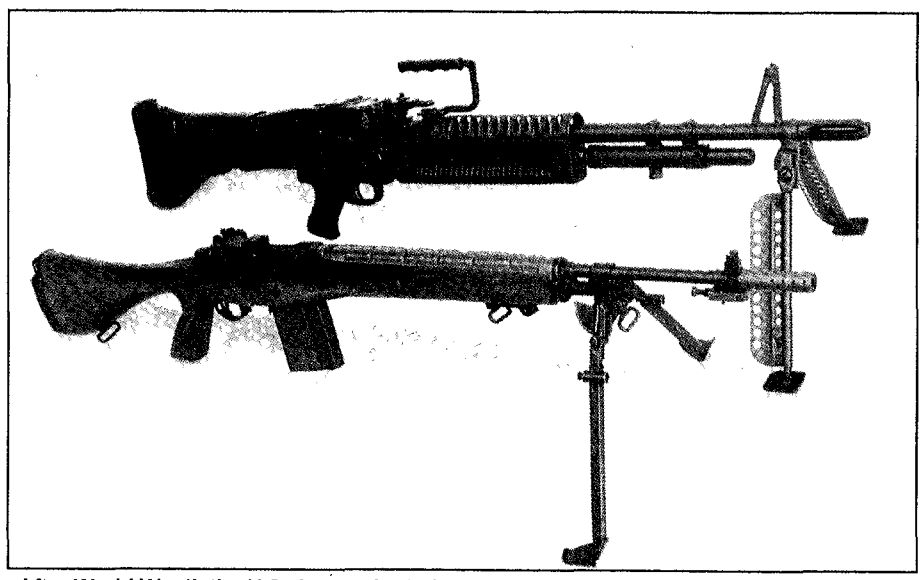
During World War II, the German army developed the first assault rifle to be issued on a large scale. Originally fielded as the MP43, the rifle was later redesignated the StG44, reflecting a change in nomenclature from machine pistol to *Sturmgewehr*, which loosely translates in English as *assault rifle*. The StG44 was chambered for the 7.92x33mm round, a cartridge with less power and more compact size than that fired by the standard infantry rifle. Because studies had indicated that most infantry combat occurred at relatively short engagement distances, the Wehrmacht deemed it unnecessary and wasteful to continue using the heavier, bulkier ammunition.

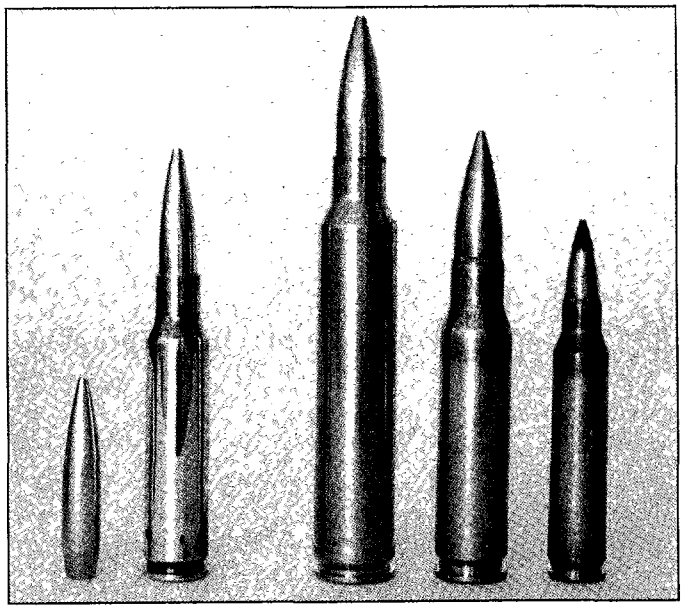
In marked contrast, Germany's paratroopers—who were a component of the air force, not the army—undertook the development of the FG42, a select-fire combat rifle that used the full-power 7.92x57mm service cartridge. Because they had found themselves outranged by British riflemen and machinegunners during the initial stages of the 1941 airborne assault on Crete, the German paratroopers reasoned that it was distinctly better to have long-range capability and not need it than to need it desperately and not have it.

