6.5x25 CBJ

The pistol size cartridge with rifle performance

CBJ Tech AB

Pistols and submachine guns are weapons with distinct benefits such as low weight, compact size and, in the case of submachine guns, high firepower. However, in modern combat these weapon systems, mainly based on the 9x19 Parabellum round, are proving less effective because of lack of penetration, limited effective range and poor wounding power.

Assault rifles are increasingly used for applications that used to be typical for submachine guns, like close quarter battle etc.

On the other hand, assault rifles too have important limitations. Firepower is reduced due to higher recoil and there are problems with overheating during intense firing. They are heavy, and due to their length awkward to handle in vehicles and confined spaces. Attempts to make them more compact by shortening the barrel have resulted in significantly reduced ballistic performance regarding penetration capability and wounding power, due to reduced muzzle velocity.

Realizing this, CBJ Tech has developed a cartridge system based on the new caliber, 6.5x25 CBJ, which after changing the barrel, can be used in most weapons chambered for the 9x19 Parabellum. The 6.5x25 CBJ, in combination with suitable weapons (like pistols and submachine guns), covers the full range of applications traditionally covered by everything from pistols up to and in some cases including assault rifles, and offers high firepower and superior penetration and wounding power at combat ranges up to 300m in any combat situation.

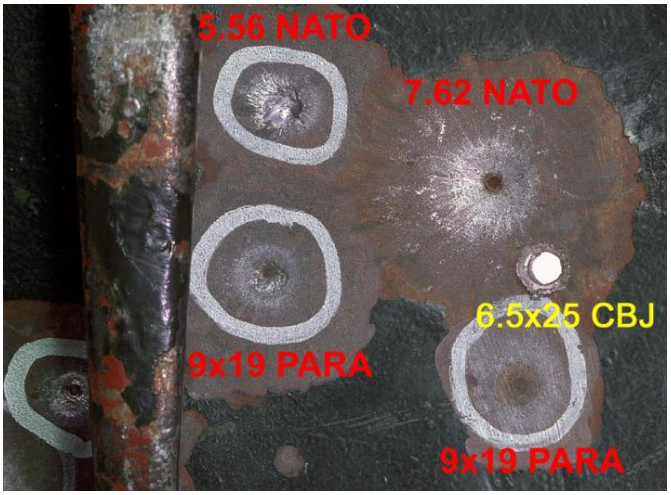
Weapon effectiveness

There are many factors that constitute weapon effectiveness, other than bullet performance in bare tissue even if this, of course, is critical. Weapon effectiveness can be defined as the ability of a soldier or policeman armed with a certain weapon system (weapon and cartridge) to defeat an enemy. This in turn is a function of how well the weapon system is adapted to the skills of the person using the weapon, the characteristics of the target and the combat environment. Focusing on the weapon system, this means there are three main aspects to consider, which are as follows in order of importance.

1. The ability to **hit** the target.
2. To have sufficient **penetration** to defeat barriers protecting the target and then penetrate deep enough in the target to reach vital structures to incapacitate reliably.
3. To have a high **energy transfer** to the target in order to increase the chance of rapid incapacitation.

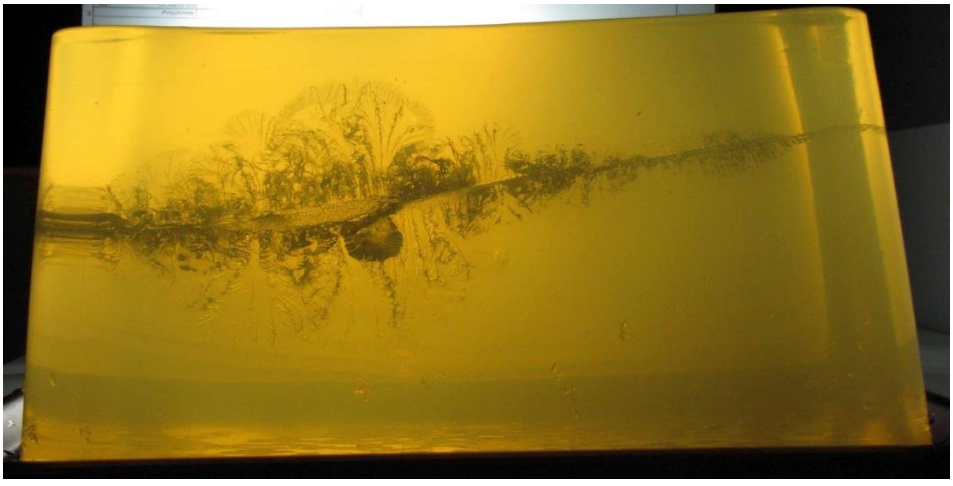
How the 6.5x25 CBJ solves it:

1. Hit probability is increased because of the low recoil generated, allowing rapid firing with high precision, and in the case of fully automatic weapons, the ability to fire accurate bursts. Also, at longer ranges and at moving targets, the high velocity of the projectiles with resulting flat trajectory and short time of flight to the target, reduces the need for compensation (like bullet drop and lead), which greatly simplifies aiming.



2. The required penetration depends on the situation. For instance, the soldier in combat generally needs more penetration capability than the average police officer. Within the 6.5x25 CBJ cartridge system, the entire spectrum of penetration is covered, from maximum penetration against tough hard targets, to minimum penetration against unprotected targets in sensitive environments.

3. The different variants of the 6.5x25 CBJ have projectiles with high energy and effective means to transfer it to soft tissue, resulting in a high wounding effect.



The 6.5x25 CBJ

6.5x25 CBJ APDS | 6.5x25 CBJ HET | 6.5x25 CBJ Subsonic AP | 6.5x25 CBJ Frangible

The 6.5x25 CBJ cartridge is of course primarily intended to be used in weapons designed and optimized for this caliber. However, it is also designed to be used in 9x19 mm weapons, converted by barrel change to the 6.5x25 CBJ. The cartridge generates the same level of impulse as the 9x19 mm, which assures functioning of the weapons. The bolt face, extractor groove and cartridge case diameters and taper angle up to the shoulder of the 6.5x25 CBJ are identical to the 9x19 Parabellum, as is the cartridge overall length (COAL), 29.7mm.

This makes the transition to the 6.5x25 CBJ easy. Another benefit is that existing stocks of 9x19 Parabellum ammunition can still be used for training instead of being scrapped. For pistols with easily interchangeable barrels, it is extremely simple to switch back and forth between the 9x19 mm and the 6.5x25 CBJ cartridges.

There are many different potential users for the 6.5x25 CBJ, such as military, law enforcement, security units etc., with accordingly different demands. To be highly effective in all situations, the 6.5x25 CBJ has several cartridge alternatives, and all of them use lead free projectiles.

For training, there are cost-effective alternatives. For combat, there are different cartridge alternatives depending on the situation and desired performance, from maximum penetration capability to balanced or minimal.

The development of the variants intended for combat has followed a number of criteria, mainly;

- The bullet shall be effective within the entire desired combat range.
- It must be able to penetrate any reasonable barrier typical for the application without breaking apart.
- After penetrating such barriers, it must be able to penetrate at least 30cm of soft tissue to cause reliable incapacitation from any angle of impact.
- After achieving the above, it shall have as high energy transfer to the target as possible.

cartridge system

6.5x25 CBJ HP | 6.5x25 CBJ Blank | 6.5x25 CBJ Drill | 9x19mm Nato

To ensure effectiveness, extensive testing has been conducted. To test performance and assess energy transfer in soft tissue, 10% ordnance gelatin shot at 4°C has been used and the permanent and temporary cavities studied. The wound channels have been visualized using the generally acknowledged Wound Profile Method by Fackler and Malinowski.

Barriers in front of the soft tissue simulant have included various body armors (notably the NATO CRISAT), car windshields, building materials, APC armor plate, military aircraft titanium and aluminum plates etc. Also, realistic composite tests have been made with scenarios such as uniformed protected soldier with web gear, protected soldier inside vehicle etc. The results confidently confirm that all development criteria are met.

To further assure effectiveness in real world combat, many side-by-side tests with the 6.5x25 CBJ and battle proven cartridges with known effects have been made, including 5.56x45 NATO, 7.62x51 NATO, various 9x19 cartridges, 7.62x39 and 5.45x39 shot from various weapons with different barrel lengths.

