

Proof of Non-Lethality of Airsoft Guns

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ABSTRACT

The potential lethality of Airsoft guns, of various types and models, was tested, in order to prove their non-lethality according to Israeli law. 10 different Airsoft guns, including replicas of pistols, machine guns, assault rifles and bolt action rifles, were tested, each with two types of 6mm (0.236in.) plastic pellet: a light one, weighing 0.2 gr (3.09 grain) and a heavy one, weighing 0.43 gr (6.63 grain). The muzzle velocity for each shot was measured and the penetration energy of each pellet was calculated. Not one shot reached a level of life threatening penetration energy or even a risk of superficial injury to the skin. It was determined that shooting Airsoft guns with plastic pellets is not lethal in any way.*

Definition

Airsoft guns [1] are replica firearms that shoot plastic pellets (also known as BBs) by way of compressed gas or electric and/or spring-driven pistons. Depending on the mechanism propelling the pellet, an airsoft gun can be operated manually or cycled by either compressed gas such as Green Gas (propane and silicone mix) or CO₂, or by compressed air via a spring or an electric motor pulling a piston. All these products are designed to be non-lethal and to provide realistic replicas.

Introduction

In Israel, Airsoft guns are not considered as firearms or weapons, but are defined as “dangerous toys”. As such, they fall into the jurisdiction of the Ministry of Industry, Trade & Labor. When the use of Airsoft guns started to spread, from shooting clubs to private users, the ministry started to raise questions about the applications of citizens possessing large amounts of such “toys”, which bear remarkable resemblance to real firearms.

One of their main lines of concern was the safety of these guns and the implications for innocent bystanders who might get shot mistakenly by them. In order to prove they are completely safe, a test was initiated to measure muzzle velocities and to calculate penetration energies.

Method

Ten different types of Airsoft guns were selected, as listed below:

1. Three semiautomatic pistols.
2. One submachine gun.

3. Three assault rifles.
4. Two sniper rifles.
5. One carbine.

Six shots were fired from each gun, three with light pellets, weighing 0.2 gram (3.09 grain), and three more with heavy ones, weighing 0.43 gram (6.63 grain). The velocity of each shot was measured at the muzzle. Maximum velocity from each batch of shots was taken and the mean velocity was then calculated. Maximum kinetic energy, mean kinetic energy, maximum penetration energy and mean penetration energy were then calculated respectively .

Results and Conclusions

Maximum velocities varied from 52.1 m/s (170.93 ft/s) to 173 m/s (567.58 ft/s). Maximum penetration energies varied from 2.07 J/cm² to 14.92 J/cm².

For example, the maximum velocity for the 0.2 gram pellet was 173 m/s (567.58 ft/s) and for the 0.43 gram pellet it was 140 m/s (459.32 ft/s). The maximum penetration energy for the 0.2 gram pellet was 10.59 J/cm² and for the 0.43 gram pellet it was 14.91 J/cm².

Since the minimal penetration energy level commonly accepted in Israel, as being necessary to perforate the skin, is approximately 33 J/cm², it was quite easy to determine there is no hazard to human life if someone is accidentally shot.

Discussion

As mentioned above, the minimal value of penetrating energy commonly accepted in Israel is 33 J/cm². This value was adopted from a study conducted by the Metropolitan Police of

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* Penetration energy = kinetic energy divided by the pellet's cross section area

London, England [2].

However, a literature review reveals other tests with different results. For example, DiMaio et al. [3] conducted a test with .177 & .22 caliber lead air gun pellets and with a 113-grain, 0.38 caliber round-nose bullet. They reported conclusive skin penetration at values of 22.3 J/cm², for the .177 caliber pellet, 17.25 J/cm², for the .22 caliber pellet and 19.0 J/cm² for the 0.38 caliber bullet. In this test, all projectiles were metallic and the fact they are much harder than plastic should be taken in consideration when comparing the results to those of plastic pellets.

In another study, Marshall et al. [4] describe a test, conducted with accordance with the Canadian Criminal Code, which proves that Airsoft guns do fulfill the definition of a firearm, being “**capable of causing serious bodily injury or death to a person**”. They report that Canadian courts accepted the criteria of “**penetration or rupture of an eye**” as a “serious bodily injury” and they claim that 6mm plastic pellets can penetrate an eye.

They fired plastic pellets, at various velocities, at pig’s eyes, and according to their study, a pellet achieving an impact velocity of 99 m/s or greater would cause “serious bodily injury”. The penetration energy for an impact velocity of 99 m/s and a mass of 0.25gram was calculated to be 4.3 J/cm²!

It should be borne in mind that in Israel, the law [5] defines an object as a firearm or a weapon, only if its projectile is “**capable of causing death to a person**”, where a person could be even a newborn infant. Thus, according to Israeli law, our test proved that Airsoft guns cannot be considered as firearms.

Even though the results were conclusive, some precautions were advised while using Airsoft guns:

- a. To mark Airsoft guns clearly with a bright color on the frame, muzzle brake, etc.
- b. When the gun is stored, to separate the magazine and the driving mechanism (gas or electric battery) from it.
- c. Never to use the guns with metallic pellets.
- d. Never to shoot at a person, especially not in the direction of the eyes.
- e. To wear a protective mask and clothing while practicing on a club’s grounds.

