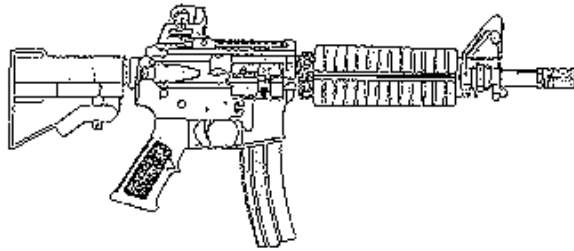


SPECIAL ANALYTICAL SERVICES  
MICHAEL R. HARRIS



MINI ASSAULT RIFLE SYSTEM  
(MARS)

Special Analytical Services has teamed with Colt's Manufacturing Company to develop a revolutionary new weapons concept called the Mini Assault Rifle System or MARS US (patent applied for). The MARS is a new class of weapon that will provide a personal defense weapon system for self-defense as well as emergency force protection or close quarters combat. This weapon will obsolete 9mm pistols and submachine guns among the military, special police, and security forces. It is envisioned to replace 80% of the pistols, all submachine guns, and 20% of the rifles/carbines in current military inventories. The MARS weapon and ammunition have been designed to overmatch threat weapons (AK-47/AKS-74) in speed and accuracy for ranges 0-400 meters (2 MOA accuracy), enhanced lethality (Ph/Pk) over the 9mm and 5.7mm weapons, have a significantly increased capability for aimed automatic fire, and be lighter than current submachine guns (i.e. MP-5, MP-5K PDW and FN P-90). In consideration of current levels of defense spending, the MARS concept focused on both cost and operational effectiveness and will keep development, procurement, training, and maintenance costs extraordinarily low. The MARS program was designed to offer a quantum increase in battlefield capabilities along with the maximum integrated value. The weapon and ammunition were designed to fully compatible current manufacturing facilities, materials, and practices to exploit unused capacity, reduce risk, cost, and schedule.



**Note the four ejected cases in the air and the lack of muzzle flash or climb  
Figure 1.**

Critical interfaces are retained in the design to ensure interface with the accessories in the USSOCOM and US Army Modular Weapon Program, ( i.e., rail system, pistol grip, suppressor, visible / IR illuminators, visible / IR lasers, etc. ), the Close Combat Optical Sight, Thermal Weapons Sight, AN/PAQ-4 lasers, Insight Technologies ITPIAL, and the USSOCOM/DOE controlled penetration projectiles, etc.

**BACKGROUND:** Military individual weapons generally consist of 9mm pistols, 9mm / 45 cal submachine guns and 5.56mm or 7.62 rifles. Pistols are for individual protection and do not have the range (25-50m), probability of hit, or probability of kill to contribute to the mission in a fire fight. They are light and the holster allows hands free carry. However, the proliferation of assault rifles and submachine guns have made the pistol obsolete as a militarily effective weapon, offering little protection from the overwhelming firepower of submachine guns and assault rifles. A down-sized military, modern fluid battlefields, and constant rear area threat from unconventional and conventional forces calls to question the practice of equipping combat support troops with an inadequate personal defense weapon, and as a result, giving them no ability to contribute to force protection or a close quarters battle in emergencies.

Submachine guns and the 30 cal carbine, while lightweight and compact, suffer from the inadequacies of the cartridges they fire. The effective range is limited to about 100 -150m with limited penetration and lethality. Recent combat operations in Grenada, Panama, Kuwait, and Somalia have painfully demonstrated the ineffectiveness of 9mm weapons in battle against weapons such as the 7.62x39mm AK-47. On the other hand, the typical battle

rifle in 7.62mm or 5.56mm/5.45mm is designed to fire 500-800m. These weapons are designed to shoot much further than the average soldier can locate, identify, or hit the enemy. As a result, weapons are heavy and cumbersome, the ammunition is heavy, and recoil, muzzle blast, and flash are excessive. Studies have shown that 95% of the target engagements are at 400m or less, and 25% are with full-automatic fire during which these weapons are difficult to control and impossible to aim.

