Experimental .38 Caliber Pellet for Use in Environments Requiring Limited Penetration[1]

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The purpose of this presentation is to offer the results of a study that evaluates an experimental subsonic .38 caliber non-diabolo styled pointed lead alloy pellet for use in environments that require limited penetration for projectiles. Aircraft passenger compartments and cockpit areas may be suitable for this type of ammunition in anti-terrorist situations. The risk of rupturing an aircraft fuselage would be less probable with the experimental .38 caliber pellet because it would have considerably less energy than a standard .38 caliber bullet. The development of a large caliber pellet would give law enforcement officers some options when selecting ammunition for environments that require limited penetration.

An experimental .38 caliber pellet was designed and a limited number were produced for the test. A positive pellet mold was made by turning a piece of aluminum stock on a lathe .350 thousandths of an inch in diameter and .620 thousandths of an inch long with a 45-degree point. The positive pellet mold was placed in a soft pliable mixture of plaster of Paris and allowed to solidify. Once the plaster solidified the positive mold was removed to produce a negative mold of the pellet's form. When the plaster mold was completely dry, molten lead was poured in the negative impression to produce a .38 caliber lead pellet. The 45-degree nose point of the pellet was machined on the lathe and the base was drilled to produce the pellet. The base of the pellet was drilled to a .250 thousandths of an inch diameter and .300 thousandths of an inch deep to produce the cavity in the pellet. The length of the experimental pellet was .620 thousandths of an inch long and the outside diameter was .360 thousandths of an inch. The wall thickness at the base of the pellet is approximately .060 thousandths of an inch. The exterior surface of the pellet's tip was filed while in the lathe to produce a smooth finish.

A.357 Smith & Wesson model 686 with a four-inch barrel was used to test the experimental pellets. The pellets with an average mass of 5.302 grams were tested with five propellant charges to determine the average velocity of each propellant charge. The average velocity for pellets loaded with 0.5-grains of Hercules Unique powder was 45 m/s (149 ft/s); 1.0-grains was 213 m/s (697 ft/s); 1.5-grains was 263 m/s (865 ft/s); 2.0-grains was 273 m/s (897 ft/s); and, 3.0-grains was 379 m/s (1244 ft/s). The test determined that pellets loaded with less than 1.0-grains of propellant did not always have sufficient energy to exit the barrel of the weapon; this was possibly due to the amount of friction between the pellet and barrel. Pellets stuck in the barrel were removed with a bullet puller.

DiMaio, et al., have determined that the minimum velocity needed for a .38 caliber round nose lead bullet with a weight of 113-grains to perforate skin is 58 m/s (191 ft/s). The Formula, Kinetic Energy, $KE=\frac{1}{2}\cdot mv^2$, was used to convert the bullet mass and the minimum velocity to the amount of energy in joules needed to perforate the skin. The mass is expressed in kg and the velocity in m/s. The 113-grain bullet with a mass of 7.345 grams produces 12.5 joules (9.21 ft-lb) of energy. Therefore, the experimental pellets need to have at least this much energy or higher to perforate skin. Since the mass of the .38 caliber test pellets is less than 7.345 grams, they will need more velocity to obtain the minimum amount of energy to perforate skin.

Based on the KE needed to perforate skin, two propellant charges were selected for testing the experimental pellets. Four test pellets were loaded with 1.0-grains of Hercules Unique

smokeless powder and four rounds were loaded with 1.5-grains of Hercules Unique smokeless powder. The range of mass for the test pellets loaded with one grain of powder was 5.302 grams to 5.436 grams with a mean mass of 5.370 grams. The average velocity for these pellets was 188 m/s (615 ft/s). The range of mass for test pellets loaded with 1.5-grains of powder was 5.388 to 5.670 grams with a mean mass of 5.480 grams. The average velocity was 273 m/s (897 ft/s). The pellets were fired at a distance of 7.62 m (25 ft) into a pine board 53.34 cm (1-¾ in) thick. A chronograph was used to determine the velocity for each pellet and the depth of penetration was measured with the depth gauge on dial calipers.

The average KE for pellets loaded with l.0-grains of propellant was 95 joules (70 ft-lb) and for pellets loaded with l.5 grains of propellant, it was 205 joules (151 ft-lb). Even though 1.0-grains of propellant produce more than the minimum amount of energy required to perforate the skin, the load with 1.5-grains was determined to be more reliable during the testing. The ammunition containing 0.5-grains more propellant had more than twice the amount of energy needed to perforate skin, but performs more consistently in the weapon than the 1.0-grains load and has considerably less energy than a .38 caliber factory load. A .38 special factory load with a 158-grain lead round nose bullet with a mass of 10.24 grams produces 271 joules (200 ft-lb) of energy. This is 71 joules (52 ft-lb) more than the experimental pellet. The degree of penetration in the pine board was obtained by measuring from the surface of the wood to the base of the pellet. The range of depth for pellets having an average energy of 95 joules (70 ft-lb) was 8.25 mm (.325 in) to 12.22 mm (.481 in) with an average depth of 10.16 mm (.400 in). The range of depth for pellets having an average energy of 205 joules (151 ft-lb) was 18.21 mm (.717 in) to 25.27 mm (.995 in) with an average depth of 21.34 mm (.840 in). Reliable .38 caliber pellet ammunition delivering approximately 200 joules (148 ft-lb) of energy would give law enforcement officers an option when limited penetration is required.

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