Exotic 12 Gauge Shotgun Ammunition

Performance Summary

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Bottom Line Up Front

We tested a wide assortment of ‘exotic’ ammunition for the 12 Gauge Shotgun that was marketed as either producing exceptional terminal ballistic damage or yielding some kind of special incendiary or foliage-penetrating effect when fired. Our samples were produced by Fire Quest International and consisted of: Double Slug, a pair of unstabilized stacked lead shotgun slugs; Flame Thrower, a strong incendiary commonly known as dragon’s breath; a Signal Flare of the type that one would use to signal approaching aircraft while lost at sea; a cartridge that fires a shot cup of small sharp steel darts called Flechettes; Macho Gaucho, commonly referred to as a bolo round, which links two lead weights together with a 5.3” long steel wire; Rock Salt which contains chunks of salt and is reportedly used as a non-lethal cartridge; Terminator, a shell consisting of an unstabilized lead slug and #4 birdshot and the Zombie Killer, which contains a mixture of #4 lead birdshot and 00 lead buckshot.

In the interests of maintaining relevancy to the shooter in the field, we covered the target gelatin blocks in different materials to include a light cotton T-shirt and fresh pig skin to simulate human skin. The Double Slug offers great theoretical benefit by increasing both hit probability and damage to the target but failed to disperse significantly at the 10 feet distance between the muzzle of the shotgun and the front of the gelatin block. Flame Thrower failed to set the skin simulant on fire but succeeded in setting fire to the surrounding grass, table and target fixture. Signal Flare was shot at a cotton T-shirt covering skin simulant and a ballistic gelatin block. The Flare did not penetrate the ballistic gelatin block but did cause light burning to the cotton T-shirt. Flechette cartridge lacked the muzzle velocity to stabilize the flechette rounds in air and demonstrated lackluster penetration and terminal performance as a result. Macho Gaucho separated in air once out of the three shots fired, exposing the steel wire to cut the ballistic gelatin during penetration. Rock Salt was not able to penetrate the fresh pig skin barrier at the ten feet distance. Terminator yielded an impressive combination of shallow damage and deep penetration on the instances where the slug impacted the gelatin at an angle close to 90 degree obliquity. Zombie Killer offered satisfactory terminal performance with its combination of shallow damage and pellet deformation of the larger buckshot pellets.
Introduction

Shotguns offer several unique advantages that include the ability to launch relatively large diameter heavy projectiles and compatibility with unstabilized projectiles such as birdshot and buckshot. This allows the shotgun to function in almost unlimited roles as a signaling device, incendiary weapon reminiscent of a small flamethrower, non-lethal crowd control weapon and as a devastating close quarters combat weapon if needed.

With the exception of the Flame Thrower cartridge, all ammunition was tested three times each. All shots were fired with a distance of ten feet between the muzzle of the shotgun and the front impact face of the ballistic gelatin block as depicted in Figure 1. The test shotgun had a twenty-four inch barrel length and a Skeet I choke installed.

Figure 1. Test site setup diagram (overhead view)

Impact events were recorded by a Photron SA-5 Color High Speed Video camera set at 60,000 frames per second. Velocities were recorded by a Pact Model 1 XP chronograph placed at 7ft distance from the muzzle.

For scale, the grid upon which the gelatin blocks sit during the test event measure 1.00” across the aluminum square and 1.00” between squares. As a standard reference we included the 45ACP 230gr FMJ impacting at 787 ft/sec on the terminal ballistics graphs.
Results

**Double Slug**

Figure 2. Double Slug (Front of package, Rear of package)

Figure 3. Double Slug cartridge

The Double Slug consists of two non-rifled 394gr slugs stacked one on top of the other.
The damage done by the Double Slug to the gelatin is heavily dependant upon the angle of attack during penetration. Shots 1 and 2 feature the Double Slug traveling at pronounced angles of attack and Shot 3 illustrates the effect of the Slug impacting at close to a 90 degree obliquity with the gelatin block.
Figure 6. Double Slug Shot 1 static view

Figure 7. Double Slug Shot 2 (visual and red-filtered)
Figure 8. Double Slug Shot 2 static view