6.5x25 CBJ APDS

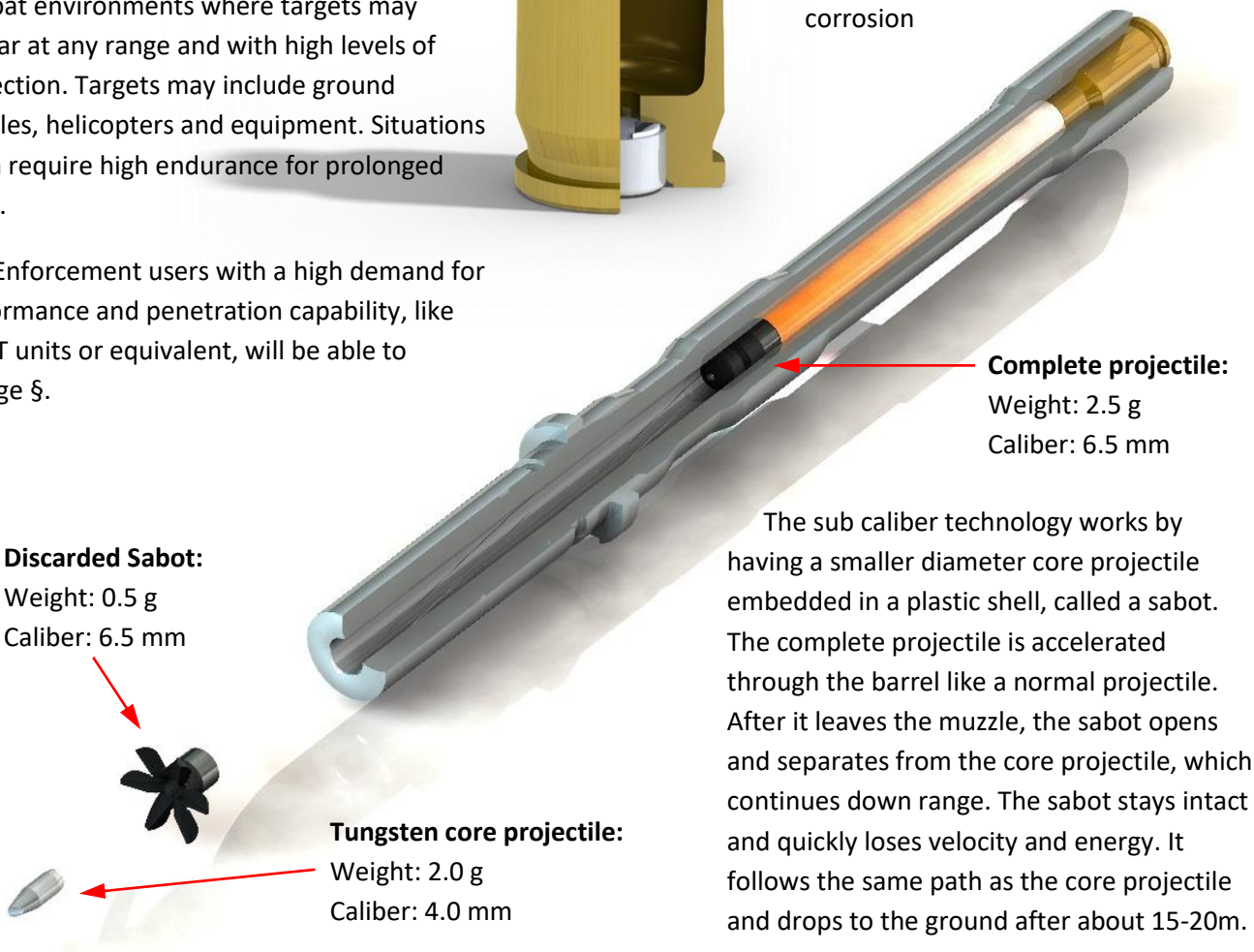
The 6.5x25 CBJ APDS (Armor Piercing Discarding Sabot) utilizes subcaliber technology. It is the highest performing cartridge in the 6.5x25 CBJ cartridge system. It has a tungsten core projectile enclosed in a discarding plastic sabot.

Typical application:
All-round military cartridge, used in varying combat environments where targets may appear at any range and with high levels of protection. Targets may include ground vehicles, helicopters and equipment. Situations often require high endurance for prolonged firing.

Law Enforcement users with a high demand for performance and penetration capability, like SWAT units or equivalent, will be able to engage §.

Key characteristics:

- Projectile weight 2.5g (2g core)
- Muzzle velocity from 730m/s to 900m/s depending on barrel length
- High penetration capability
- High hit probability
- Engage targets up to 300m
- High impact velocity at full ranges
- High wounding effect
- Low levels of barrel wear and corrosion



Complete projectile:
Weight: 2.5 g
Caliber: 6.5 mm

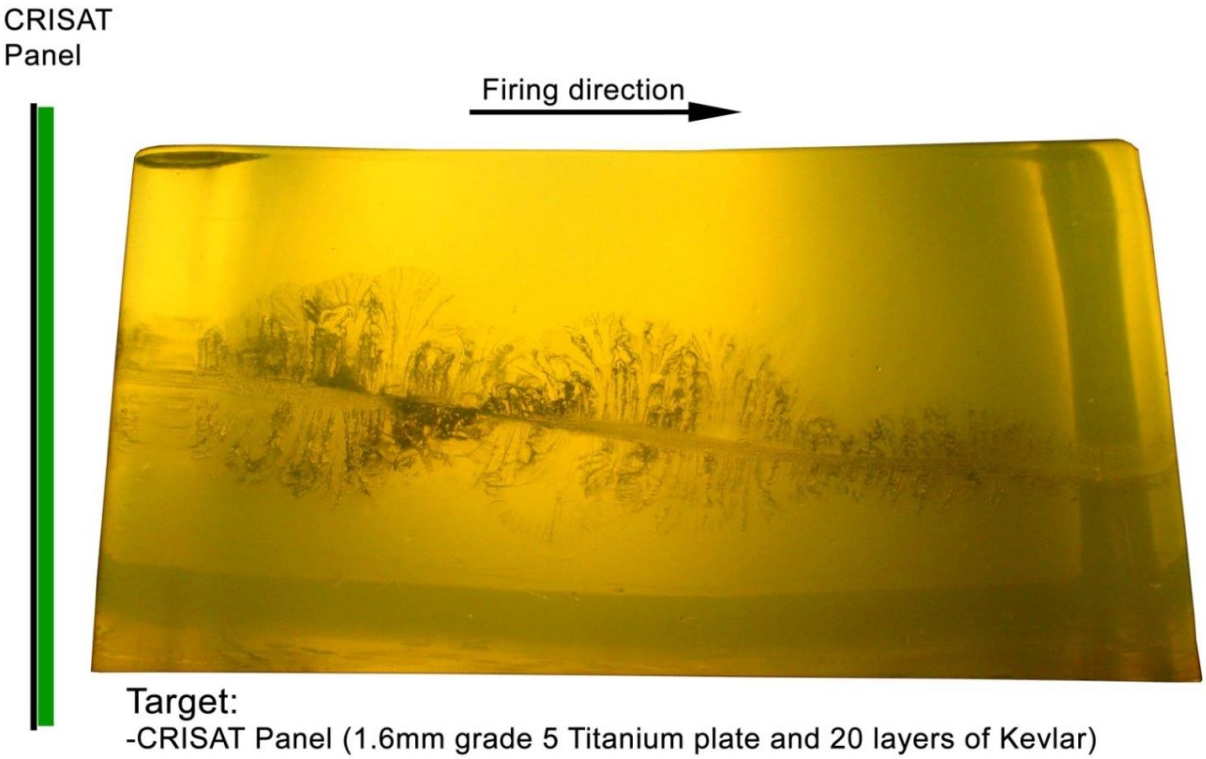
Discarded Sabot:
Weight: 0.5 g
Caliber: 6.5 mm

Tungsten core projectile:
Weight: 2.0 g
Caliber: 4.0 mm

The sub caliber technology works by having a smaller diameter core projectile embedded in a plastic shell, called a sabot. The complete projectile is accelerated through the barrel like a normal projectile. After it leaves the muzzle, the sabot opens and separates from the core projectile, which continues down range. The sabot stays intact and quickly loses velocity and energy. It follows the same path as the core projectile and drops to the ground after about 15-20m.

