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P4_7 Do bullets flash on impact with solid objects?

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Abstract

During Hollywood films, such as James Bond, special effect teams often portray a bullet hitting a solid object giving off a flash of bright light. This article investigates whether for normal lead bullets from a handgun/submachine gun would do this. It was found that, assuming all the energy from the bullet was thermal and remained inside the bullet it would melt upon impact and not glow/flash.

Introduction

When two solid objects strike each other with a force they get very hot. This is the same for a lead bullet. In order to test the best possible scenario for a flashing bullet to be produced when striking an object, it is assumed that all of the bullets kinetic energy was instantly converted to thermal energy. It is also assumed that all of the thermal energy remains inside the bullet.

The handgun investigated is the P228 designated L117A1 which uses a 9mm Parabellum cartridge [1]. Whilst there are many variants of the 9 x 19mm cartridges, the one studied is the 150grain cartridge.

Analysis

The 9mm, 150grain cartridge has a mass of 9.7g and has muzzle velocity of 290m/s [1]. The kinetic energy can be calculated from the magnitude of the velocity and the mass using the following equation:

$$KE = \frac{1}{2}mv^2, \qquad (1)$$

where *KE* is the kinetic energy, *m* is the cartridge mass and *v* is the muzzle velocity of the round. Using equation 1 the kinetic energy value for the 9mm Parabellum cartridge is 408J. With the previously stated assumptions in mind, the temperature rise of the lead bullet upon impact can be calculated using the equation:

$$\Delta T = \frac{Q}{mc}, \qquad (2)$$

where ΔT is the temperature difference, Q is the heat energy of the bullet, m is the mass of the bullet and c is the specific heat. Using the specific heat of lead, 0.128J/g/K a value for ΔT was calculated to be 328.6 Kelvin. Taking the normal temperature of a room to be 298K the final temperature of the bullet can be calculated using:

$$T_f = T_i + \Delta T, \qquad (3)$$

Where T_i is the initial temperature of the cartridge and T_f is the final temperature. Using the ΔT calculated above a final temperature of 626.6 K is produced.

At hot temperatures a body emits light by visible electromagnetic radiation. This is called incandescence and occurs at a critical temperature point called the Draper Point. This temperature was calculated in 1847 to be 798K [2]. Below this temperature incidence still occurs, it is just not visible in normal lightning conditions.

This calculation assumed that all of the energy from the bullet was theoretically transferred from thermal, in order to test the theory of flashing bullets at maximum possibility. However in reality this is not true. A more likely scenario would be that 10% of the

energy could be for thermal, therefore resulting in even less of a temperature rise. Assuming 10% was transferred the bullet would reach 33K, and would definitely not incandesce upon impact.

Conclusions

If the 9mm Parabellum cartridge hit a solid surface, assuming all the energy was thermal and remained inside the bullet it would reach a temperature of626.6K. At this temperature the lead is too cool to emit visible light by incandesce. As a result when a lead bullet strikes a solid surface it would not be seen to flash upon impact as depicted in many Hollywood films.

References

[1] Sellier and Bellot, http://www.sellier-bellot.cz/pistol-and-revolver-detail.php?ammunition=9&product=74 [accessed 06/11/2011]

[2] Mahan. J, Radiation heat transfer: a statistical approach, Volume 1. 2002, Page 58.