

SOUTHERN FIREARMS UNIT
109 Lambeth Road
London
SE1 7LP

Laboratory ref: 300974287
Order number: 401357872

Direct Line: 0207 160 4903
Facsimile: 0207 160 4151
Email: mark.mastaglio@fss.pnn.police.uk

ACC Adrian Whiting
Olympic-Paralympic Security & Specialist Operations Support
Dorset Police Headquarters
Winfrith
Dorchester
DT2 8DZ

FAO: ACC Adrian Whiting

Date: 24th March 2011

Report on work carried to establish airsoft threshold lethality

Introduction

Test firings were conducted using two Japanese electrically operated airsoft guns, a Tokyo Marui Co. designed to look like a Heckler and Koch G3 and a Systema M4-A1 designed to look like a Colt M4A1. Both were supplied to the FSS by Fire-Support Ltd. Ballistic soap covered with a skin simulant¹ was used to assess the wounding potential of the discharged 6 millimetre diameter plastic pellets. The velocity of the pellets was varied by using different piston cylinders also supplied by Fire-Support Ltd. The velocities of the discharged pellets were measured by using a calibrated chronograph. The pellets were discharged in both semi and full auto modes; previous experience has shown that the potential wounding capacity of full-auto fire exceeds that of semi-auto fire when the pellets are targeted on a single area. The kinetic energy of each discharged pellet was then calculated using the measured velocity and mass.

Forensic Science Service Ltd.

Registered office and headquarters: Trident Court, 2920 Solihull Parkway,
Birmingham Business Park, BIRMINGHAM B37 7YN. United Kingdom.
Registered in England and Wales: number 5607780

The Forensic Science Service[®] is a trading name of Forensic Science Service Ltd.
Forensic Science Service Ltd. is a UK Government owned company.

Facilities: Birmingham, Chepstow, Chorley, Huntingdon, London, Sunderland, Wetherby.

VAT number GB871 3115 43



1277



FS 24279

Results

The below table shows values for skin penetration and perforation from the literature, theoretical calculations and known lethality velocities and associated kinetic energies for various projectiles together with the measured velocities (V) and calculated kinetic energies (KE) for the airsoft test firings. The calculated cross sectional kinetic energy density (E/A) is also given.


Source	Weight (gns)	V (fps)	KE (ftlb)	KE (J)	Diameter (mm)	E/A (J/cm ²)
Background Data: Minimum velocities for steel BBs and lead air weapon pellets						
EYE PENETRATION (Powley, pig, .17"BB) ²	5.5	214	0.6	0.8	4.4	5.0
SKIN PERFORATION (Di Maio, human, .177awp) ³	8.25	331	2.0	2.7	4.5	17.1
SKIN PERFORATION (Di Maio, human, .22awp) ³	16.5	245	2.2	3.0	5.5	12.5
SKIN PERFORATION (Haag, pig, .17BB) ⁴	5.24	350	1.4	1.9	4.4	12.7
Lowest known fatality <i>Paediatrics</i> 1990 (non-FSS, estimated KE, .17BB) ⁵	5.24	420	2.1	2.8	4.4	18.3

6mm plastic BB: Calculated Velocity required to give E/A values as above						
Min EYE penetration velocity	3.04	352	1.0	1.4	6	5.0
Min SKIN perforation velocity	3.04	621	2.6	3.5	6	12.5

6mm plastic BB: Minimum theoretical velocity for skin perforation using sectional density formulae from separate studies collated in <i>Jussila et al Forens Sci Int 150 (2005) p.65</i>						
Sellier(1994) ⁶ , Jauhari(1976-8) ⁷	3.04	554	2.1	2.8	6	9.9
Sperrazza(1968) ⁸	3.04	661	2.9	4.0	6	14.1
Mattoo(1984) ⁹	3.04	718	3.5	4.7	6	16.7

6mm plastic BB: Minimum velocity for perforation of skin simulant (x10 tests)						
1mm natural rubber at surface of ballistic soap; FSS NFU 9/12/10	3.04	562	2.1	2.9	6	10.2

6mm plastic BB: Full-auto burst of 6 pellets, 1 of 6 perforated <i>MV measurements not contemporaneous; MV figures are min, mean, max.</i>						
1mm natural rubber at surface of ballistic soap; FSS NFU 27/1/11	3.04	410	1.1	1.5	6	5.4
1mm natural rubber at surface of ballistic soap; FSS NFU 27/1/11	3.04	418	1.2	1.6	6	5.7
1mm natural rubber at surface of ballistic soap; FSS NFU 27/1/11	3.04	424	1.2	1.6	6	5.8

Colour Key		References
Minimum velocity calculated using E/A derived from Powley		Velocity Necessary for a BB to Penetrate the Eye: an Experimental Study Using Pig Eyes'; Powley, Kramer, D., Dahlstrom, Dean B., Atkins, Valerie J., and Fackler, Martin L.; Wound Ballistics Review, vol. 3, No. 1, pp. 10-12.