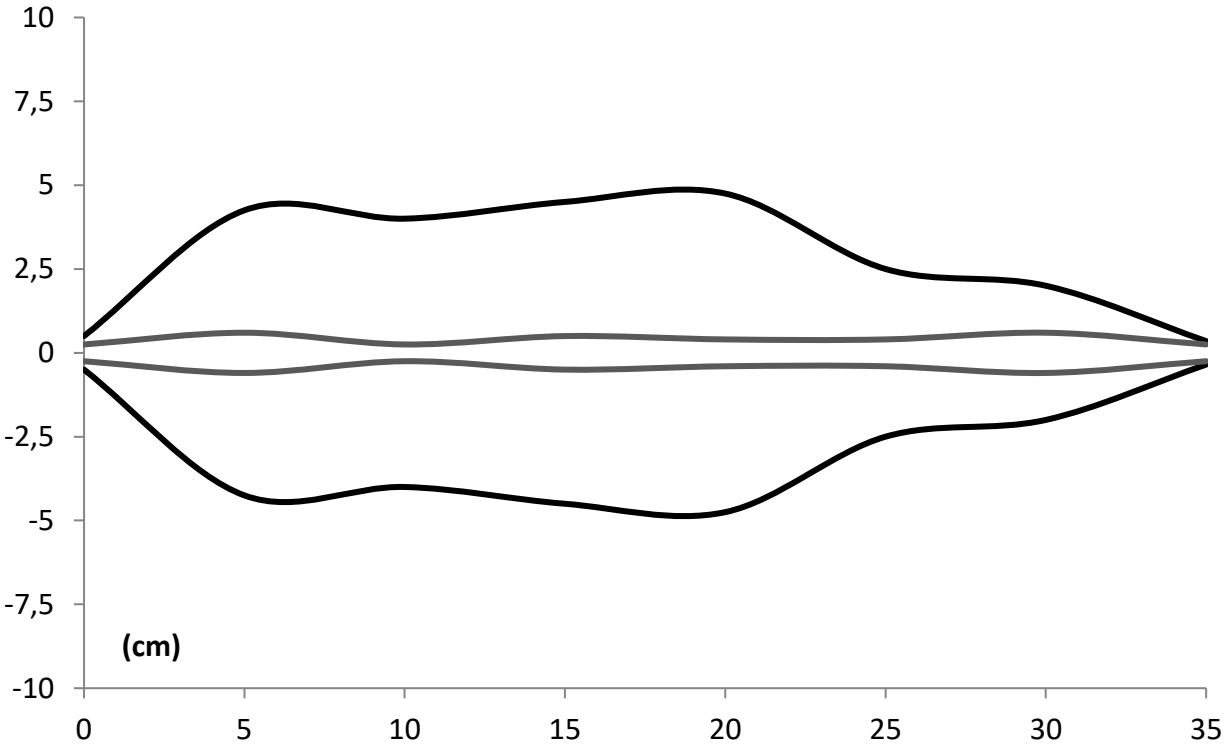
In a test of performance against hard targets, a hardened 7mm thick armor plate taken from a rear door of a Russian MT-LB armored personnel carrier was fired at from a distance of 50 meters. The target was fully penetrated and the bullet retained considerable wounding potential, as was evident by a block of gelatin positioned behind the target. Standard military ball ammunition such as 5.56 NATO, 7.62 NATO and 9x19 Parabellum fail to penetrate this target at any distance.

Illustrated below is the effect in soft tissue simulant (ordnance gelatin) of the 6.5x25 CBJ APDS after penetration of the NATO CRISAT target, which is a body armor panel consisting of a 1.6mm grade 5 titanium plate in front of 20 layers of Kevlar. 9x19mm ammunition fails to penetrate this body armor panel at any distance.



Target:
-CRISAT Panel (1.6mm grade 5 Titanium plate and 20 layers of Kevlar)
-Gelatin block (10% ordnance gelatin shot at +4ºC) with dimensions:
Length (Firing direction): 340mm, Height: 200mm, Width: 250mm
Vt (Impact velocity): 847m/s

Shown below is the Wound Profile of the test, which visualizes the permanent and temporary cavities. The permanent cavity is outlined in the center and represents the remaining cavity after the projectile has passed through. The outer lines represent the temporary cavity which occurs when the projectile is passing through the tissue simulant. The plot is based on measurements taken of the radial cracks in the gelatin according to the internationally recognized Wound Profile Method by Fackler and Malinowski.



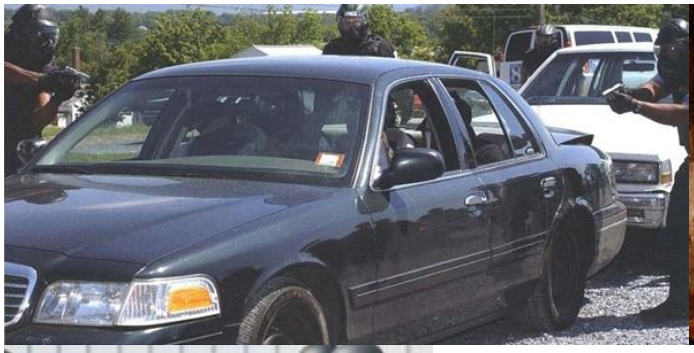
6.5x25 CBJ HET

The 6.5x25 CBJ HET (High Energy Transfer) has a full caliber solid brass projectile with a hollow base.

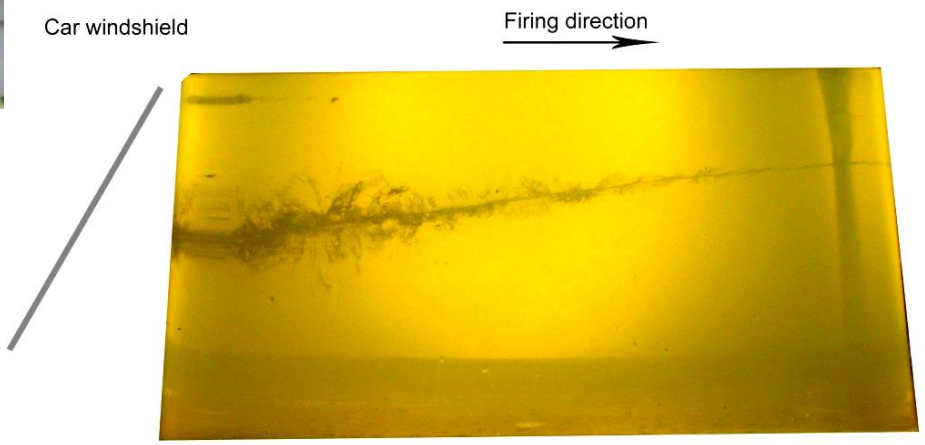
It has a carefully balanced penetration capability combined with limited lethal range, making it ideal for Law Enforcement users. The solid brass projectile with high impact velocity will penetrate NIJ level II body armor, as well as car doors or windshields with minimal deflection, and deliver energy to the target reliably. Beyond the lethal range, the projectile quickly loses energy, which reduces the risk of collateral damage.

Key characteristics:

- Projectile weight: 2.5g
- Muzzle velocity from 730m/s to 900m/s depending on barrel length
- Reduced lethal range: Pistol 80m, submachine gun 100m
- High impact velocity within lethal range
- High hit probability
- High wounding effect
- Balanced penetration capability according to Law Enforcement requirements

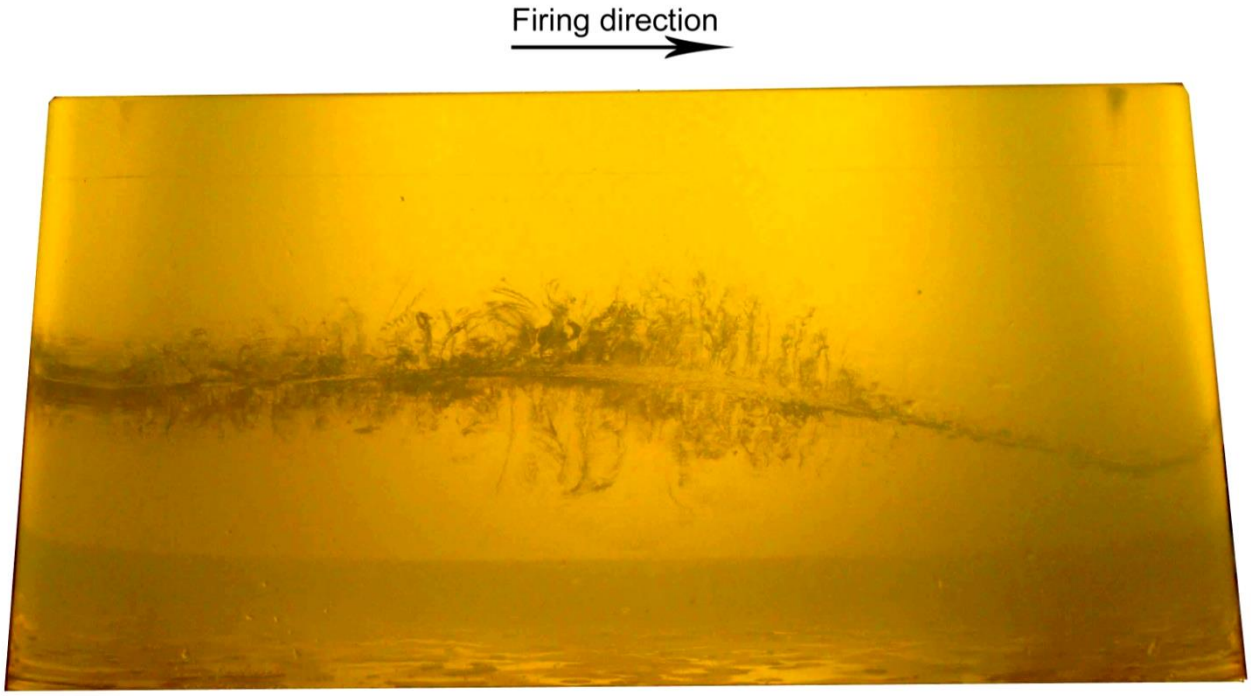


A typical difficult situation in this application is a target inside a vehicle. Seen below is the test result of a simulation of such a situation. The car windshield was placed 45cm in front of the gelatin block, and inclined 45° vertically and 15° to the left. The projectile penetrated the windshield with minimal damage, and continued to penetrate the entire 340mm deep gelatin block. After this the bullet had negligible energy left and had dumped over 99% of its initial energy.