Figure 9. Double Slug Shot 3 (visual and red-filtered)
Table 1. Double Slug angles of attack and Kinetic Energy drop per unit of Penetration depth

<table>
<thead>
<tr>
<th>Shot</th>
<th>Impact Velocity (ft/sec)</th>
<th>Angle of Attack (degree)</th>
<th>Average Kinetic Energy drop Per inch of Penetration Depth (ft-lbf/inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>877</td>
<td>20.2</td>
<td>103.3</td>
</tr>
<tr>
<td>2</td>
<td>889</td>
<td>13.2</td>
<td>86.0</td>
</tr>
<tr>
<td>3</td>
<td>980</td>
<td>6.3</td>
<td>161.3</td>
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</table>
We see that the fluid flow around the slugs as they penetrate is most violently disturbed by the low angle of attack and as the pitch/yaw angles become more extreme, as in Shot 1, the surface area of the mass is increased and the drag begins to increase again.

The impact velocity of all tested rounds was too low for the slugs to expand. Pure lead reaches its yield strength at a stagnation pressure of 2400 psi, which corresponds to a velocity in gelatin of approximately 600 ft/sec. These permanent deformations are not significantly large, however, until the projectile reaches approximately 1100 ft/sec. With an average impact velocity of 915 ft/sec it is reasonable to conclude that the ‘expansion’ of these slugs was not sufficient to influence the drag acting on the slug and subsequently the kinetic energy drop of each projectile.

If both slugs were spin-stabilized, as in a rifled slug for smoothbore shotguns and both slugs made independent penetration tracks, the performance of this cartridge could be significantly increased. The wounding benefits provided by this cartridge could also be improved by increasing the muzzle velocity, though with a combined weight of 788gr this may prove to be difficult without spiking the chamber pressure beyond safe limits. The average kinetic energy of this cartridge was 1465 ft-lbf which is in contrast to the average kinetic energy of a standard 2 3/4” rifled slug which is approximately 2486 ft-lbf - 59% the kinetic energy of a standard 1-ounce rifled slug.

Flame Thrower

Figure 12. Flame Thrower (Front of package, Rear of package)
The Flame Thrower cartridge consists of incendiary material separated from the propellant by a thin disk. Upon propellant ignition, the incendiary mix begins to burn.

Figure 14. Flame Thrower impacting Skin Simulant and ballistic gelatin block
Figure 15. Range camera still footage of Flame Thrower impact event
Ballistic damage and penetration into the gelatin stopped at the skin layer due to the impact velocity of 644 ft/sec and light weight of the incendiary particles. The ballistic gelatin block under the skin received no burns or cracking and the skin did not catch on fire. Testing was halted after a single shot due to the fire hazard. We highly recommend this cartridge for its incendiary effect though we caution that it has no usefulness as a ballistic weapon.

Signal Flare

Figure 17. Signal Flare (Front of package, Rear of package)
The Signal Flare is intended for use in flare launchers intended for boating emergencies. Here we evaluate its potential as a ballistic and incendiary weapon.
Figure 20. Signal Flare impacting T-shirt/Skin/Ballistic gelatin target

Figure 21. Range camera still footage of Signal Flare impact event
Table 2. Signal Flare impact velocity

<table>
<thead>
<tr>
<th>Shot</th>
<th>Impact Velocity (ft/sec)</th>
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<tbody>
<tr>
<td>1</td>
<td>478</td>
</tr>
<tr>
<td>2</td>
<td>436</td>
</tr>
<tr>
<td>3</td>
<td>496</td>
</tr>
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</table>

The Signal Flares impacted at an average of 470 ft/sec and failed to penetrate the skin simulant material. Due to the lit incendiary mix, the T-shirt material did catch on fire and was able to support combustion.

