Comparative Analysis of the Terminal Effectiveness of the 22LR and 25ACP handgun

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Brass Fetcher Ballistic Testing

Exterior Ballistics • Terminal Ballistics

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Introduction

Many people who carry a concealed firearm will opt, at least part of the time, to carry a smaller firearm as opposed to a more effective ‘combat handgun’. These smaller guns, often called ‘mouse guns’, are much easier to conceal and lighter to carry. Despite these advantages, there are compromises with the terminal performance of the majority of these weapons (due to the small propellant charges and short barrels) and the ease of precise aiming. It is in this interest that we look to find an optimized load for the 22LR and 25ACP handgun, or at the very least identify cartridges that offer the *least* in terms of *compromise*.

From a .22LR handgun (Walther P22 with 3.4” barrel length), we evaluated the CCI 40gr *Velocitor* hollowpoint, Aguila 60gr *Sniper SubSonic* lead round nose and the CCI 40gr *Segmented Subsonic*. As a baseline, the CCI 40gr *Velocitor* hollowpoint was fired from a Ruger 10/22 (with a barrel length of 18.5”). These cartridges and barrel lengths were chosen as representative of the types that are readily available on the consumer market. We will directly investigate the logic of using hollowpoint ammunition from a 22LR handgun (which typically do not reach their intended velocity in the shorter barrel lengths and thus, do not expand in tissue) versus firing the same ammunition from a rifle-length barrel. Additionally, more ‘exotic’ 22LR ammunition is explored in the form of pre-fragmented projectiles and long length-over-diameter (L/D) projectiles that are useful because they are likely to tumble inside of an attackers body.

As a point of practical comparison, a .25ACP handgun (Beretta 21a with 2.4” barrel length) was used to fire Winchester 50gr FMJ, Glaser Blue 35gr *Safety Slug*, Speer 35gr *Gold Dot* JHP and Hornady 35gr *XTP* JHP. Due to multiple failures to expand (from the 2.4” barrel length) in the 20-percent gelatin (whose density is less than 1% different than 10-percent gelatin), we dropped the Speer 35gr *Gold Dot* JHP from the analysis.

The following information is presented in terms of kinetic energy transfer as a function of penetration depth. To measure these quantities, a high speed video camera was set up and the gelatin blocks were filmed as the bullets penetrated the media. This gives an indication not just as to how damaging a particular bullet is, but how damaging a particular bullet is at the desired *penetration depth*. All shots were made in 20-percent ballistic gelatin – which resists bullet penetration to a significantly greater extent than the 10-percent gelatin blocks used for static ballistic gelatin testing.

Results

Figure 1. Kinetic Energy Transfer versus Penetration Depth for the tested 22LR and 25ACP cartridges

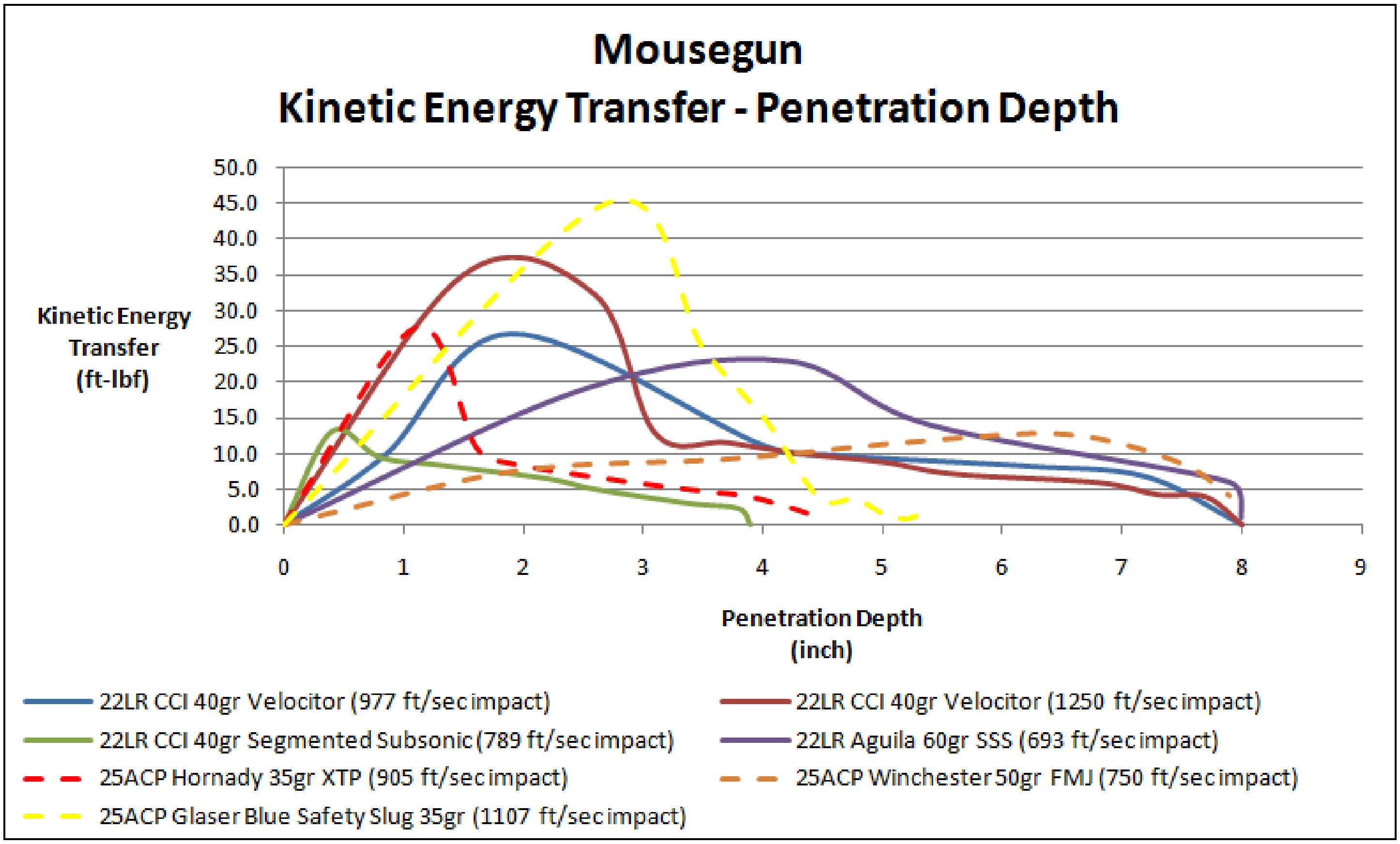


Figure 1 is an overall view of the kinetic energy transfer versus penetration for the cartridges that were tested. The chart is somewhat crowded, so we will break it down in segments below.