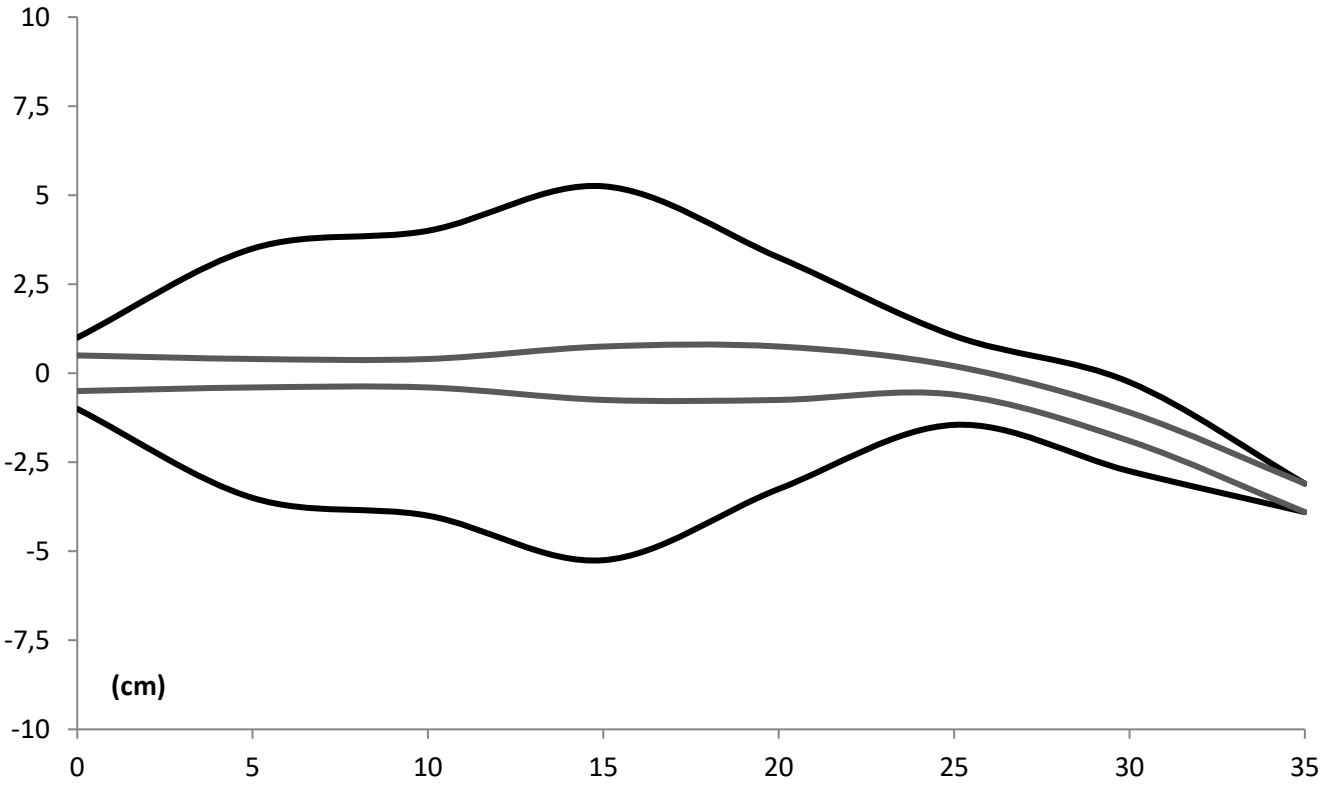
Target:
-Car windshield, inclined 45º vertically and 15º to the left, offset 45cm from the gelatin block
-Gelatin block (10% ordnance gelatin shot at +4ºC) with dimensions:
Length (Firing direction): 340mm, Height: 200mm, Width: 250mm
Vt (Impact velocity): 831m/s

Shown below is the effect of the 6.5x25 CBJ HET in bare gelatin.



Target:
-Gelatin block (10% ordnance gelatin shot at +4ºC) with dimensions:
Length (Firing direction): 340mm, Height: 200mm, Width: 250mm
Vt (Impact velocity): 824m/s

The Wound Profile of this test is shown below.



6.5x25 CBJ Subsonic AP

The 6.5x25 CBJ Subsonic AP fires an 8g/124gr full caliber copper jacketed solid tungsten projectile at subsonic speed.

Typical application:
Sound suppressed operations by military special forces or police SWAT teams. Targets may appear at short to medium range and carry body armor.

The penetration capacity is less than that of the 6.5x25 CBJ APDS, but sufficient to defeat most light body armors, notably the NATO CRISAT. The projectile is long and tumbles in the target which produces a substantial permanent cavity, thus creating a high wounding effect considering the low velocity of the bullet.

Key characteristics:

- Projectile weight: 8g.
- Cartridge weight: 12g.
- Muzzle velocity from 310m/s to 320m/s depending on barrel length.
- Reduced velocity drop down range compared to 9x19mm Subsonic.
- Relatively high wounding effect due to the bullet tumbling in soft targets.
- Relatively high penetration capability compared to 9x19mm Subsonic.

6.5x25 CBJ Frangible

The 6.5x25 CBJ Frangible has a full caliber projectile made of a sintered metal powder. The bullet has very low penetration capability and completely disintegrates when hitting a hard object, causing no ricochets.

It works well against all types of reactive targets, like steel plates or poppers, as well as plastic targets. The projectiles have enough impact energy to safely knock over these targets. Hits on edges of steel targets always results in full disintegration of the projectile.

Key characteristics:

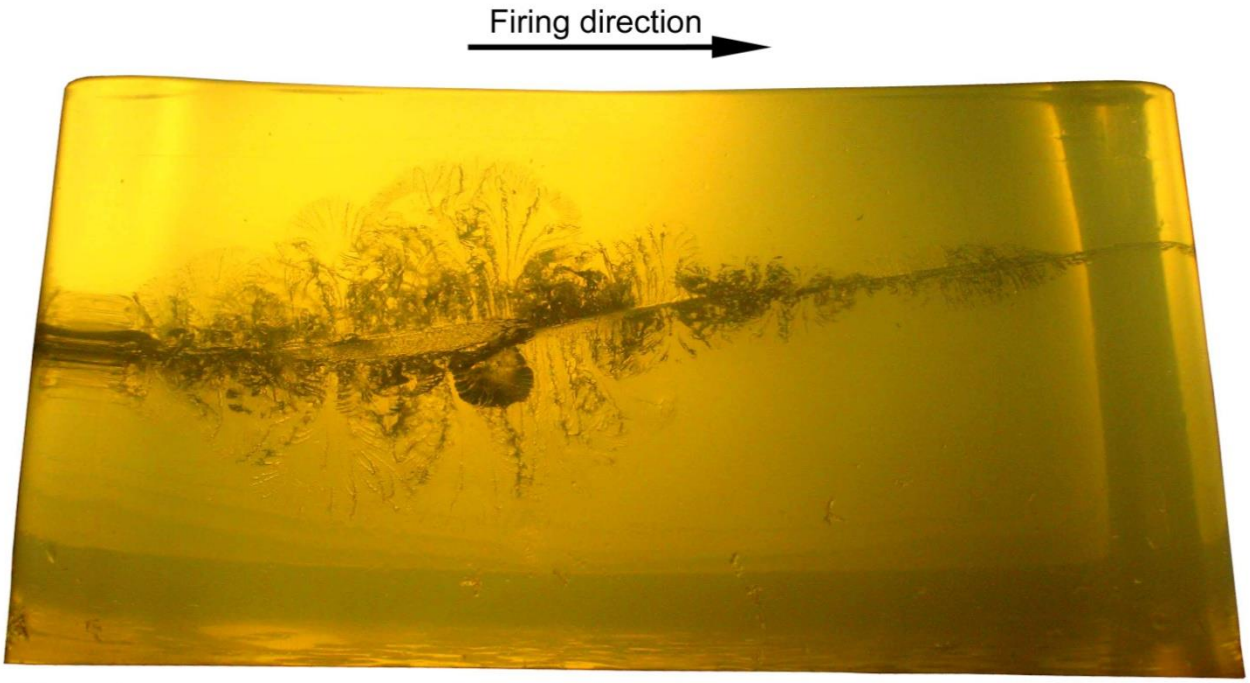
- Projectile weight: 2.5g
- Muzzle velocity from 730m/s to 900m/s depending on barrel length
- Reduced lethal range: Pistol 80m, submachine gun 100m
- High impact velocity within lethal range
- Minimum penetration of hard objects
- Increased safety during training
- Low wear on training facilities

Typical training application:
Short range (up to 100m) training round, used primarily in urban warfare training facilities.