**MARS COMPARISON TO CURRENT PERSONAL DEFENSE WEAPONS**

WEAPON	CALIBER	WEIGHT/LBS	EFFECTIVE	MUZZLE	BULLET	MUZZLE	ENERGY
		WITH 30RDS	RANGE	VELOCITY	WEIGHT	ENERGY	AT 150M
MARS	5.56X30MM	6.34	400M	2620 FPS	55g	838FT/LBS	538FT/LBS
FN P-90	5.7X28MM	6.35	150M	2346 FPS	31g	370FT/LBS	221FT/LBS
MP5K-PDW	9X19MM	7.29	150M	1230 FPS	123g	413FT/LBS	245FT/LBS

TABLE I



Figure 2.

**MILITARY APPLICATION**

The effectiveness of a military weapon system must be assessed against the threat. Personal defense and force protection for combat support/combat service support personnel and combat crewmen requires a weapon with the range, accuracy, and lethality to overmatch the enemies' assault rifle capabilities. Threat levels may involve all-out war, or activities other than war, in all possible environments and conditions. These include such operations as military, peacekeeping, rear area protection, counterinsurgencies, and combating terrorism. Threats to our forces, available resources, and facilities, must be considered in all planning and modernization efforts. Consequently, small arms today and in the future, must be designed with the threat in mind.

The threat operates at three levels that the friendly forces may face individually or in any combination. The main battle area is the highest at a Level III scenario and requires a

full-up battle rifle such as the M4/M4A1 or M16A2 for Infantry. Level-III includes close combat with all the conventional threats to include airborne, heliborne, amphibious force incursions and large combined arms ground combat operations. Level-II includes long range reconnaissance, intelligence gathering, and sabotage operations conducted by special purpose forces, guerrilla forces, or small tactical units. These specially trained and organized forces conduct rear area raids against, strategic weapons facilities, command and control nodes, air defense facilities, and logistic support operations. Level-I includes small scale threats from criminals, agents, sympathizers, partisans, and agent controlled or independent terrorist activities.

Special operations forces, security forces, and support troops would benefit from the light, compact, quick handling, and lethal capabilities MARS across all three threat levels. Similarly, the MARS is an ideal weapon for heavy weapons crews, snipers, special or urban reconnaissance teams.

The combat support and combat service support troops require a personal defense weapon to provide self-defense and in emergencies, force protection and even a close-in combat capability. No pistol to include the US Offensive Handgun meet the threat effectively.

Terrorists attacks, raids and ambushes by enemy commandos, or enemy penetrations require rear area troops to defend themselves and their facilities. Effective fire is the key to disrupting the attack and holding the enemy at bay until supporting fires and quick reaction forces can be brought to bare. Combat support/combat service support and combat crewmen require a compact, lightweight weapon that allows a hands free carry capability. The ergonomics of the weapon and fire control must provide a high hit probability at short to medium ranges with an absolute minimum of training.

### HELICOPTER CREWMEN

Recent conflicts have shown that if personnel engaged in evasion and recovery operations can hold the enemy at bay for as little as 20 minutes, airstrikes can be brought to bear and extraction can be made by accompanying aircraft or a rescue mission mounted.

The M16 rifle and M4 carbine are too cumbersome for the pilot and co-pilot in the cockpit. The 5.7mm P-90 and 9mm/45cal pistols / submachine-guns, while compact and easy to carry, lack sufficient range, power and accuracy to sustain the evader when outnumbered by even local militia armed with AK-47's.

Anything not secured in close proximity to the cockpit crew is not likely to accompany them as they scramble out of a crashed aircraft.

The amount of ammunition and level of marksmanship likely to be found among downed aircrews requires enhanced fire control for a higher probability of hit and suppression.

Reducing the firing signature to avoid detection and confusing pursuers is critical to

the aircrew's maintaining the tactical initiative.

### MARS is an ideal aircrew weapon.

#### ARMOR CREWS

Like aircrews, armor crews (APCs, tanks, self propelled guns, etc) require a compact, light weapon that can be secured to him for hands-free carry as he scrambles from a disabled vehicle. The weapon must provide sufficient firepower to hold enemy infantry at bay until supporting armor or dismounted troops can assist.