Figure 2. Kinetic Energy Transfer versus Penetration Depth for the tested 22LR cartridges

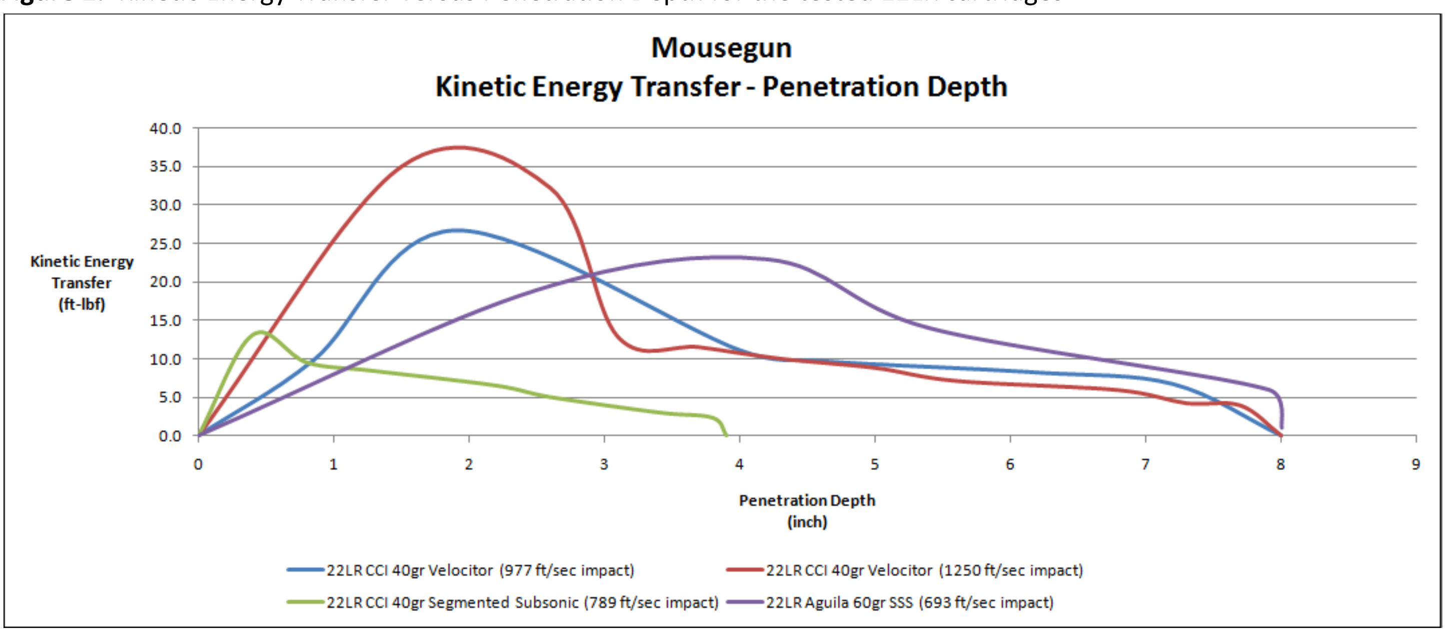
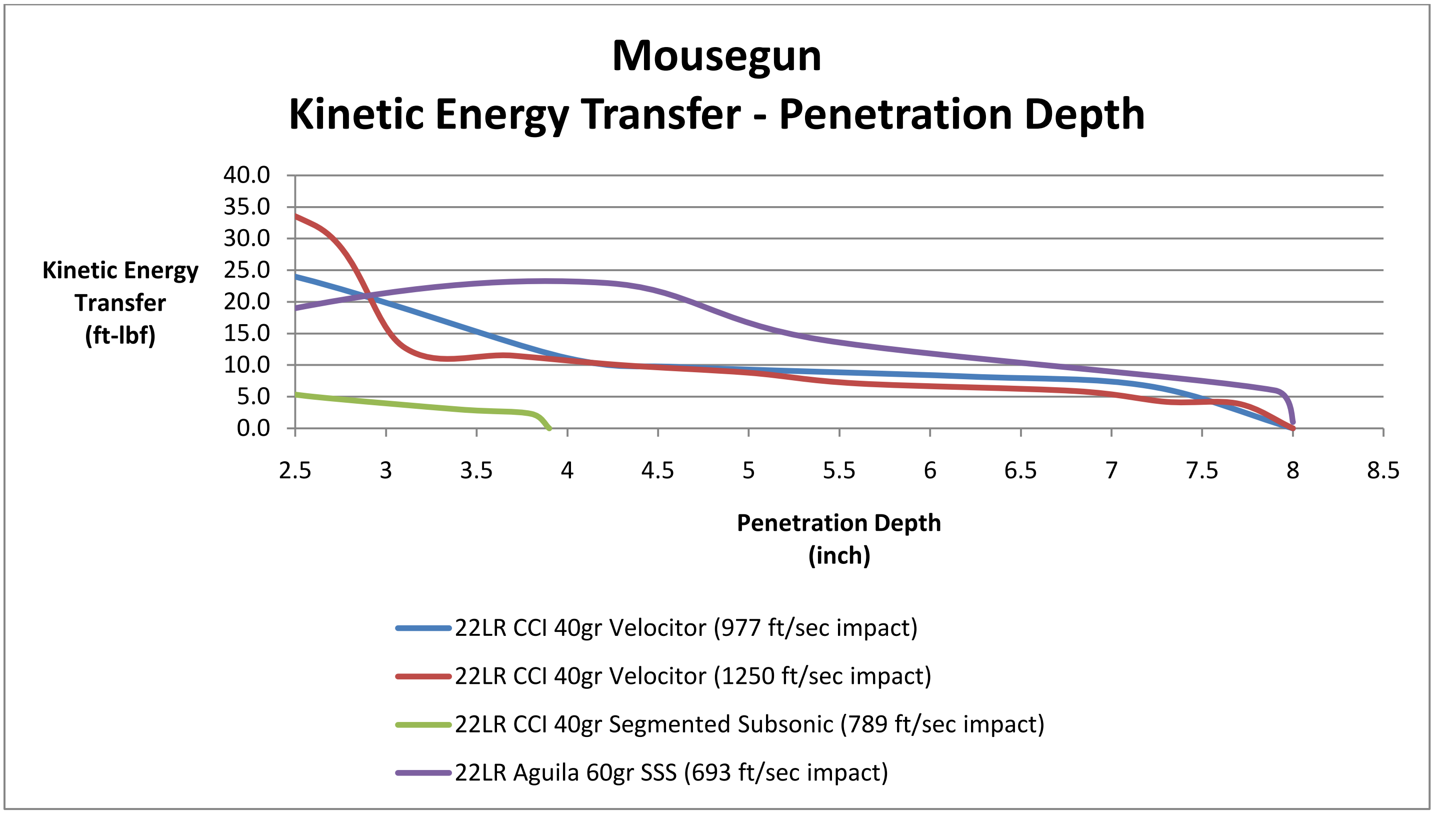


Figure 2 shows the difference between an expanded JHP (rifle-fired Velocitor) and what was essentially a .22LR wadcutter (Velocitor fired from .22LR pistol, which partially expanded into a wadcutter profile). Per the customers request, we begin the analysis at 2.5” depth in order to disregard non-vital tissues within the human body.