Typical combat application:
Very sensitive environments, such as public areas, operations inside buildings with high risk of friendly fire and with presence of civilians etc. Targets appear at short range and without protection and in most cases there is a need for instant incapacitation of the target.

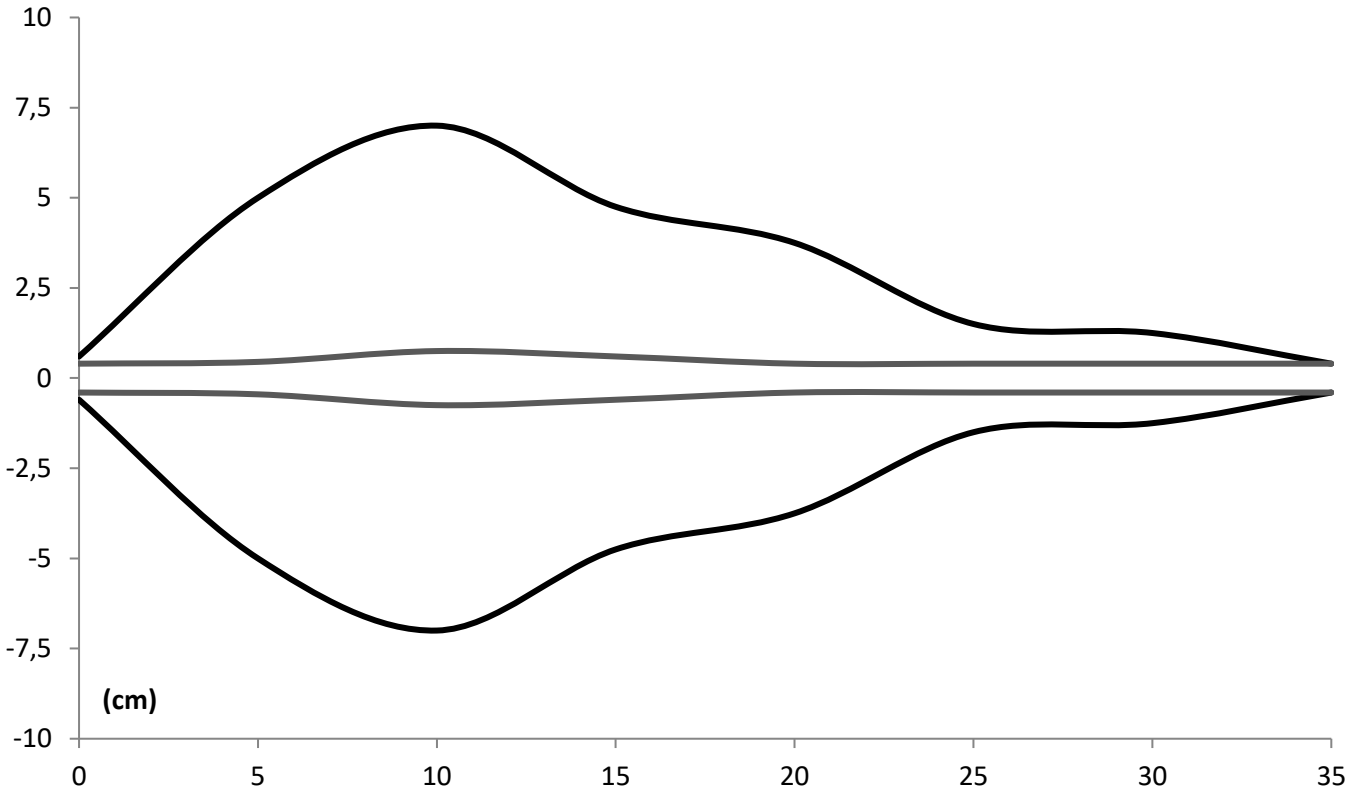
The 6.5x25 CBJ Frangible will disintegrate when striking hard objects but will not fragment when passing clothes or soft tissue. This ensures that the bullet will have sufficient penetration in soft tissue to be an effective combat cartridge against unprotected targets within combat ranges up to 50m.

Shown below is the effect of the 6.5x25 CBJ Frangible in bare gelatin.



Target:
-Gelatin block (10% ordnance gelatin shot at +4ºC) with dimensions:
Length (Firing direction): 340mm, Height: 200mm, Width: 250mm
Vt (Impact velocity): 904m/s

The Wound Profile of this test is shown below.



6.5x25 CBJ HP

The 6.5x25 CBJ HP (Hollow Point) has a full caliber 2.5g solid copper projectile with a hollow point. It has properties very similar to the 6.5x25 CBJ HET, except for slightly lower armor piercing capability (comparable to high performing 9x19mm FMJ) and slightly shorter and wider Wound Profile in ballistic gelatin.

Key characteristics:

- Projectile weight: 2.5g
- Muzzle velocity from 730m/s to 900m/s depending on barrel length
- Reduced lethal range: Pistol 80m, submachine gun 100m
- High impact velocity within lethal range
- High hit probability
- Very high wounding effect
- Balanced penetration capability according to Law Enforcement requirements
- Legal for civilian use in the USA.

Typical application:
It is excellent for law enforcement or home defense use. One of the benefits compared to the 6.5x25 CBJ HET is that this projectile is legal for civilian use on the US commercial market among others. This means that it can also be used for competition shooting or as a hunting cartridge for small game.

The picture below shows the projectile before being loaded in the cartridge on the left, and a projectile that has been shot into ballistic gelatin on the right. The high impact velocity ensures a rapid and consistent mushroom effect, or opening of the hollow point, which increases the wounding effect in soft targets.

6.5x25 CBJ Blank

This is a conventional star crimped blank cartridge developed for training purposes, such as double-sided exercises etc. A blank firing device needs to be attached in order to have a fully functioning cycling of weapons.

6.5x25 CBJ Drill

This cartridge is an inert dummy cartridge intended for training purposes such as loading and unloading drills, actions during stoppage etc.

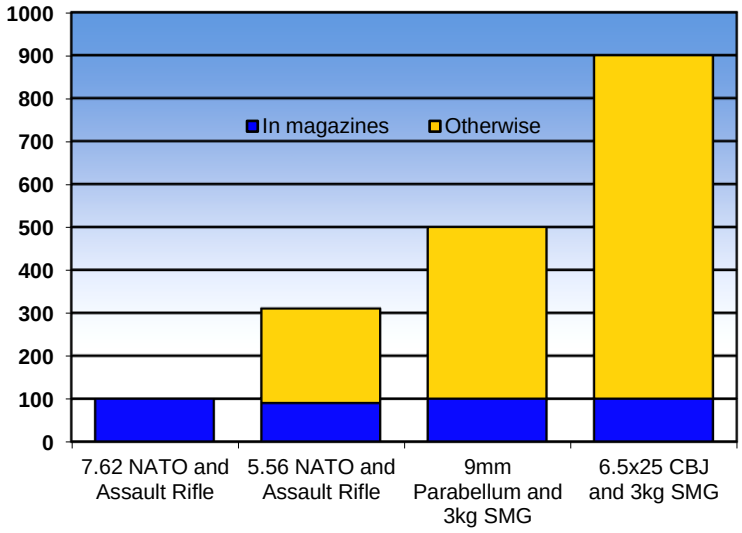
Soldiers and policemen must be skilled marksmen who can effectively apply their shooting skills in combat. The proficiency attained depends on proper training and application of basic marksmanship fundamentals. More rounds spent on the firing range means more accurate and effective fire in combat. The low cost of training ammunition allows for more extensive training.

Many tactical benefits granted by the 6.5x25 CBJ stems from high firepower, which is the ability to deliver a high amount of projectiles in a short period of time onto the target.