**The MARS carry system combines an assault sling and velcroed holster strap provide a secure but ready hands free unencumbered carry.**

**Figure 3.**

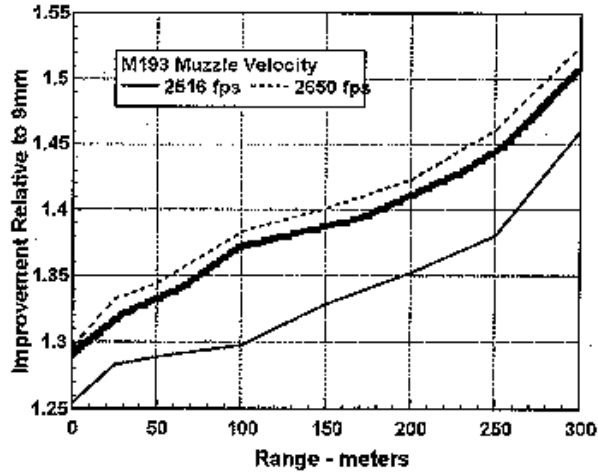
#### CLOSE QUARTERS BATTLE

At close quarter combat ranges of 25-50 ft, instant incapacitation is essential to preventing friendly casualties. The enhanced ergonomics of the MARS design makes it faster than the M9 Pistol or M16A2 Rifle in delivering lethal hits on close targets.

The MARS selector can be flicked from safe to semi or full and back to safe in one smooth quick motion without having to shift the firing hand on the pistol grip. The redesigned sights and selector combined with controllable recoil allow the average soldier to place a 5-6 round burst into the enemy 0.3 to 0.5 seconds before the M9 or M16A2 equipped

soldier can get off his first aimed shot.

**Relative Incapacitation  
Improvement Over the 9mm  
(9mm FMJ Performance = 1.0)**



\*Based on probability of incapacitation of a fully motivated assault soldier in less than 30 seconds

The 5.56mm MARS is, round for round, 30-50% more effective in incapacitating an enemy soldier making a determined assault than a 9mm from a MP5 submachine gun and even more so for a 9mm from a pistol. The low recoil impulse and enhanced ergonomic design provides rapid engagement of CQB targets with 5 to 6 round bursts that enable the shooter to instantly incapacitate an enemy soldier with a pistol or rifle and avoid becoming a casualty himself.

**MARS PROVIDES THE FIREPOWER REQUIRED TO SURVIVE THE THREATS  
ON THE BATTLEFIELD OR BEHIND THE LINES.**

**ENGAGEMENT REQUIREMENTS**

Typical Battlefield Data shows the following type and frequency of engagements that can be expected:

Range (meters)	Target Type	Time
0-100 30-40%	Point 20-25%	Day 50%
0-200 65-75%	Group Source of	Night 30%
0-300 75-85%	fire or danger 55%	Mixed Dusk/
0-400 85-95%	Other buildings	Dawn 20%
	vehicles, etc. 20%	
<b>Firing Positions</b>		<b>Firing Modes</b>
Prone w/wo cover or support	25-30%	Aimed semi-auto 15-20%
Standing or other		Aimed full-auto 25%

stationary position 30% Offhand/point 50%  
 Running, walking, moving vehicle 40-45%

This data supports a light, compact, and quick handling weapon whose ergonomics and sighting system supports point shooting at close range and the accuracy and lethality to reach 300-400 meters day or night.

The MARS cartridge is designed as part of the weapon system and exploits the high energy densities of modern Ball powders. It uses a fast ball powder to achieve 2600 ft/sec with a 55g FMJ projectile in only an 11 inch barrel. The high ballistic coefficient and high velocity result in a higher hit probability by limiting the effects of range estimation, wind drift, and moving targets. When the MARS is Battlesight zeroed at 200m, the path of the bullet stays within 3 inches of the line of sight. At 250 or 300 m, the operator only has to hold slightly higher on the target to achieve a hit.

### BALLISTIC COMPARISON

WEAPON	VELOCITY=FPS	ENERGY=FT-LBS	TRAJECTORY=IN.
5.56MM MARS	2620	838	-2.62
25M	2529	781	-0.68
100M	2335	629	2.65
150M	2108	543	2.47
200M*	1955	467	0
300M	1673	342	-13.24
400M**	1430	<b>250</b>	-41.32
9MM MP5K-PDW	1230	413	-2.07
25M	1158	366	3.64
100M	1013	280	8.61
150M* **	947	<b>245</b>	0
200M	891	217	-19.72
300M	797	174	-98.08
5.7MM FN P-90	2346	379	-3.84
25M	2233	343	-1.73
100M **	1917	<b>253</b>	1.31
150M*	1725	181	0
300M	1260	109	-27.92
5.56MM M4/M4A1	2858	1124	2.62
25M	2763	1051	-0.05
100M	2578	915	5.58
150M	2489	853	7.33
200M	2153	638	7.2
300M*	1850	471	0
400M	1583	345	-19.15
500M **	1354	<b>252</b>	-54.57

Note: \* Indicates the recommended battle zero range.