Figure 3. Kinetic energy transfer to the vital tissues for 22LR handgun



We see impressive performance from the Velocitor at 1250 ft/sec impact, for the first 0.4” of the analysis, when compared to the Velocitor at 977 ft/sec. Because it’s frontal surface area was 0.080 in^2, the bullet slowed down quickly compared to the 0.034 in^2 surface area of the non-expanded Velocitor. In line with the readers intuition, the expanded JHP damaged the gelatin severely in the first two inches of non-vital penetration – but this did not leave the projectile enough kinetic energy to effectively damage the target at the deeper penetration depths. The unexpanded Velocitor actually damaged more tissue (compared to the expanded projectile) from approximately 5.0” penetration depth to 7.5” during which the bullet pitched heavily, increasing its drag inside of the target. In short, we do not feel it is practical to obtain a muzzle velocity of 1250 ft/sec with a 40gr projectile from a 22LR handgun, so the performance for the rifle-fired Velocitor should be considered to be the upper performance band for a 40gr 22LR bullet that expands.

Figure 4. Time lapse view of Velocitor impacting at 977 ft/sec (at 2-, 4-, 6-, 8-inch penetration depth)

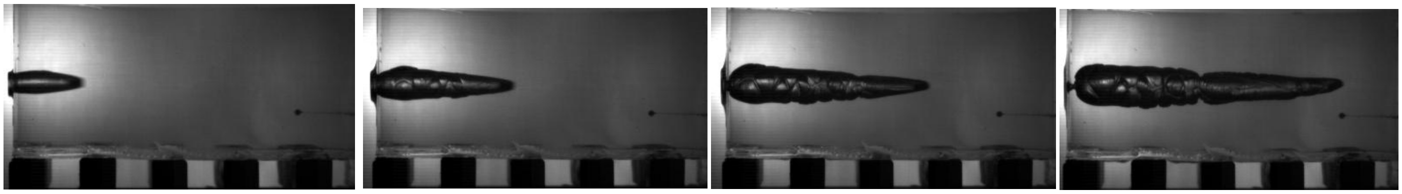
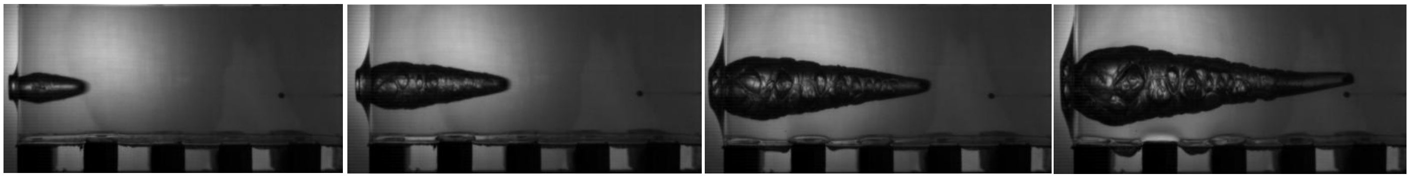


Figure 5. Time lapse view of Velocitor impacting at 1250 ft/sec (at 2-, 4-, 6-, 8-inch penetration depth)



It is a fair statement to say that the diameter of the temporary cavity (examples immediately above) is a *qualitative* expression of the amount of kinetic energy transferred at a given depth. For instance, we can see from Figure 5 that the Velocitor expanded at around 0.3" depth from the sudden increase in the diameter of the temporary cavity. Since the velocity of the bullet is highest immediately after impact, we can see around the area of the 1" mark of Figure 5 (fourth frame) where the drag on the bullet was highest and therefore the transfer of kinetic energy was highest at this point.

Figure 6. Time lapse view of Aguila 60gr SSS impacting at 693 ft/sec (at 2-, 4-, 6-, 8-inch penetration depth)

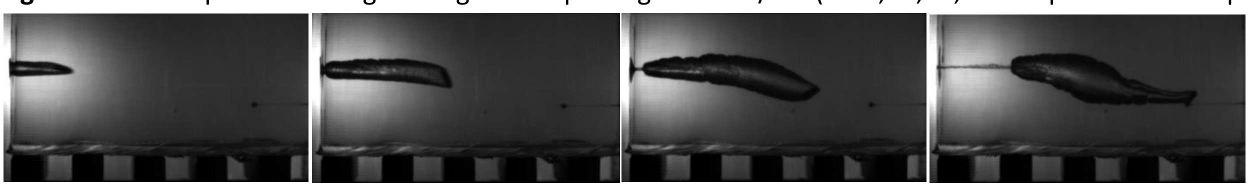


Figure 7. Time lapse view of CCI 40gr Segmented Subsonic impacting at 789 ft/sec (at 2- and 4-inch penetration depth)