This however requires that an ample supply of ammunition can be carried by the soldier without increasing weight or bulk.

In a pouch designed for 5.56 NATO magazines, twice as many magazines and rounds of the 6.5x25 CBJ or 9x19 Parabellum can be stored. The picture shows three 30 round 5.56 NATO magazines in one pouch, and six 30 round 6.5x25 CBJ magazines in the other identical pouch.

Regarding weight, not only the weight of the ammunition itself but also the weight of the weapon must be considered. A typical 7.62 NATO assault rifle with 100 rounds in magazines weighs approximately 8.4kg. At the same weight a 5.56 NATO assault rifle allows for up to three times more ammunition to be carried.
A submachine gun weighing 3kg chambered for 9x19 Parabellum will allow even more rounds to be carried, owing to the lighter weight of the weapon. When the same weapon is chambered for the 6.5x25 CBJ the amount of ammunition that can be carried is three times that of a 5.56 NATO weapon system, or nine times that of a 7.62 NATO system.



6.5x25 CBJ Technical Data

Cartridge name	6.5x25 CBJ APDS	6.5x25 CBJ HET	6.5x25 CBJ Subsonic AP	6.5x25 CBJ Frangible	6.5x25 CBJ HP
Case weight, g	5	5	5	5	5
Cartridge weight, g	8	8	13	8	8
Projectile Ø, mm	4.0	6.5	6.5	6.5	6.5
Projectile weight, g	2.0	2.5	8	2.5	2.5

Below figures apply when shot from a 120mm pistol barrel / 150mm pistol barrel

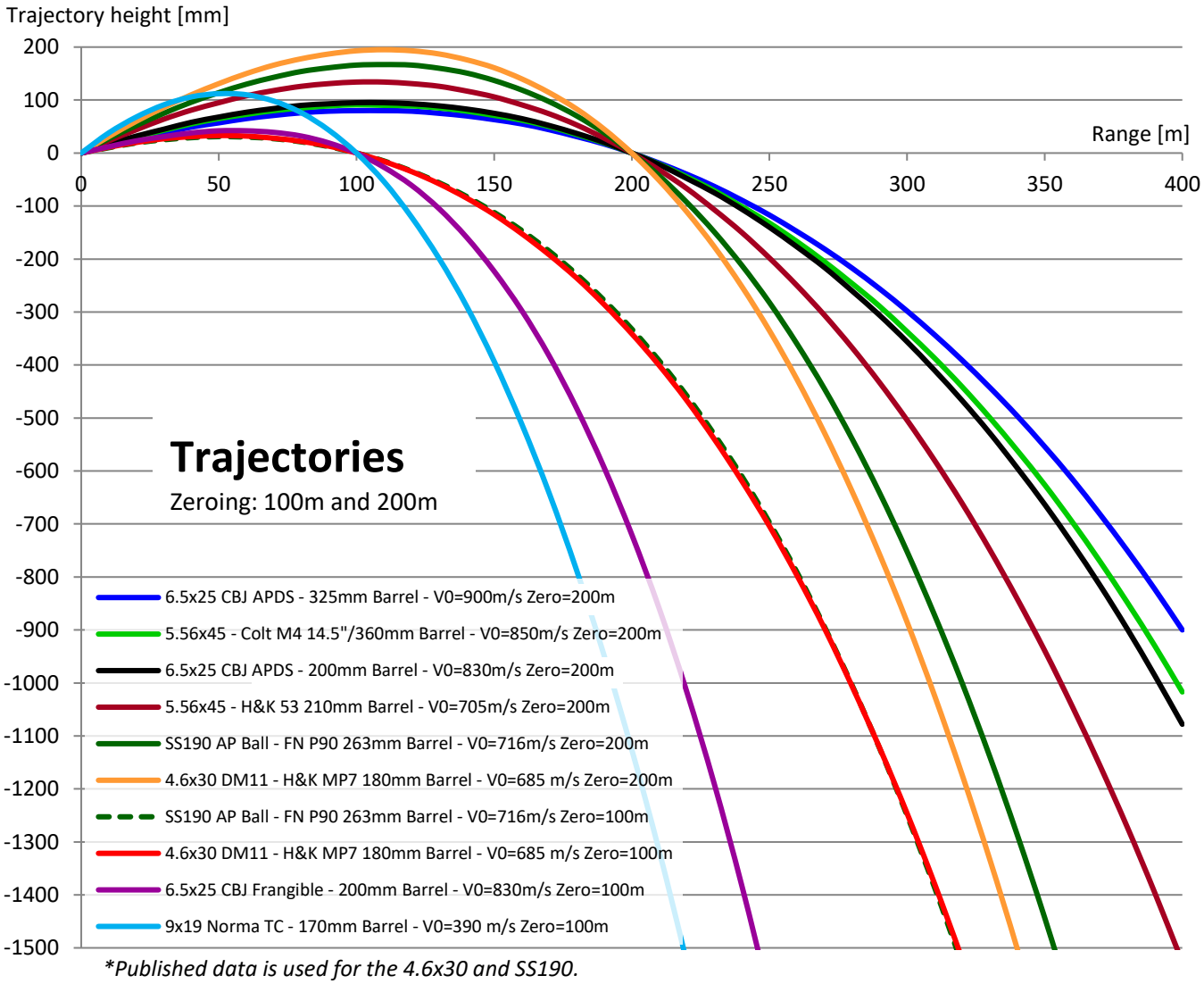
V_0, m/s	730 / 780	730 / 780	300 / 310	730 / 780	730 / 780
E_0, J	533 / 608	666 / 761	360 / 384	666 / 761	666 / 761

Below figures apply when shot from a 200mm submachine gun barrel

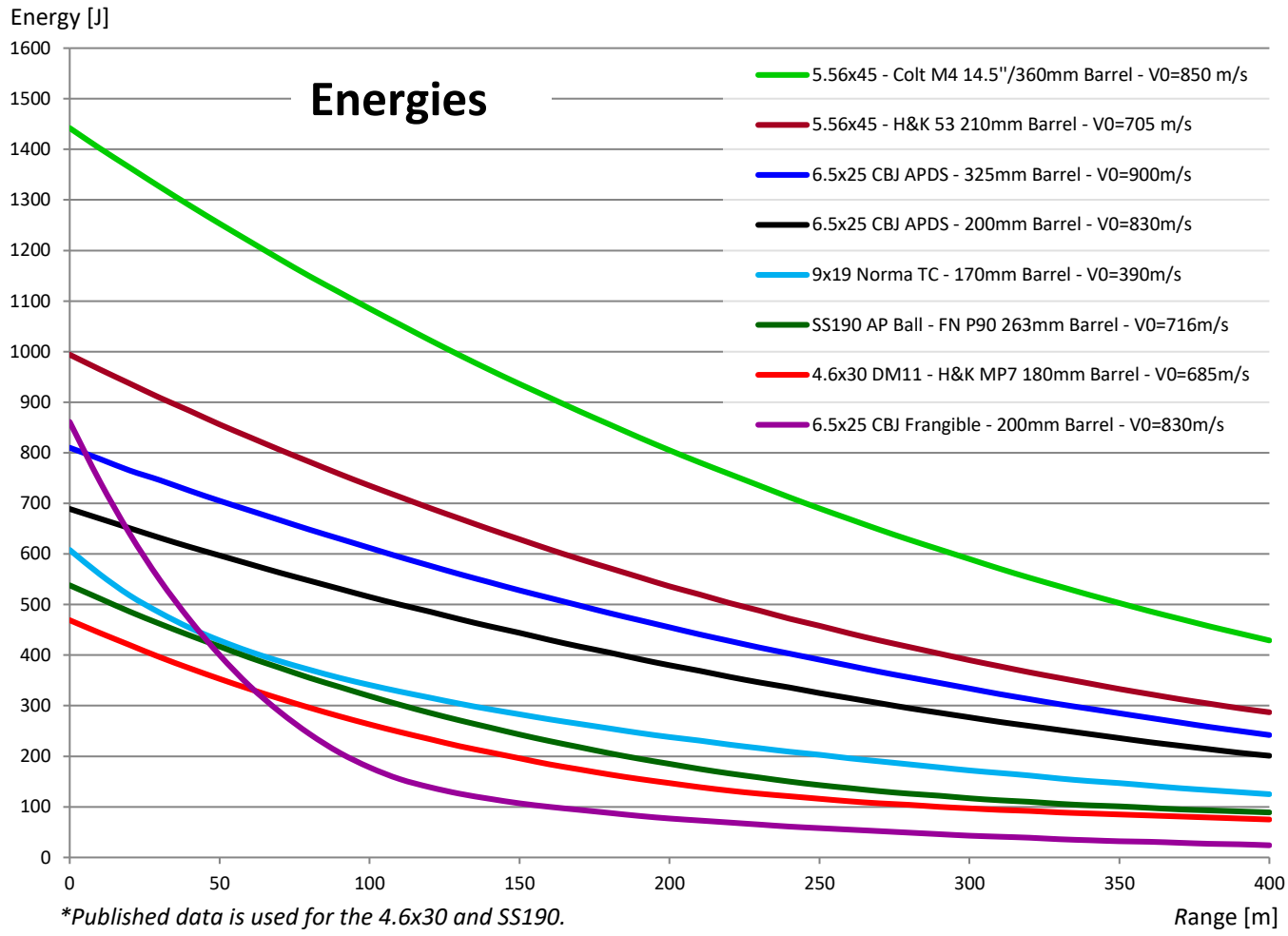
V_0, m/s	830	830	320	830	830
E_0, J	689	861	410	861	861