After World War II, these opposing philosophies appeared again, during the effort by NATO countries to adopt a standard rifle cartridge. Britain led one faction, which was in favor of selecting the British 7x43mm assault rifle round. On the other side was the U.S. Army, which wanted to retain the range and power of the .30 caliber cartridge then in use. Needless to say, as the most powerful and influential member of NATO at the time, the United States prevailed, and the 7.62x51mm round became NATO-standard shortly after the end of the Korean War.

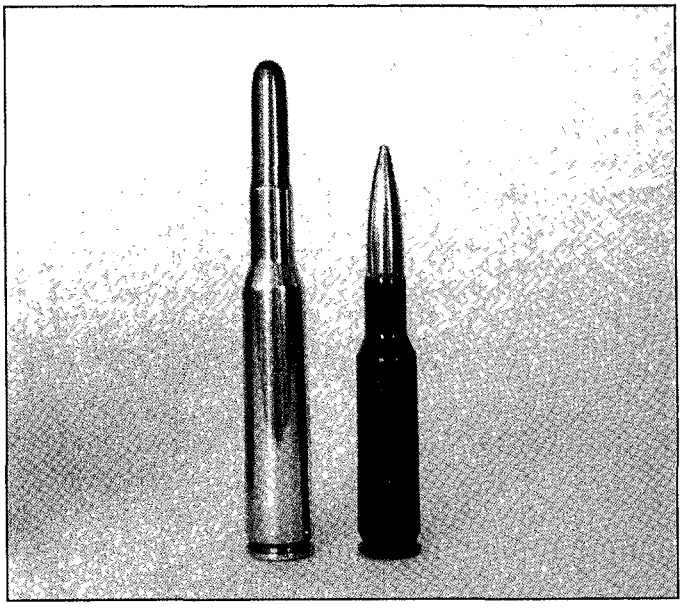
Another reason the United States preferred full-power ammunition was to simplify logistics. The Army had fought World War II and the Korean conflict with a wide variety of small arms that were chambered for two completely different calibers. The standard .30 caliber cartridge was used in the M1903 Springfield, 1917 U.S. Enfield, and M1 Garand rifles, M1918A2 Browning automatic rifles, M1917A1 (water-cooled) heavy machineguns, and M1919A4/A6 (air-cooled) light machineguns, while the shorter and less potent .30 Carbine round was required for M1, M1A1, M2, and M3 carbines. The Army wanted to replace this menagerie with only two basic weapons—a rifle and a general purpose machine-



After World War II, the U.S. Army adopted a one-caliber, two-weapon philosophy, developing the M60 general purpose machinegun and the M14 rifle to replace the array of small arms and two calibers of ammunition then in service. From the logistical viewpoint, this was a good concept, but circumstances prevented its full implementation.



The conceptual 6mm Optimum cartridge (left) would have the velocity and trajectory of the .300 Winchester Magnum, the penetration and tracer performance of 7.62 NATO, in a format almost as compact and lightweight as 5.56 NATO.



The 6mm Navy round (left) was adopted in 1895 for use by the Marines and naval landing parties. In the 1970s, the Army developed the 6mm XM732 cartridge (right) for the squad automatic weapon program.

gun—and one caliber of ammunition.

This was a very worthwhile objective, but it was doomed to failure. The substantial recoil generated by the 7.62mm NATO round made the rifle difficult to control when fired on full-automatic, even in the M14A1 automatic rifle version. In addition, by insisting on a full-power .30 caliber cartridge, the Army ensured that the M14—which was originally supposed to be a "light rifle"—would be almost as heavy as its predecessor.