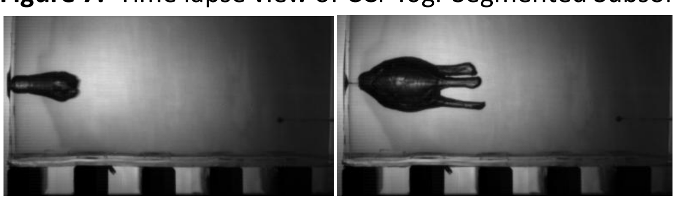
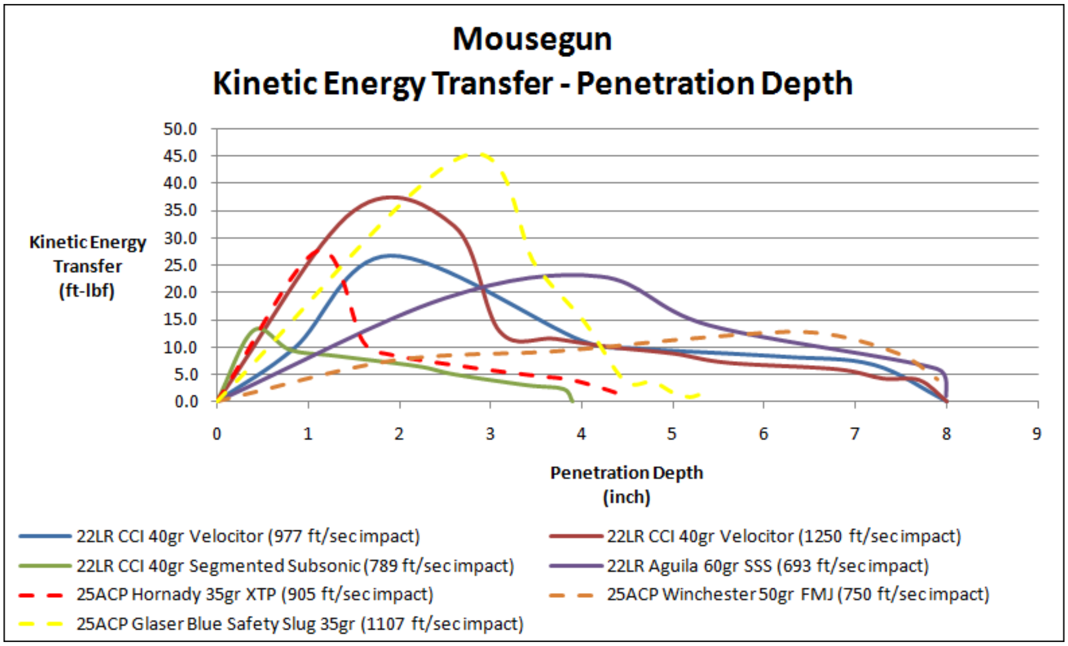


Figure 6 shows the tendancy of the Aguila 60gr SSS bullet to penetrate nose-forward until destabilization around three inches of penetration, followed by tumbling. This is advantageous because the nose-forward travel reduces the amount of kinetic energy lost by this bullet in non-vital tissue, until a depth typifying vital tissue is reached. At this point, the bullet begins to expose more surface area (during the pitch/yaw) which increases the fluid drag on the bullet and thus, the kinetic energy transfer and damage done to the target.

We see the CCI 40gr Segmented Subsonic bullet fragment nearly upon impact with the gelatin and penetrate to a final depth of approximately 4", in Figure 7. This performance would be devastating on varmint animals, but not nearly sufficient penetration to disable two-legged predatory animals.

Since firearms chambered for .22LR can usually be found also chambered in .25ACP (due to similar size cartridges and initial kinetic energies) and vice versa, analyzing the .25ACP provides a good frame of reference as to what sort of terminal performance is reasonably expectable out of these smaller cartridges.

Figure 8. Kinetic Energy Transfer versus Penetration Depth for the tested 22LR and 25ACP cartridges

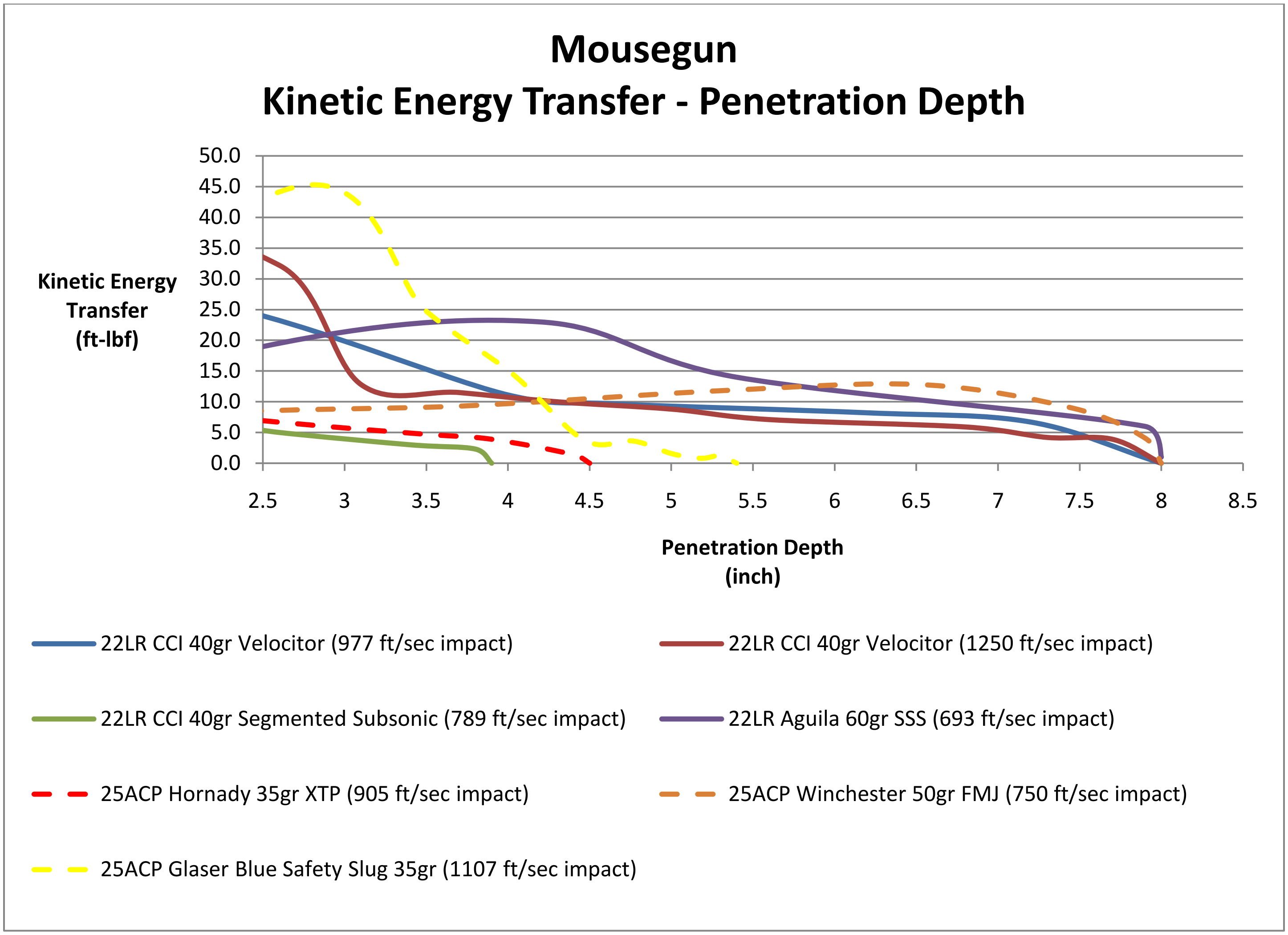


For convenience, Figure 1 is presented again, as Figure 8. The difference in kinetic energy transfer as a function of penetration depth between expanding bullets and non-expanding bullets becomes clearer with Figure 8. It is possible for the performance of calibers to overlap and even for 'lesser' calibers to perform better than 'bigger' calibers, depending solely on bullet design.