**Figure 22.** T-shirt burned by Signal Flare

![Image of T-shirt burned by Signal Flare](image1.png)

**Figure 23.** Skin unburned by impact with Signal Flare

![Image of Skin unburned by Signal Flare](image2.png)

The Signal Flare should be able to start fires at a distance but it has no place as a ballistic weapon.
The Flechette cartridge contains 20 MIL-F-48167 flechettes that weigh an average of 7.8gr per flechette. These were originally loaded in the 105mm M546 APERS shell with a muzzle velocity of 1550 ft/sec but apparently have been repurposed for usage in a 12 gauge shotgun cartridge.
Figure 26. Kinetic Energy expended by the individual Flechette in the gelatin target

Figure 27. Flechette Shot 1
Figure 28. Flechette Shot 1 static view (side view)

Figure 29. Flechette Shot 1 static view (top view)
Figure 30. Flechette Shot 2

Figure 31. Flechette Shot 2 static view (side view)
Figure 32. Flechette Shot 2 static view (top view)

Figure 33. Flechette Shot 3
Table 3. Flechette impact velocity

<table>
<thead>
<tr>
<th>Shot</th>
<th>Impact Velocity (ft/sec)</th>
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<tbody>
<tr>
<td>1</td>
<td>827</td>
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<td>2</td>
<td>842</td>
</tr>
<tr>
<td>3</td>
<td>833</td>
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Each individual flechette impacted with an average of 12 ft-lbf of kinetic energy - about that of a modern adult airgun pellet. These particular flechettes were designed to be used in the M546 APERS, a 105mm artillery shell for horizontal firing against ground troops. The muzzle velocity of the M546 from an 105mm artillery gun is 1550 ft/sec. The average muzzle velocity of the three shots from the 12 gauge was 834 ft/sec - too slow for the flechettes to stabilize and then yaw in the target.

Flechettes are effective when they hit the target in a point-forward orientation and then ‘fish hook’ inside of the target through the mechanism of tumbling. Performance can be substantially enhanced by orienting all flechettes point-forward inside the shell and dramatically increasing the shot-start pressure. Using a simple kinetic energy balance equation and assuming excellent interior ballstic work has been done with the components of the shell and using a custom propellant, it is estimable that a shell producing 2486 ft-lbf of kinetic energy at the muzzle would propel each flechette to a velocity of 2730 ft/sec at the muzzle.
Macho Gaucho

Figure 35. Macho Gaucho (Front of package, Rear of package)

Figure 36. Macho Gaucho cartridge

The Macho Gaucho consists of two lead weights linked together with a 5.3” long steel wire.
Figure 37. Kinetic Energy expended by the Macho Gaucho in the gelatin target

Figure 38. Macho Gaucho Shot 1
Figure 39. Macho Gaucho Shot 1 static view

Figure 40. Shot 1 Recovered Fragment
Figure 41. Macho Gaucho Shot 2

Figure 42. Macho Gaucho Shot 2 static view
Figure 43. Shot 2 Recovered Fragment

Figure 44. Macho Gaucho Shot 3
Figure 45. Macho Gaucho Shot 3 static view

Figure 46. Shot 3 Recovered Fragment
Table 4. Macho Gaucho impact velocity

<table>
<thead>
<tr>
<th>Shot</th>
<th>Impact Velocity (ft/sec)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1116</td>
</tr>
<tr>
<td>2</td>
<td>1242</td>
</tr>
<tr>
<td>3</td>
<td>1123</td>
</tr>
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</table>

We see that one out of three of the Macho Gaucho projectiles separated prior to impact, exposing the wire to cut the target. If the distance to target were increased, it is likely that at least one of the other Macho Gaucho projectiles would have separated. We test at ten feet distance as this is what is called for in the FBI gelatin testing protocol and is also typical of shooting distances during self-defense situations.

Performance from this cartridge could be markedly increased by mechanically forcing the separation of the two weights and exposing the wire between them to the target material.

*Rock Salt*

*Figure 47. Rock Salt (Front of package)*
Figure 48. Rock Salt cartridge

Figure 49. Rock Salt impacting Skin and ballistic gelatin block

Figure 50. Range camera still footage of Rock Salt impact event
Figure 51. Pig skin after being impacted by 3 shots of Rock Salt

Table 5. Rock Salt impact velocity

<table>
<thead>
<tr>
<th>Shot</th>
<th>Impact Velocity (ft/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>502</td>
</tr>
<tr>
<td>2</td>
<td>471</td>
</tr>
<tr>
<td>3</td>
<td>NR</td>
</tr>
</tbody>
</table>

The Rock Salt failed to penetrate the pig skin and created no permanent trauma to the gelatin behind it. We are skeptical as to the efficacy of this load at breaking the skin and “putting salt in the wound” as many believe it will. That said, the author has no desire to be shot by this load.

