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P4 8 The Writing's On The Wall

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Abstract

In this paper we discuss the effects of the exploding pen from the James Bond film "GoldenEye". During a demonstration, the pen is seen to be able to remove the torso of a human. A typical Parker jotter pen, the apparent pen used in the film, can hold 8.2 ml of high explosives, in this case that is 14 g of TNT. This releases 32,000 J of energy into the chest. By treating the explosion like crater formation we can calculate a hole created by the pen to be 89 mm. This would kill a human but would not cause the total destruction of a torso as seen in the film. For this to be the case a 6.9 kg stick of TNT would be needed, not quite as stylish as a slim Parker pen.

Introduction

James Bond is well known for having a variety of gadgets and unique weapons at his disposal. One of their smallest, but still powerful ones, is the exploding pen, as seen in GoldenEye. As demonstrated by Q, the head of research and development for MI6, when the pen is armed by clicking the top three times, it will explode four seconds later with the power equivalent of a class 4 grenade [1]. It can also be disarmed by clicking a further 3 times. This paper discusses the plausibility of such a device to cause the same destruction as seen in the film. For the pen to be a success, it must be able to remove the torso of a human in the same way shown during the pen's demonstration.

Theory

The pen seen is a similar design to a standard Parker jotter pen, therefore dimensions are taken from this design. The possible space for an explosive charge is a cylinder with radius 5 mm and height 105 mm, figure 1. This gives a volume of 8.2 ml. The taper of the pen is not considered here as there is an overestimation towards the front of the pen, but an underestimation in the middle. This should account for the loss in the taper. The function of the pen is also inhibited as there would be no room for a cartridge.

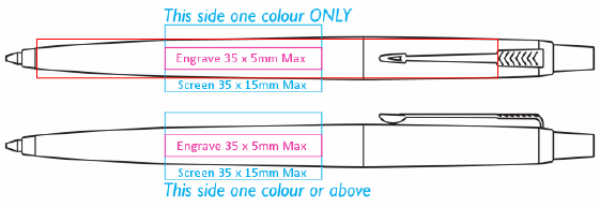

Figure 1: A Parker jotter pen [2] with a drawn on outline (red) of a possible location where the explosive could be located. This should leave enough room in the top for a small electronic igniter and the switch.

The next part is to ascertain what possible form of explosive could be in the pen. It is not specified what type of high explosive is inside of the pen. However, a typical explosive used in

grenade cores is TNT [3]. So, we will be assuming this is the high explosive used. TNT has an energy density of 4.6 $MJkg^{-1}$ [4] and a density of TNT is 1.7 gcm^{-3} [5]. Therefore, there is 14 g of TNT within the pen. Which means that 64,000 J will be released during the detonation of the device. Given the cylindrical shape of the explosive charge, we can assume the explosion is isotropic around the curve of the pen. This means that half of the explosion would have gone away from the dummy seen in the film. Hence only 32,000 J would be released into the torso.

Some simplifications need to be made to keep this within the scope of this paper due to the complexity of modelling an explosion like this. We assume there is negligible losses from the ends of the pen due to the much smaller surface area in contact with the explosive. There is also more material such as the nib and the cap in the way. One way of simulating this explosion is via crater formation. The density of a substance is not considered a factor during the formation of a crater due to the high energies of the impactors. So, this should be an appropriate analogy even with human flesh. If the diameter of the crater made by the explosion is greater than the diameter of an average torso, then we can assume total destruction. A simple relation for a crater diameter is given by [6],

$$D = 2.79 \times 10^{-6} E^{\frac{1}{3}} \quad (1)$$

Where D is diameter in km and E is the energy of the impactor in J. The two values are scaling constants. Substituting E = 32,000 J yields a diameter of 89 mm, which is less than that of a human torso. This would undoubtedly kill a human however, but we would not see the level of destruction as seen in the film. This also agrees experimentally from explosive experts [7].

To recreate the level of destruction seen in the film, a 0.7 m "crater" would be needed to completely destroy a torso. This is a measurement taken from a 5' 10" adult male. Using the reverse of equation 1, the energy needed would be 16 MJ. So, the total power from the explosion would need to be 32 MJ. This in TNT would be a mass of roughly 6.9 kg.

Conclusion

The explosives from a Parker pen would be enough to kill a human, leaving roughly a 89 mm hole in their chest. However, this is not the same level of destruction we see in the film. For this to be the case a 6.9 kg chunk of TNT would be needed, a 49,000% increase in mass. A very impractical solution given the typical stealth and style needed by James Bond.

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