

TECHNICAL REPORT: THE eXact iMPact 1006 (XM1006)

Originally printed April 2000

INTRODUCTION:

The use of specialty impact munitions has become a popular tool in the force continuum. These munitions offer increased engagement distances, providing greater standoff from physical contact. They have been used effectively as a pain compliance tool for crowd routing during civil disturbances and more recently for the momentary incapacitation or disorientation of aggressive, lightly armed subjects. The ability to disorient or incapacitate an individual without engaging in physical contact inevitably ensures the safety of the officer, while providing a favorable alternative to deadly force when officer or public safety is not compromised.

In order for a specialty impact munition to be effective, it must have the ability to consistently deliver an optimal amount of energy across a wide range of distances. By nature, impact munitions will have an inherent potential for causing injury, but with a low probability of causing serious physical harm. The impact of the projectile, along with the associated pain, work together to deter the individual from the unwanted aggressive action.

The US Army Research Laboratory developed the 40mm spin-stabilized XM1006 for military use during peacekeeping operations. The requirement for an accurate, less lethal capability over longer ranges was not commercially available at that time. In 1999 Defense Technology Corporation of America (DTCA) entered into an exclusive licensing agreement with the Department of Defense for the rights to manufacture and distribute the XM1006. While the US law enforcement community is predominately 37mm, DTCA chose to pursue this 40mm projectile for reasons presented in this report.



DESIGN:

The XM1006 is a two-component design utilizing a military engineered projectile incorporated with a Defense Technology propulsion system. This combination provides an extremely accurate projectile, which delivers consistent impact energies over a broad range of engagement distances.

The projectile is made up of a high-density sponge nose that is very aerodynamic in flight. The XM1006 does not rely on the dispersion of shot or the expansion of material to maximize surface area. The nose provides the largest impact surface available from a standard bore munition, assuring a non-penetrating impact. In addition, the nose acts as a dampening material, which allows the XM1006 to be shot at extremely close distances with no greater risk of injury.

The propulsion system designed by Defense Technology utilizes a modified hi-lo configuration that is standard on all DTCA's smokeless products. This smokeless system ensures an extremely efficient powder burn resulting in very consistent shot to shot velocities. The crimp of the projectile to the base further ensures that a maximum pressure is reached before the projectile is discharged. The rifling band of the projectile creates a tight seal preventing blow-by of the hot gases while spinning the projectile in-bore. The smokeless powder reduces fouling of the barrel and minimizes smoke that can obscure vision when targeting an individual. Because of the low powder charge and design, this system produces a lower report and recoil than conventional black powder systems.

The combination of this aerodynamic projectile and the smokeless propulsion system produces an impact energy that is consistent throughout its range of engagement. The accuracy allows an individual to target a specific impact location depending on the threat level of the subject.



RESEARCH AND TESTING:

The US Military has invested more than a million dollars and over five years of effort into the development of this cartridge. During that time, every facet of the projectile was examined, resulting in optimal flight characteristics that would yield sufficient impact energies to disorient or incapacitate an individual, without causing serious physical harm (See Figure 1). By design, the large surface area allows the impact energy to be distributed both evenly and consistently, preventing high energy densities that can result in penetration. The composition of the sponge nose acts as a dampening material, which yields similar impact deformations from 5 feet to over 80 feet.

The XM1006 has been tested against every available impact media, including ballistic clay, ordnance gelatin, and the 3 Rib Chest Structure (3-RCS) developed by General Motors Research Laboratory. In addition, the probability of lethality has been calculated using several accepted methods (Figure 1). The ballistic clay impacts are based upon the standard for body armor testing (NIJ Standard 0101.03). The munition is fired into Roma Plastilina No. 1 Modeling Clay and the resulting deformation is measured. The depth of the cavity cannot exceed 44mm. The gelatin impacts utilized 10% by weight ordnance type 250A gelatin. The impacts were recorded with high-speed video to measure the temporary deformation, as the XM1006 did not penetrate or lacerate the impacting surface. The 3-RCS measures a VCmax, which is a predictor to the probability of injury. A VCmax of 1.0 constitutes a great risk of injury, while a lower number corresponds to a lower probability of injury.

Lastly, the aerodynamic design, along with the propulsion system, ensures that the impact energy is consistent throughout its range of engagement. Using Doppler Radar, the flight characteristics of the XM1006 was captured to determine the effective range. By comparison, the 12 gauge bean bag projectile, which has a 40 gram mass, produces a slightly higher kinetic energy at the muzzle, but significantly lower energy at forty feet (See Figure 2). The resulting change in kinetic energy over distance may effect not only the performance of these munitions but also the scenarios in which they are deployed.

DEPLOYMENT AND TACTICS:

When deploying specialty impact munitions, several factors must be taken into account.

- Distance to subject.
- Available target area.
- Clothing worn by the subject.
- The physical stature of the subject.

As the officer can not control the majority of these factors, the need for a munition that minimizes these variables is clear. The ability to deploy one munition in diverse scenarios (such as suicide by cop, armed subjects, and crowd control) is not available with any other projectile. The accuracy of the XM1006 should allow individuals to become proficient in marksmanship with less training. This diversity creates the potential for this round to be deployed from the emergency response unit all the way to the patrol level officer.

Engagement scenarios are very dynamic in nature, placing a premium on accuracy and reliability. The XM1006 offers the greatest range of engagement backed by the most comprehensive impact data available. The XM1006 is suitable for cell clearings or close quarter engagements, while just as effective for increased distances such as a recreation yard.



CONCLUSION:

As the deployment scenarios for specialty impact munitions have become more diverse, the need for an impact munition to adapt to these engagements is extremely important. In any given scenario the threat level is prone to change as distances and available target picture change. The ability to deal with these scenarios with close, medium, and long range rounds is not a viable option, as this merely transfers the accountability and liability from the manufacturer to the officer. The XM1006 has been designed and tested to ensure that the energy imparted on an individual remains consistent through its range of engagement. As these engagements are very dynamic in nature, the officer need not be tasked with determining which munition is best suited for the situation. Their time and energy is better suited minimizing the threat and ensuring the safety of all individuals involved.

David K. DuBay, Director of Research, Defense Technology/Federal Laboratories, Casper, WY