Below figures apply when shot from a 300mm carbine barrel

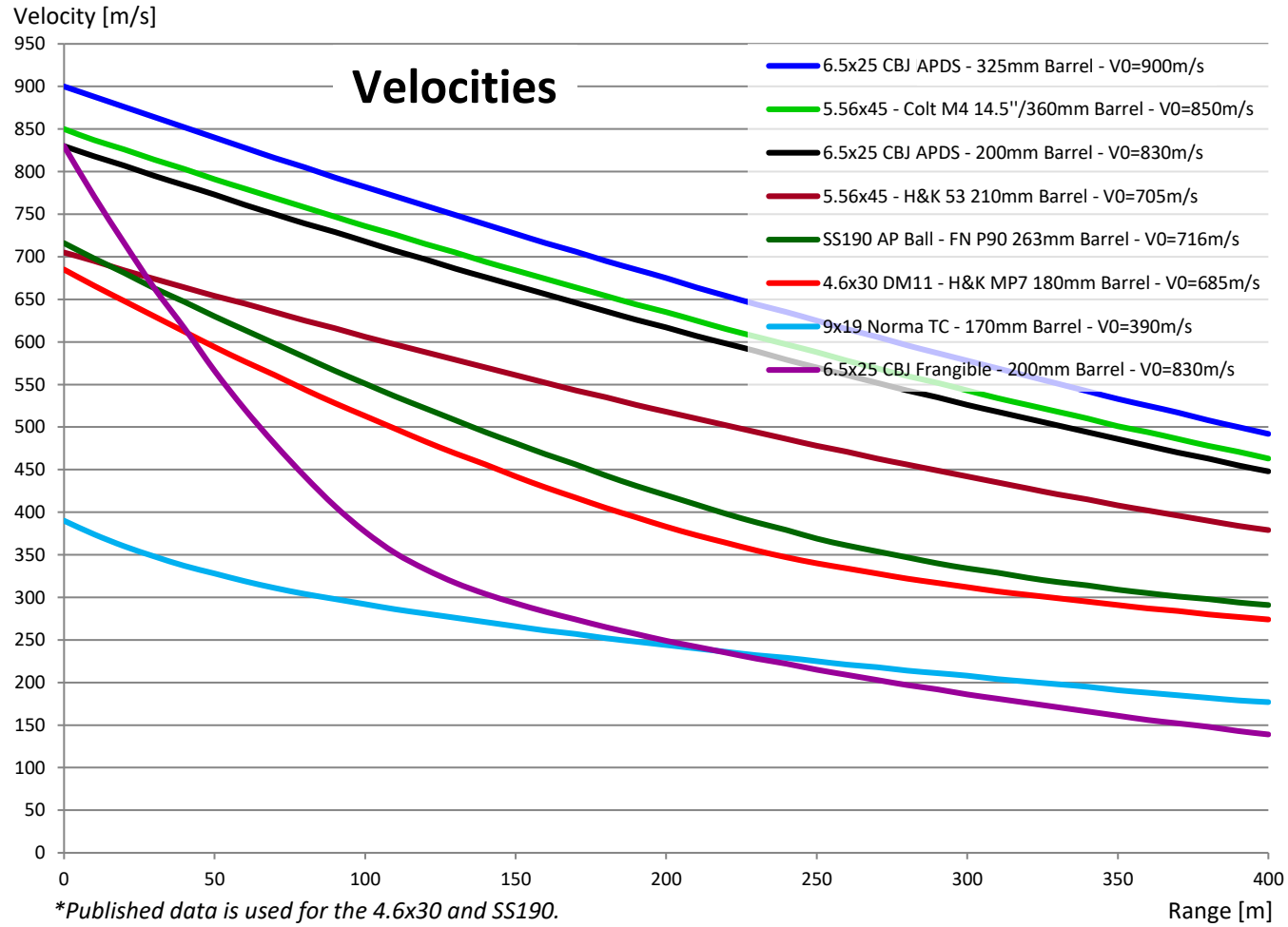
V_0, m/s	900	900	325	900	900
E_0, J	810	1013	423	1013	1013



**Published data is used for the 4.6x30 and SS190.*



**Published data is used for the 4.6x30 and SS190.*



**Published data is used for the 4.6x30 and SS190.*

6.5x25 CBJ Accuracy

The image to the left shows a typical pattern with the 6.5x25 CBJ Frangible fired at 100m with a Submachine Gun under field conditions. The pattern width is 193mm and height is 89mm. This performance is very similar for the Frangible, HET and HP variants.

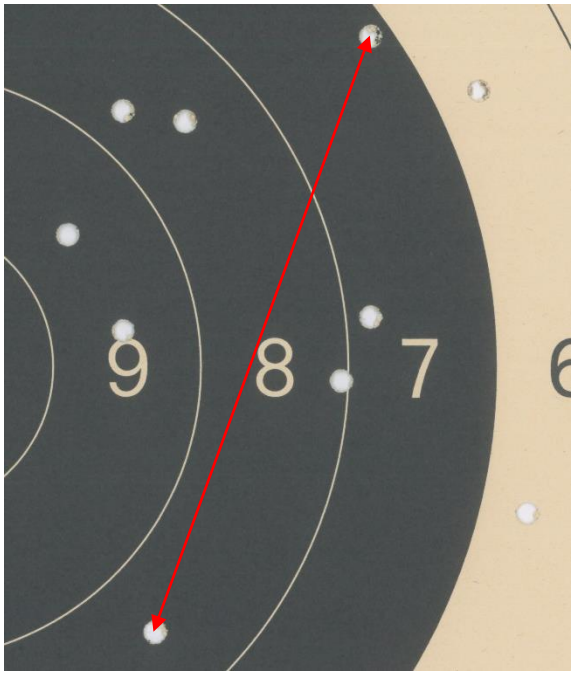
At 50 m range, all hits are typically found within a 50mm diameter circle when fired under the same conditions.

6.5x25 CBJ APDS - Practical Accuracy at 100m

Several tests of the practical accuracy of the 6.5x25 CBJ APDS when fired from a Submachine gun at a 100 m range have been done.

The subcaliber technology with a discarding sabot is hard to master due to the sabot separating from the core projectile after the muzzle. Any asymmetry during the separation phase will disturb the core projectile and ruin the accuracy.

According to NATO reference: AEP-97 MULTI-CALIBRE MANUAL OF PROOF AND INSPECTION FOR NATO SMALL ARMS AMMUNITION (MC-MOPI), the AEP-97 MC-MOPI accuracy requirement for 5.56x45mm NATO is: Horizontal and vertical standard deviation at 550m ≤ 200mm (ref. MC-MOPI vol. 18). Scaling linearly (which should be defensible, since both 5.56x45mm NATO and 6.5x25mm CBJ APDS remain supersonic beyond 550m, this equals to a requirement at 100m for horizontal and vertical standard deviation of ≤ 36,4mm.



The picture to the left shows a typical 10 round hit pattern at 100m with the 6.5x25 CBJ APDS. The maximum distance between the outer hits (red arrow) is 107mm.