The weight factor, perhaps more than any other, sealed the M14's fate. In the late 1950s, the Air Force was offered the M14 as a replacement for its aging, but delightfully lightweight, M1 and M2 carbines. The offer was declined, and a few years later the Air Force purchased the ArmaLite AR-15, a rifle that was a little heavier than the obsolescent carbines then in its inventory. Not long after that, the Office of the Secretary of Defense also directed the Army to buy the AR-15 (subsequently known as the M16), and discontinue the acquisition of M14 rifles, thereby forcing the Army back into a two-caliber system.

Could the Army have taken a course that would have avoided the return to a two-caliber system? Clearly, not by sticking to the demand for a full-power 7.62mm round. As the British had correctly pointed out, the power of the ammunition determines the size and weight of both the cartridge and the weapon in which it is fired. Nor could the Army have avoided this outcome by adopting the British 7x43mm caliber. Every nation that has issued assault rifles to its armed forces has found it necessary to retain a full-power cartridge in the inventory for use in machineguns and sniper rifles.

Considering the technical and political difficulties involved, is a one-caliber family of small arms an achievable goal? Answering that question requires a look at the desired characteristics of the infantry rifle, the machinegun, and the sniper rifle.

For the infantry rifle, the weapon and ammunition should weigh as little as possible, consistent with a maximum effective range of at least 500 meters.

For the machinegun, the same weight considerations apply but with a maximum effective range of 1100-1200 meters. Ball ammunition should be able to defeat "hard" targets at least as well as the 7.62 NATO round. Tracers should be visible out to more than 800 meters during daylight.

For the sniper rifle, the weight of weapon and ammunition is not as important as accuracy and effective range. Maximum effective range should be greater than 800 meters, with the flattest possible trajectory.

Of these characteristics, the snipers' need for a flat trajectory and short time-of-flight to the target would seem to be the most critical, so this would be the logical start point in developing the

BALLISTICS DATA

Caliber	5.56 NATO	6mm Optimum	7.62 NATO	.300 Win Mag
Bullet weight (grains)	62	100	147	190
Muzzle velocity (fps)	3100	2900	2800	3000
Muzzle energy (ft-lbs.	1323	1867	2559	3796
Velocity @ 1200m (fps)	913	1149	990	1214
Energy @ 1200m (ft-lbs.)	115	293	320	622
Flight time to 1200m (sec)	2.63	2.21	2.54	2.10
Deflection @ 1200m in 10 mph wind (inches)	240	151	200	139
Maximum trajectory inches)	365	244	332	218

Note that even with a conservative estimate for the muzzle velocity of the 6mm Optimum cartridge, computed data for 1200-meter velocity, flight time, wind deflection, and trajectory height are greatly superior to both 5.56 and 7.62 NATO rounds.

optimum small arms cartridge. In order to achieve a flat trajectory, the bullet must have a very streamlined shape and be propelled at high velocity. The shape of a bullet can be described in terms of its ballistic coefficient (BC)—the higher the BC, the more streamlined the projectile and the flatter the trajectory.

For instance, the 168-grain bullet in 7.62mm M852 Match ammunition has a BC of 0.48, which is well below that of the 190-grain projectile (BC = 0.54) used in the .300 Winchester Magnum cartridge. Because the M852 round has a rather low muzzle velocity (2600 feet per second, when fired from the M24 sniper weapon), the trajectory is high, the time-of-flight is long, and the maximum effective range is no more than 800 meters. On the other hand, the faster muzzle velocity (3,000 feet per second) and superior bullet shape of the .300 Winchester Magnum result in an extremely flat trajectory, a very short flight time, and a maximum effective range of about 1,000 meters.

Obviously, it would be quite desirable to incorporate the described characteristics of the .300 Winchester Magnum into the optimum cartridge; doing so would mandate the use of a projectile with a ballistic coefficient as close to 0.54 as is practical. In order to achieve the penetration capabilities the machinegun needs, bullet weight would have to be substantially heavier than the 62-grain projectile of 5.56mm M855 Ball, but much lighter than the 147-grain service bullet now in 7.62mm M80 Ball. A weight of 100 grains seems like a reasonable, if intuitive, compromise—light enough to be pushed at or near the desired velocity, but without the bone-jarring recoil of the powerful .300 Magnum.