Most projectiles, except for shotgun pellets, require some form of stabilization. In small arms, this usually takes the form of rifling in the barrel to impart a spin onto the projectile. During travel, a bullet resembles a football traveling in a 'spiral'. Depending on the twist rate of the rifling and the length-over-diameter ratio of the projectile, this will either be a 'tight spiral' or hardly a spiral at all. The longer a bullet, the faster the twist rate is required to stabilize the bullet. What matters in the end is the angular velocity of the bullet, IE the revolutions per second it is spinning at. This is a combination of the muzzle velocity and the twist rate of the barrel.

The cause of tumbling inside of a target is the destabilization of the projectile caused by the density of the medium being passed through and the pitch/yaw angle at that instant. The angle grows as the bullet penetrates because fluid forces impart unsymmetrical drag on one side of the projectile. Beyond a given pitch/yaw angle for a given bullet, tumbling will occur. A bullet traveling point-forward, with very little yaw or pitch, will experience very low fluid drag from the target and will also transfer very little kinetic energy. Once the angle of attack is increased, the drag on the bullet/KE transfer from the bullet will correspondingly increase. This is how the examined FMJ bullet can transfer more kinetic energy at deeper depths than did the hollowpoints that started out with significantly higher kinetic energy at impact.

Figure 9. Kinetic energy transfer to the vital tissues for 22LR and 25ACP handguns



The Glaser Blue Safety Slug 35gr shows impressive performance in the shallower penetration depths, but sheds kinetic energy too quickly to be considered a good load for general purpose self-defense use. It would be ideal in an environment where the goal is to minimize the damaging effects of overpenetration through a shallow shotline and for disabling an opponent with hits to the arms or the head/neck region.

We see the Hornady 35gr XTP expands to a respectable diameter, but this combined with relatively low weight causes the bullet to come to a halt at 4.5” depth. This is performance on par with the 22LR CCI 40gr Segmented Subsonic, and is a load that we suggest be reserved for usage against small game animals only.

Overall, the most robust performance comes from the Winchester 50gr FMJ. Typically regarded as practice ammunition, the typical FMJ can offer distinct advantages in some of the smaller handgun cartridges. In this case, the bullet travels point forward until approximately 4” penetration depth, upon which time it will begin to pitch/yaw and eventually tumble. Less effective than a 22LR wadcutter (the partially expanded Velocitor at 977 ft/sec) until 4.1” depth, the Winchester FMJ begins to exceed the performance of all 22LR ammunition (excepting the Aguila 60gr SSS) until the end of the analysis at 8.0”.

Figure 10. Time lapse view of Winchester 50gr FMJ impacting at 750 ft/sec (at 2-, 4-, 6-, 8-inch penetration depth)

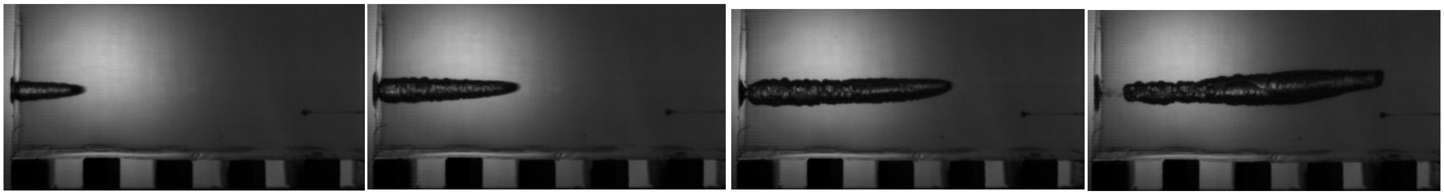


Figure 11. Time lapse view of Glaser Blue Safety Slug 35gr impacting at 1107 ft/sec (at 2-, 4- and 5.2 inch penetration depth)

Figure 12. Time lapse view of Hornady 35gr XTP impacting at 905 ft/sec (at 2-, 4- and 4.8 inch penetration depth)

Conclusion

Of the cartridges evaluated in this report, for self-defense usage against a human attacker, we recommend the Aguila 60gr SSS for .22LR handguns and the Winchester 50gr FMJ cartridge for .25ACP handguns. Both projectiles generally transfer higher average kinetic energy throughout the penetration track than the other cartridges tested here, and should be considered to be robust cartridges for the application because they have significantly higher kinetic energy transfer up to and through the maximum penetration depth of interest.