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- [5] Israeli Penal Code (1977), clause 144, sub-paragraph (C), sub-sub-paragraph (1).

Appendix A						
No.	Manufacturer	Model	Type	Operating System	Replica of...	Remarks
1	WE	5.1 GOLD	Semi-Automatic Pistol	Green gas	Colt 1911	
2	WE	P14	Semi-Automatic Pistol	Green gas	Colt 1911	
3	KWC	TAURUS PT99 AF	Semi-Automatic Pistol	CO2 gas	Taurus 92	
4	ICS	MP5	Sum-Machine Gun	Electric battery	H&K MP5	
5	G&P	M4	Assault Rifle	Electric battery	Colt M4 Carbine	
6	G&P	M4	Assault Rifle	Electric battery	Colt M4 Carbine	Upgraded piston system
7	KA	GALIL	Assault Rifle	Electric battery	IMI Galil AR	
8	ACM	VSR	Bolt Action Rifle	Spring		
9	SNOW WOLF	M24	Bolt Action Rifle	Spring	Remington M24	Upgraded spring
10	KJW	MK1	Carbine	Green gas	Ruger MK1	

Test No.	Man.	Model	BB's Spec.		Muzzle Velocities [m/s]							Ek max [J]	Ek av. [J]	Ep max [J/cm ²]	Ep av. [J/cm ²]
			D Diameter [cm]	S Cross Section Area [cm ²]	m Weight [kg]	Measured MV 1	Measured MV 2	Measured MV 3	Max velocity [m/s]	Average velocity [m/s]					
1	WE	5.1 GOLD	0.6	0.283	0.000	94.2	94.1	92.2	94.2	93.50	0.89	0.87	3.14	3.09	
2	WE	5.1 GOLD	0.6	0.283	0.000	72.1	70.9	69.8	72.1	70.93	1.12	1.08	3.95	3.83	
3	WE	P14	0.6	0.283	0.000	98.5	96.2	98.5	98.5	97.73	0.97	0.96	3.43	3.38	
4	WE	P14	0.6	0.283	0.000	61.9	71	72.3	72.3	68.40	1.12	1.01	3.98	3.56	
5	KWC	TAURUS PT99 AF	0.6	0.283	0.000	94.1	97.1	88.4	97.1	93.20	0.94	0.87	3.34	3.07	
6	KWC	TAURUS PT99 AF	0.6	0.283	0.000	74.7	74.8	70.9	74.8	73.47	1.20	1.16	4.26	4.11	
7	ICS	MP5	0.6	0.283	0.000	106	107	106	107	106.33	1.14	1.13	4.05	4.00	
8	ICS	MP5	0.6	0.283	0.000	76	74.7	75.9	76	75.53	1.24	1.23	4.39	4.34	
9	G&P	M4	0.6	0.283	0.000	90.2	94.1	92.1	94.1	92.13	0.89	0.85	3.13	3.00	
10	G&P	M4	0.6	0.283	0.000	69.9	70	68.8	70	69.57	1.05	1.04	3.73	3.68	
11	KA	GALIL	0.6	0.283	0.000	120	121	125	125	122.00	1.56	1.49	5.53	5.27	
12	KA	GALIL	0.6	0.283	0.000	77.3	77.5	77	77.5	77.27	1.29	1.28	4.57	4.54	
13	ACM	VSR	0.6	0.283	0.000	77.4	78.7	77.3	78.7	77.80	0.62	0.61	2.19	2.14	
14	ACM	VSR	0.6	0.283	0.000	50.4	51.1	52.1	52.1	51.20	0.58	0.56	2.07	1.99	
15	SNOW WOLF	M24	0.6	0.283	0.000	160	162	162	162	161.33	2.62	2.60	9.29	9.21	
16	SNOW WOLF	M24	0.6	0.283	0.000	106	112	106	112	108.00	2.70	2.51	9.54	8.87	
17	KJW	MIK1	0.6	0.283	0.000	173	155	173	173	167.00	2.99	2.79	10.59	9.87	
18	KJW	MIK1	0.6	0.283	0.000	136	139	140	140	138.33	4.21	4.11	14.91	14.56	
19	G&P	M4	0.6	0.283	0.000	146	151	149	151	148.67	2.28	2.21	8.07	7.82	
20	G&P	M4	0.6	0.283	0.000	119	117	117	119	117.67	3.04	2.98	10.77	10.53	

Legend

$E_k = 0.5 * m * v^2$ [J] $S = 3.14 / 4 * D^2$ [cm ²]
$E_p = E_k / S$ [J/cm ²]
Ek max - Maximum Kinetic Energy Measured in [Jou]l
Ek av. - Average Kinetic Energy Measured in [Jou]l
Ep max - Maximum Penetration Energy Measured in [Jou]l/cm ²
Ep av. - Average Penetration Energy Measured in [Jou]l/cm ²
1 m/s=3.28084 ft/s 1 cm=0.3937in 1 cm ² =0.155in ²