Without resorting to the use of exotic, expensive metals such as tungsten or depleted uranium, a 100-grain bullet with a BC of approximately 0.54 would have to be made in caliber 6mm. Larger diameter projectiles of the same weight have inadequate BCs, while technical limitations prohibit the use of such heavy bullets in calibers smaller than 6mm. A 100-grain, 6mm projectile of conventional construction (lead core and cupro-nickel) that is launched at close to 3000 feet per second ought to have penetration capability at least as good as that of 7.62 NATO.

AUTHOR'S REQUEST: Frankford Arsenal is said to have conducted penetration tests (probably around 1974) of the 6mm SAW ammunition, comparing it to 7.62mm NATO and possibly 5.56mm. If any *INFANTRY* reader knows where a copy of this report can be obtained, I would like very much to hear from you. Please write c/o *INFANTRY*, P.O. Box 52005, Fort Benning, GA 31995-2005.

Another benefit of 6mm ammunition is improved tracer performance. The 6mm XM734 tracer round, developed in the 1970s at Frankford Arsenal, produced a trace that was visible in daylight to a range of 1000 meters. That is at least 25 percent better than 5.56mm tracers, which are difficult to observe at 800 meters during the day.

The cartridge case for the "6mm Optimum" would have to be larger than that of 5.56 NATO but smaller than 7.62 NATO. With a 100-grain bullet, the loaded round would be midway in weight and bulk, compared to the M855 and M80 cartridges. To keep cartridge volume to a minimum, muzzle velocity might have to be limited to perhaps 2,900-2,950 feet per second, but this should still be fast enough to produce exceptional performance from the proposed round. In essence, it would be a magnum version of the 6mm XM732 Ball round made for the squad automatic weapon (SAW) program in the 1970s, which propelled a 105-grain bullet at 2500 feet per second.

The 6mm SAW was a step in the right direction, but it came too late. The 7.62mm and 5.56mm calibers were already in service, and leaders did not want to complicate the logistical situation further by adopting a third caliber. Accordingly, the squad automatic weapon was then developed to use 5.56mm ammunition.

The Army had a logistically sound idea in trying to create a small arms system of one caliber and two weapons. Unfortunately, the wrong caliber was chosen, and a golden opportunity was lost. By insisting on developing the best possible 7.62mm cartridge instead of the best possible cartridge regardless of caliber, today's logistical situation is at least as complex as that of the 1940s, with 5.56mm for the M16A2 rifle, the M4 and M4A1 carbines, and the M249 light machinegun, and 7.62mm for the M60 and M240B/G medium machineguns and the M21 and M24 sniper rifles.

One caliber—the 6mm Optimum—could do it all. A weapon sending a 100-grain, very low-drag bullet downrange at over 2900 feet per second would give snipers the flat trajectory of the .300 Winchester Magnum. And it would give machinegunners the penetration potential and tracer capability of 7.62 NATO, thereby permitting the development of an infantry machinegun light enough to replace both the 7.62mm medium machinegun and the 5.56mm squad automatic weapon. The 6mm Optimum—being a compact, lightweight cartridge, with low recoil impulse—should also allow the creation of a combat rifle that is little or no heavier than the M16A2.

If the 21st Century should bring about a renewed quest for a lightweight infantry rifle and machinegun chambered for the same caliber, there is only one choice that makes sense. The 6mm Optimum combines the best features of several existing cartridges into a compact, lightweight round that should be capable of all around performance unequaled by any other caliber. Let it be the one for all.

Note that even with a conservative estimate for the muzzle velocity of the 6mm Optimum cartridge, computed data for 1200-meter velocity, flight time, wind deflection, and trajectory height are greatly superior to both 5.56 and 7.62 NATO rounds.

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