Performance could be increased by adding small diameter steel spheres to the mixture in an effort to break the skin prior to impact with the Rock Salt.
**Terminator**

**Figure 52.** Terminator (Front of package, Rear of package)

**Figure 53.** Terminator cartridge

The Terminator cartridge consists of several #4 birdshot pellets and one 394.3gr unstabilized slug.
Figure 54. Kinetic Energy expended by the Terminator in the gelatin target

![Graph showing kinetic energy transfer vs penetration depth for different shots and types of ammunition.]

Figure 55. Terminator Shot 1

![Image of a gelatin target after being shot with the Terminator, showing a significant penetration area.]
Figure 56. Terminator Shot 1 static view

Figure 57. Terminator Shot 2
Figure 58. Terminator Shot 2 static view

Figure 59. Terminator Shot 3
We like the spreading effect caused by the penetrating slug on the pieces of birdshot. When the slug strikes the target at a low angle of attack, the cartridge is more effective than when the slug strikes at a high angle of attack. Performance can be enhanced by the use of a gyroscopically-stable slug in combination with the pieces of birdshot.
Zombie Killer

Figure 62. Zombie Killer (Front of package, Rear of package)

The Zombie Killer cartridge is a combination of #4 birdshot, 00 buckshot and an unstabilized sintered lead slug.
Figure 64. Kinetic Energy expended by the Zombie Killer in the gelatin target

![Graph showing kinetic energy transfer vs penetration depth for Zombie Killer 12 gauge bullets in 20% gelatin, with data points for different shot types including Shot 1 (00 buckshot) and Shot 3 (00 buckshot).]

Figure 65. Zombie Killer Shot 1
Figure 66. Zombie Killer Shot 1 static view

Figure 67. Zombie Killer Shot 2
Figure 68. Zombie Killer Shot 2 static view

Figure 69. Zombie Killer Shot 3
The Zombie Killer offers penetration from the birdshot that is deep enough to cause significant damage. Further benefit is realized from the deep penetration depth obtained by the 00 buckshot pellets.
**Conclusion**

The Double Slug offers great theoretical benefit by increasing both hit probability and damage to the target but failed to disperse significantly at the 10 feet distance between the muzzle of the shotgun and the front of the gelatin block. Performance would be greatly improved by spin-stabilizing both slugs but introducing a dissymmetry to the rearward slug to increase dispersion.

Flame Thrower failed to ballistically damage or set the skin simulant on fire but succeeded in setting fire to the surrounding grass, table and target fixture. If your concerns include setting target structures on fire, this is the round for you.

Signal Flare was shot at a cotton T-shirt covering skin simulant and a ballistic gelatin block. The Flare did not penetrate the ballistic gelatin block but did cause light burning to the cotton T-shirt. It has a similar effect to the Flame Thrower but functions at a further distance.

Flechette cartridge lacked the muzzle velocity to stabilize the flechette rounds in air and demonstrated lackluster penetration and terminal performance as a result. Its performance could be greatly increased with interior ballistic optimization of the cartridge.

Macho Gaucho separated in air once out of the three shots fired, exposing the steel wire to cut the ballistic gelatin during penetration. Effectiveness would be greatly improved if the projectile could be modified to reliably separate upon exiting the muzzle.

Rock Salt was not able to penetrate the fresh pig skin barrier at the ten feet distance. Adding steel ‘dust’ to the mixture could increase the long-lasting stinging effect of this non-lethal cartridge.

Terminator yielded an impressive combination of shallow damage and deep penetration on the instances where the slug impacted the gelatin at an angle close to 90 degree obliquity. Utilizing a stabilized slug would increase the terminal repeatability of the Terminator.

Zombie Killer offered satisfactory terminal performance with its combination of shallow damage and pellet deformation of the larger buckshot pellets.

All of the tested cartridges demonstrated great imagination in design of concept and many performed acceptably in the terminal ballistics test scenarios. We encourage further development of the Flechette and Macho Gaucho rounds as potentially more-effective loads than conventional buckshot or slugs.