\*\* The effective range based on range at which the energy equal @ 250 ft-lbs.

**Table II**

The maximum effective range is a function of probability of hit and probability of kill given a hit. Accuracy, in terms of dispersion, and a trajectory close to the line of sight combine to provide an increased probability of hit throughout the expected range of engagement. The lethality mechanism is based on a system that projects sufficient kinetic energy and a projectile design that uses that energy effectively. Since military bullets cannot use expanding projectiles, they depend on the diameter or the tumbling cross section to control the rate at which energy is dumped in the target. While foot-pounds of energy alone is not a standard for lethality, it can be used to compare the new FN 5.7mm and the 5.56mm MARS to the standard 9mm and 5.56mm NATO Ball. The 9mm submachine gun is considered effective to 150m. The 5.56mm M4 Carbine is considered effective to 500m. Table II shows that at their effective ranges, both weapons have an energy of about 250 ft-lb. Applying this measure to the 5.7mm FN P-90 would indicate an effective range of 100m, rather than the 150m claimed by FN, while the 5.56mm MARS would provide effective incapacitation to 400m. The military has used the range at which a bullet will penetrate the US M1 steel helmet as a standard to measure effective range. This is the basis for the 800m effective range claimed for the M16A2. In tests, the MARS 55g Ball has penetrated completely through both a PASGT helmet and vest at 300m and the M1 Steel Helmet at 400m. At close range the MARS APDS round penetrates a M113 Armored Personnel Carrier. In contrast, the 5.7mm P-90 penetrates 48 layers of kevlar at 150m making adequate for level III vest and no data has been provided against helmets.

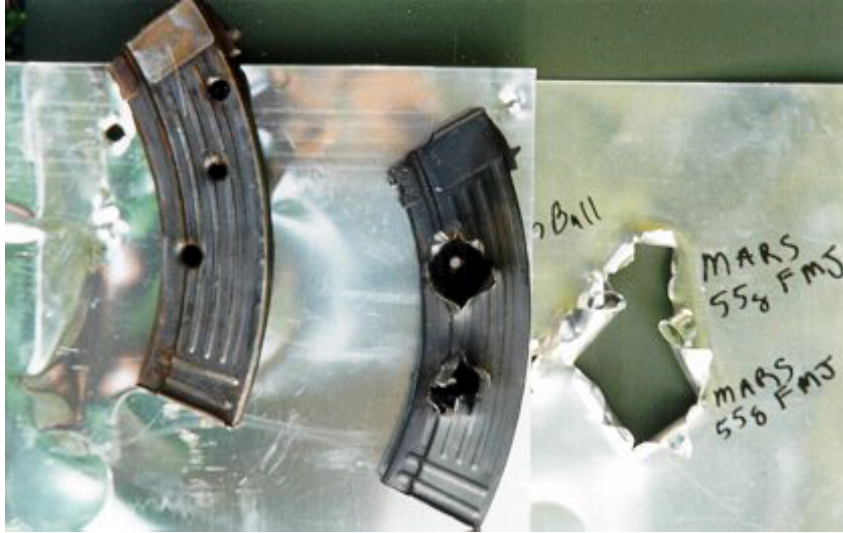
Accuracy is another component of effective range. The M16A2 with M855 ammunition normally shoots 3-5 MOA making hitting a target at 800m very unlikely. The 5.7mm P-90 shoots 6 MOA groups, while the MARS shoots 1.5-2 MOA. The trajectory and accuracy of the MARS gives it a head shot capability to 200m and a body shot without a hold-off to 300m. In practical battlefield terms, the Table II clearly shows that the MARS out shoots the P-90 and MP5K-PDW from 0 to 400m.