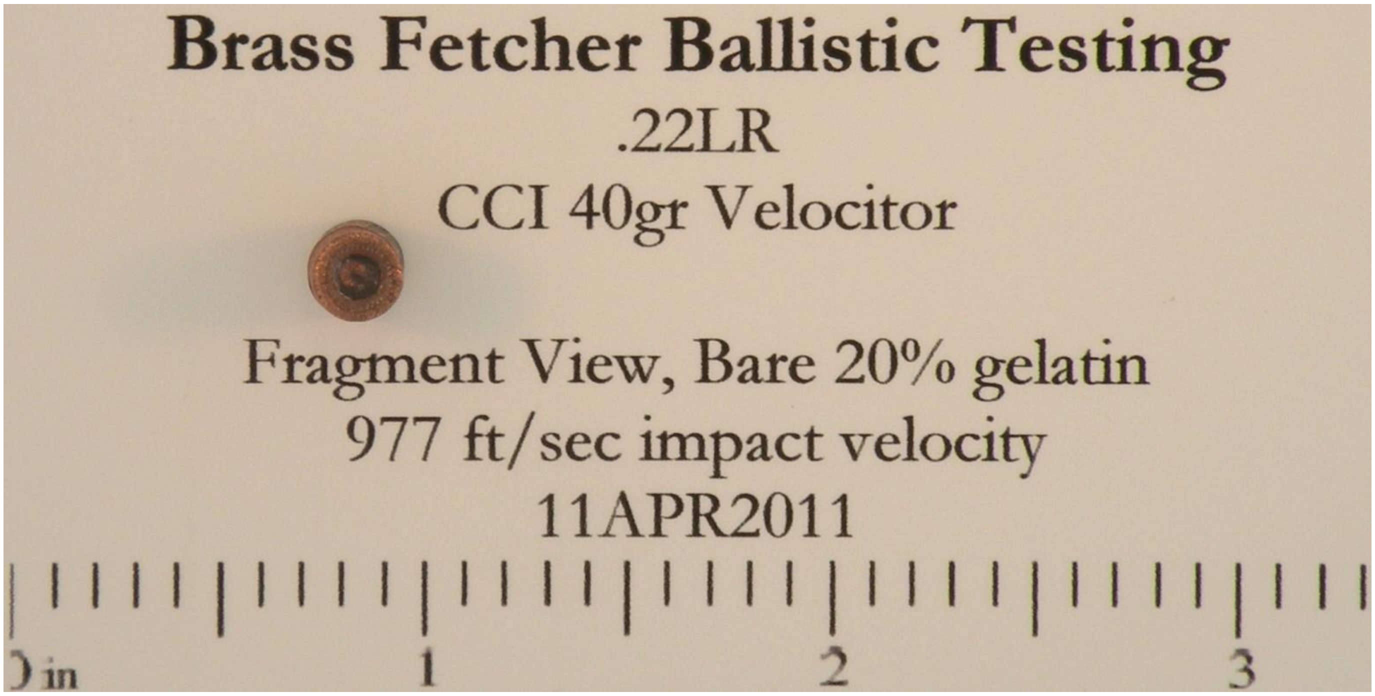
Areas of possible improvement include higher initial kinetic energies for both 22LR and 25ACP cartridges, when fired from the shorter barrels found in mouseguns and the usage of minimal-expansion hollowpoints. Higher initial KE would require faster-burning propellants and higher shot-start pressures, but considering that armed combat with mouseguns might by definition be considered a desperate fight, increasing chamber pressure and effectively creating a " .22LR +P " and " .25ACP +P " cartridge seems very appropriate.

While we like the expanded surface area of the Hornady 35gr XTP very much, performance of this round could be improved by decreasing the expanded surface area to somewhere in the vicinity of 0.07 in^2 and increasing the weight of the round to 40gr.

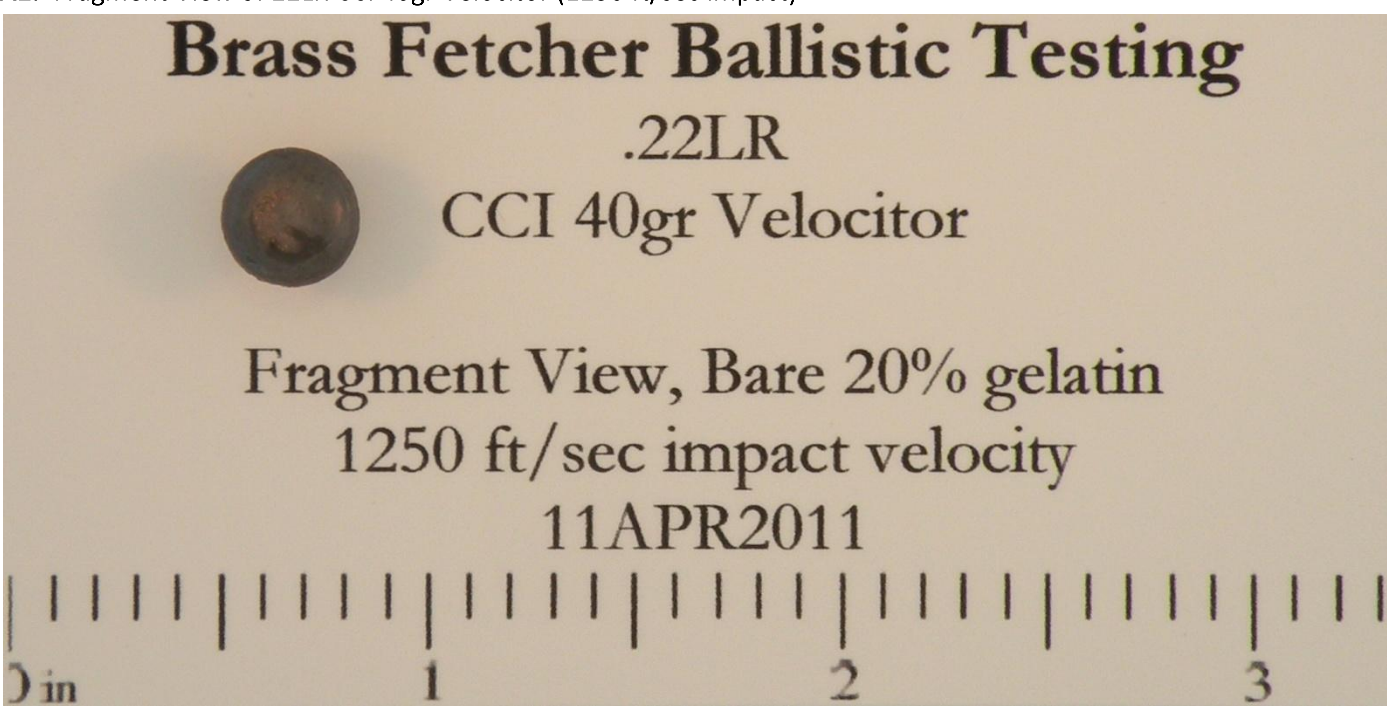
Given the lower initial kinetic energy of the factory ammunition tested here, our general recommendation is to stick with heavy, non-expanding ammunition in .22LR and .25ACP until ammunition tailored for these short-barrel weapons becomes available.