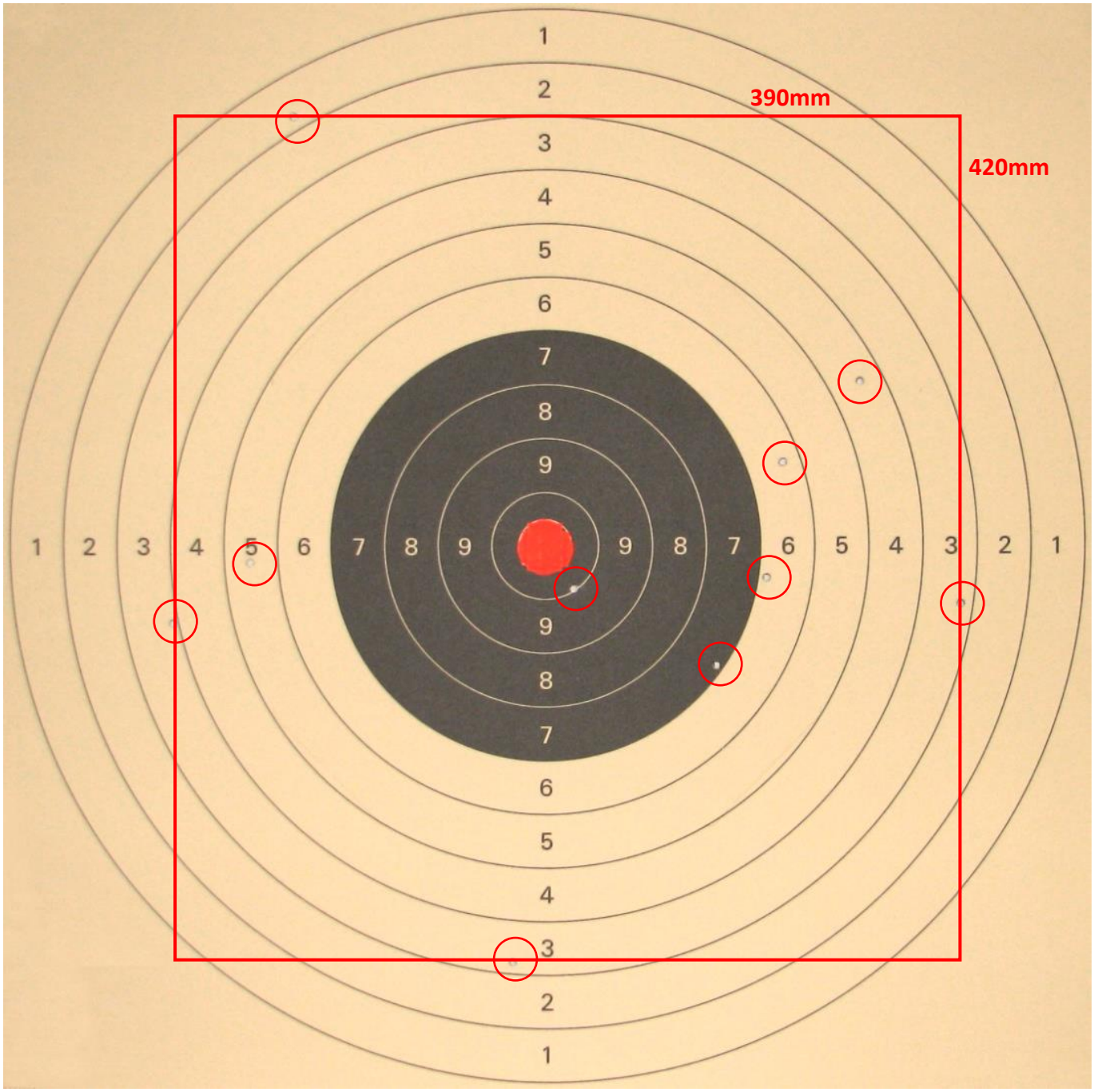
Calculating the standard deviation according to the AEP-97 MC-MOPI gives:

Horizontal standard deviation: 26,19mm

Vertical standard deviation: 31,12mm

Both values are ≤ 36,4mm, which means that the 6.5x25 CBJ APDS fulfills the NATO requirements for accuracy for 5.56x45 NATO, when fired from a Submachine Gun.

This is a typical 10 shot pattern with the 6.5x25 CBJ APDS fired at 300m under field conditions. The scoring area of the target is 500mm in diameter. The width of the pattern is 390mm and the height is 420mm.



Personal Defence Weapon

The term Personal Defense Weapon, or PDW, has been known for quite some time, and refers to small 1- or 2 handed weapons mainly used by military personnel which don't have combat with small arms as their primary task. This could be all kinds of support personnel like drivers or gun crews etc.

A PDW must be small and light enough to allow flexible carry, since the weapon is not the primary tool. An assault rifle is simply too big and cumbersome, and in most cases, carrying one will lead to the user putting it aside in order to complete the task at hand. There is a high risk that the weapon will not be available if a hostile situation quickly arises, which is common in modern asymmetrical warfare. Even the shortest assault rifles are still quite large, compared to a modern smaller submachine gun or a pistol.

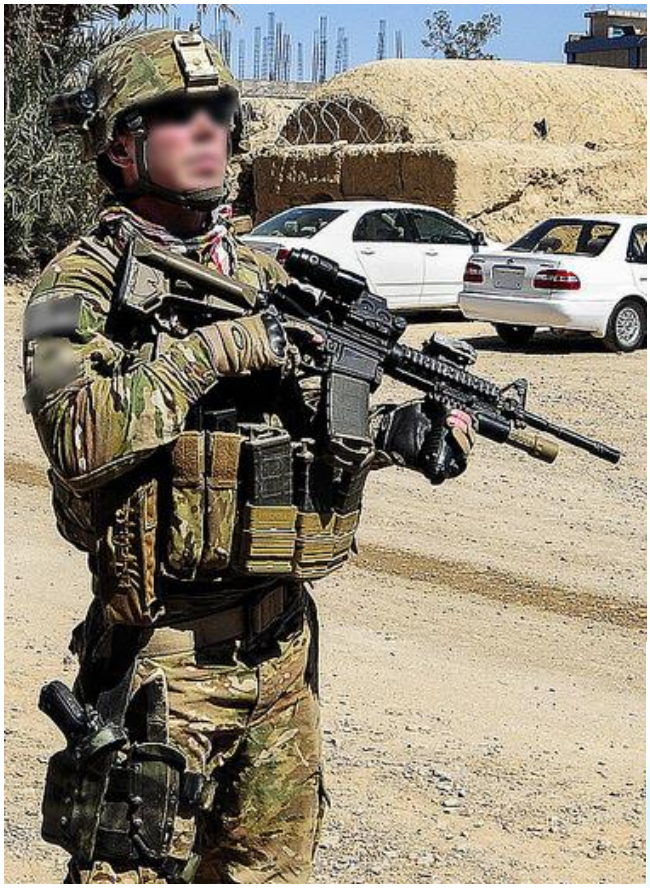
The majority of pistols and submachine guns today are chambered in 9x19mm, and the problem with this cartridge is the lack of ballistic performance in terms of trajectory, penetration capacity and terminal effect. Some efforts have been made to develop new cartridges with increased ballistic performance, but until now they have not managed to fully outperform the 9x19mm, especially when used in pistols. The penetration performance in body armors have been increased at short range, but the energy of the projectile is lower at longer range.

The 6.5x25 CBJ cartridge outperforms everything in this segment regarding penetration capacity, trajectory and energy delivered to the target, due to the use of lighter projectiles with high velocity, and in some variants also the utilization of sub caliber technology, which allows for assault rifle like performance from pistol size weapons.

A good solution for the PDW is a modern service pistol chambered in 6.5x25 CBJ, combined with a pistol carbine conversion kit with an optical sight, as shown in the picture.

The weapon is small and light enough to be carried in a holster or sling, and it gives the user maximum flexibility to adapt the weapon to different scenarios. Inserting larger 30 round magazines increases the firepower.

With this weapon the soldier or law enforcement officer can engage all targets normally engaged with small arms up to 200m. Because of the armor piercing performance of the 6.5x25 CBJ APDS, also soft skinned- and light armored vehicles can be engaged with good result at closer range.



Today it is common that riflemen are armed with an assault rifle in 5.56x45 Nato caliber as a primary weapon, and a pistol in 9x19 Nato caliber as a backup weapon.

The assault rifle is normally used for all situations, from close quarter battle (CQB) in urban areas to medium range engagements.

The pistol is used when the assault rifle is unavailable, like when there is a malfunction, when the ammunition is depleted or when the primary weapon is out of reach. The lack of performance of the 9x19 Nato cartridge limits the practical use of the pistol, especially when engaging targets with body armor, to mostly being used for self-defense in emergencies, rather than assault.

A pistol chambered in 6.5x25 CBJ and combined with a pistol carbine conversion kit could be used for more scenarios than just self-defense at short range. It can engage all targets normally engaged with small arms fire up to 50 m in pistol configuration and has the capability to engage targets out to 200 m in carbine configuration due to stability and optical sight. The ammunition is lighter than 9x19 Nato, and larger quantities can easily be carried.

Soldiers armed with heavier weapons like sniper rifles or anti-armor weapons, will benefit from the versatility of the pistol in carbine configuration. This weapon is much more suitable for close range engagements than the respective primary weapons.

CBJ Tech AB

www.cbjtech.com