**The 5.56mm MARS 55g FMJ completely penetrated both sides of the PASGT at 300 meters and one side of the M1 steel helmet with liner at 400 meters. Penetrating the M1 Helmet is the criteria used to establish the maximum effective range of small arms.**

**Figure 4.**





**Effects of the three 9mm FMJ from a M9 versus the two 5.56mm MARS FMJ  
Figure 5.**

An AK-47 Vest with three loaded magazines was suspended in front of a witness plate made of 20mil 2024 T3 aluminum plate. The Army Research Laboratory uses this 2024 plate to assess casualty-producing munitions. If the projectile has sufficient mass and velocity to penetrate the plate, it is capable of delivering a serious to lethal wound. The magazine on the left was hit three times from a range of 2 meters with US 9mm Ball ammunition from an M-9 pistol. Two of the rounds bulged the magazine and dented the plate while only one round was able to make it through and penetrate the plate. In contrast, two rounds of 5.56mm 55g FMJ from the MARS fired at the same range penetrated completely and did massive damage to the witness panel. This phenomenal increase in close quarters lethality is essential in preventing friendly casualties inflicted by a wounded, but not incapacitated opponent.

#### MARS 5.56mm ARMOR PIERCING DISCARDING SABOT (APDS)

Enemy security forces are often equipped with armed tactical vehicles, i.e., light tactical trucks equipped with medium to heavy machine guns, automatic grenade launchers and occasionally anti-aircraft automatic cannons. Somalia demonstrated how even third world countries can jury rig these heavy weapons to commercial vehicles and produce a credible threat. In addition, enemy reaction forces are equipped with light armored cars, armored personnel carriers and even infantry fighting vehicles.

Raids and ambushes often include these vehicles among the targets along with VIP vehicles armored against small arms, and fortified guard posts. Security on WMD, and security/reaction forces are often equipped with armored shields or body armor up to level 4+ to include state of the art ceramic/metal composites (cermet) now being marketed world wide by the Russians.

The truck bomb in Beirut at the Marine compound and the embassy were ineffectively engaged by small arms fire.

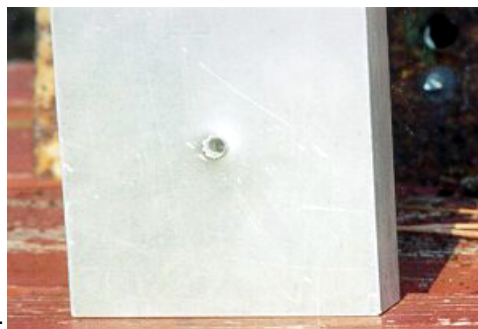
Gunmen in civilian vehicles ran check points and executed drive by shootings in Panama and again M16 fire alone was not effective.

SOF units where subjected to close assault by reaction forces supported by armored cars during Operation Urgent Fury and Just Cause.

Ship-boarding allows the enemy to fire from the cover of steel bulkheads and portholes against raiders initially exposed on the open decks.

The APDS round was developed with Hugh McElroy ( McEroy & Associates) offers enhanced penetration over the standard M855 in addressing this target set. The APDS is designed to give maximum penetration against the outer layer and then tumble to enhance lethality behind the armor.

In offensive operations against harden targets, the APDS ammunition offers enhanced lethality and would be used in addition to anti-tank rockets. In defensive actions, the APDS offers an emergency self defense capability against a close assault by security forces mounted in armored cars and/or armored personnel carriers.



**MARS APDS penetrated 1 inch aluminum armor from a M113 Armored Personnel Carrier. Note the damage to the hardened steel stop plate that can be seen at the right edge of the photo.**

**Figure 6.**

### LOGISTICS

MARS ammunition is packed in standard 5.56mm 10 round stripper clips, bandoleers and ammo cans. The 5.56m MARS is short enough that the cartridge shoulders do not overlap in the bandoleer pouches. As a result, four 10 round striper clips are packed in each pouch on the bandoleer with seven bandoleers packed per standard ammo can. This provides 1120 rds of 5.56 MARS rather than 840 rds of M855. MARS provides a dramatic increase in rounds provided for weight and cube moved through the logistic system or carried on an individual. A pound of 9mm ammunition is 36 rounds while a pound of 5.56 MARS is 45 rounds a 25% increase in the number of rounds with each round 30%-50% more effective. In addition, over one hundred of the parts in the MARS are common to the M16/M4 weapons greatly reducing maintenance costs and training.

The MARS provides a weapons system that will meet all the requirements of a personal defense weapon system for self-defense and emergency force protection or even a close quarters combat capability. This weapon would obsolete the pistol and 9mm submachine guns among the military, special police, and security forces.