Appendix

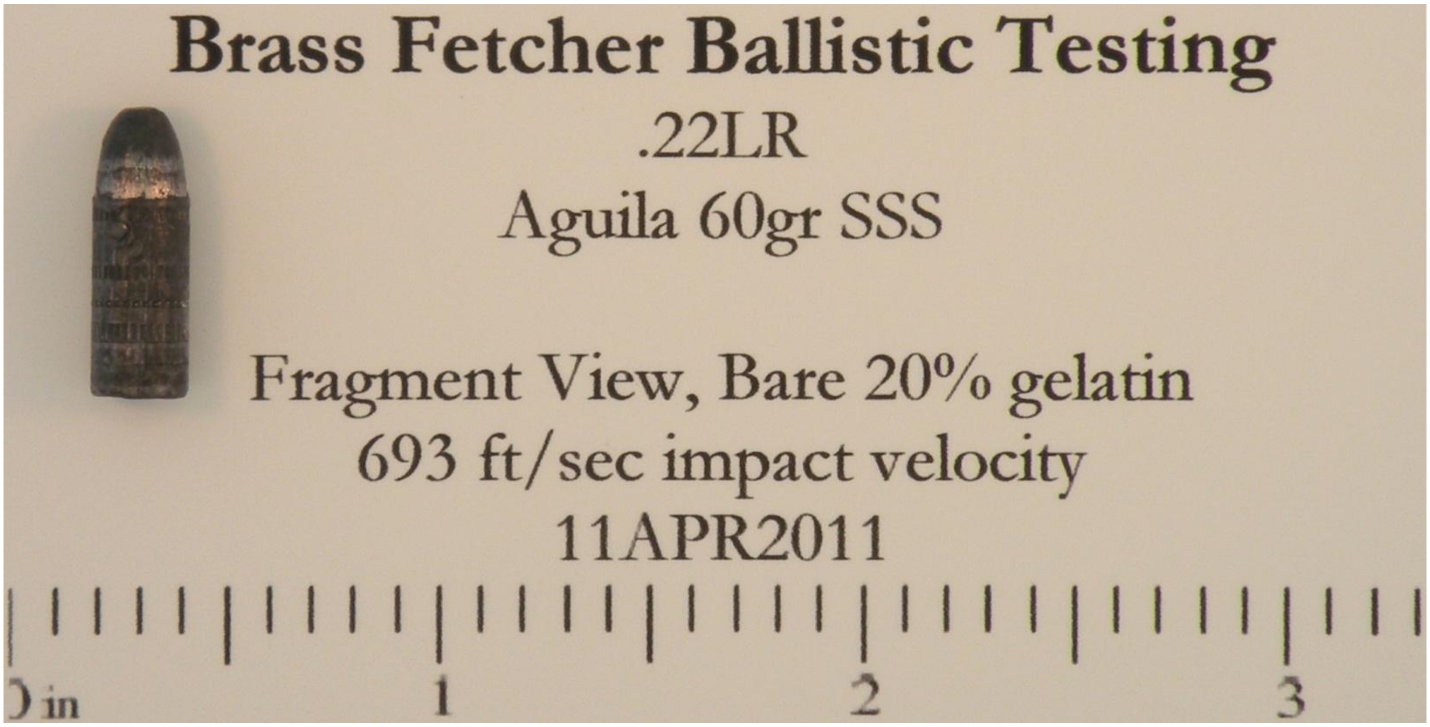
A1. Fragment View of 22LR CCI 40gr Velocitor (977 ft/sec impact)



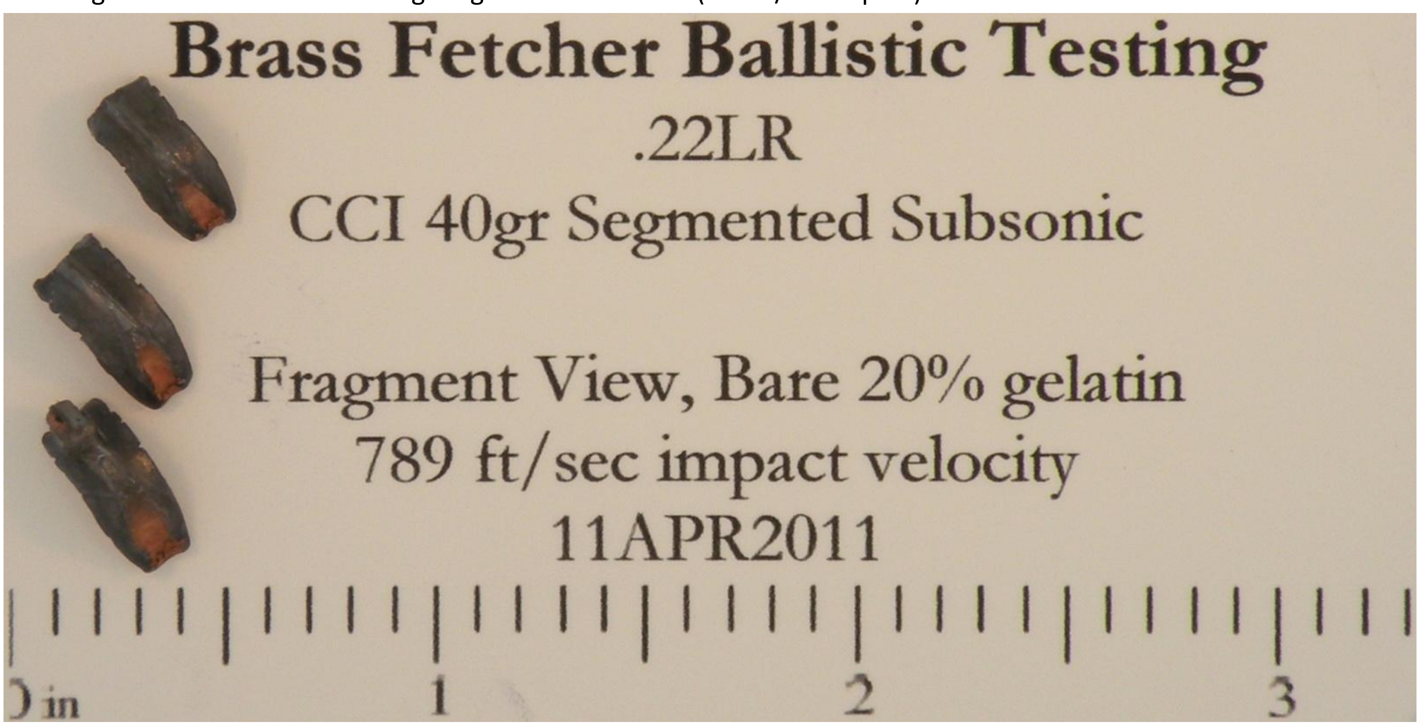
A2. Fragment View of 22LR CCI 40gr Velocitor (1250 ft/sec impact)



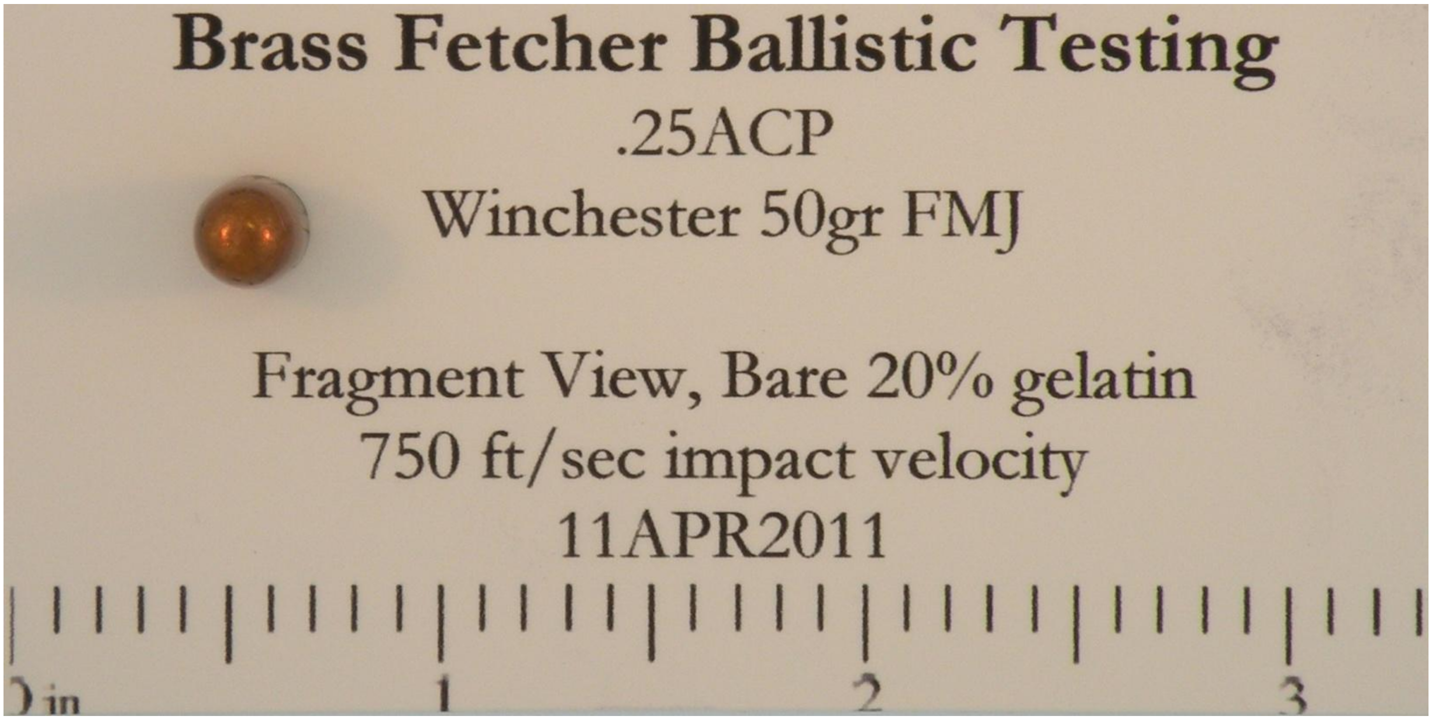
A3. Fragment View of 22LR Aguila 60gr SSS (693 ft/sec impact)



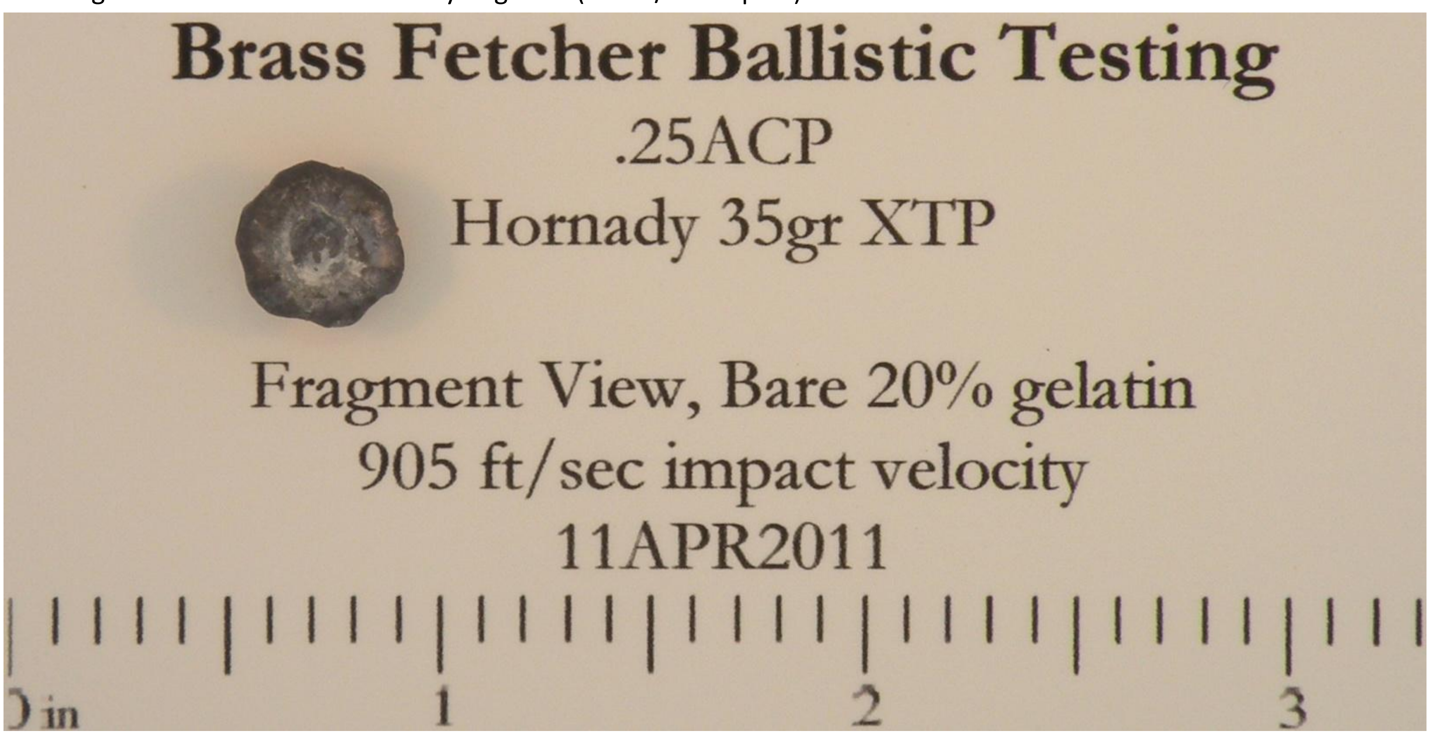
A4. Fragment View of 22LR CCI 40gr Segmented Subsonic (789 ft/sec impact)



A5. Fragment View of 25ACP Winchester 50gr FMJ (750 ft/sec impact)



A6. Fragment View of 25ACP Hornady 35gr XTP (905 ft/sec impact)



A7. Fragment View of 25ACP Glaser Blue Safety Slug 35gr XTP (1107 ft/sec impact)