Colour Key		References
Minimum velocity calculated using E/A derived from Di Maio		'Minimal Velocities Necessary for Perforation of Skin by Air Pellets and Bullets'; Di Maio, V.J.M., Copeland, A.R., Besant-Matthews, P.E., Fletcher, L.A., & Jones, A.; Journal of Forensic Sciences, vol. 27, No. 4, October 1982, pp. 894-898.
Minimum velocity calculated using published formula		Sellier & Kneubuehl 'Wound Ballistics and the Scientific Background' Elsevier, 1994, ISBN 0-444-81511-2
		Sperrazza & Kokinasis, Ballistic limits of tissue and clothing, Am NY Acad Sci 152(1) 1968, 163-167
		Mattoo, Minimal velocities necessary for perforation of skin by air gun pellets and bullets, J. Forens Sci 29(3) 1984, 700-703
NFU tests: measured velocity		

Conclusions

The results clearly indicate that pellets, with a given velocity, discharged at a single area of a target, in full auto-fire, can cause greater damage than pellets discharged in semi-auto fire. This is not surprising as one is concentrating multiple impacts at the same part of the target leading to cumulative damage.

A precise determination of a lethal threshold has not been possible as the equipment used, i.e. the supplied guns were not capable of being tuned to give specific pellet velocities. Also experiments to assess eye injuries have not been carried out as part of this assessment but theoretical values have been taken into account. However given the results obtained we believe it is possible to give values for full and semi-auto fire which would be extremely unlikely to result in a fatal injury. These values are 1J for full-auto fire and 2J for semi-auto fire.

M S Mastaglio

P Olden

¹ *Ballistic Skin Simulant*, Jussila et al, Forens Sci Int 150 (2005) p.65

² *Velocity Necessary for a BB to Penetrate the Eye: an Experimental Study Using Pig Eyes*; Powley,

Kramer, D., Dahlstrom, Dean B., Atkins, Valerie J., and Fackler, Martin L.; Wound Ballistics Review, vol. 3, No. 1, pp. 10-12

³ 'Minimal Velocities Necessary for Perforation of Skin by Air Pellets and Bullets'; Di Maio, V.J.M., Copeland, A.R., Besant-Matthews, P.E., Fletcher, L.A., & Jones, A.; Journal of Forensic Science, vol. 27, No. 4, October 1982, pp. 894-898

⁴ Standard Steel BB Perforation of Fresh Pigskin Over Standard Ordnance Gelatin: L. Haag, AFTE Journal Vol 42 No1 (2010) p56-60

⁵ 'Fatal Non Powder Firearm Wounds: Case Report and Review of the Literature'; H. Steven Lawrence, Pediatrics, Vol 85 No2, February 1990.

⁶ Sellier & Kneubuehl 'Wound Ballistics and the Scientific Background' Elsevier, 1994, ISBN 0-444--81511-2

⁷ Jahauri & Mahanta, Wound Ballistics: Study of the rupture of human skin membrane under the impact of a projectile: 8th International Meeting of International Association of Forensic Science 1978, p218

⁸ Sperrazza & Kokinasis, Ballistic limits of tissue and clothing, Am NY Acad Sci 152(1) 1968, 163-167

⁹ Mattoo, Minimal velocities necessary for perforation of skin by air gun pellets and bullets, Journal of Forensic Science, 29(3) 1984, 700-703



**ASSOCIATION OF
CHIEF POLICE OFFICERS**



**Association of Chief Police Officers
Firearms & Explosives Licensing Working Group**

**Andy Marsh, Chair
Deputy Chief Constable, Hampshire Police
Hampshire Police Headquarters, Winchester, Hampshire,
SO22 5DB
(01962 871148)**

19th September 2011

To Firearms Licensing Managers

Dear Colleague

Re: Airsoft lethality thresholds

Testing has been conducted by the Forensic Science Service, (at my request following a discussion with a number of interested parties) as to the actual lethality thresholds for airsoft BB 6 mm plastic pellets (0.2 grams). This work has become necessary in the light of the Violent Crime Reduction Act since a greater focus has been given to differentiating between realistic imitation firearms (often used for airsoft skirmishing) and firearms above the lethality threshold that would fall to be considered low powered airguns (or Section 5 (1) (a) prohibited weapons if capable of fully automatic fire).

I attach a statement from the Forensic Science Service following their recent work. Whilst you will see that it has not been possible to precisely define a lethality threshold, the testing has established that there is a difference between fully automatic and semi automatic or single shot fire and, given the wording of the legislation in terms of "lethal" there would now appear to be some greater complexity in this area. However, I propose some relatively straightforward arrangements to best guide working practices.

The testing established that in respect of fully automatic fire of such pellets the energy level to achieve penetration and, therefore, potentially engage with lethality, was 1.5 joules. In relation to single shot, the necessary energy level was 2.9 joules. To describe a more or less absolutely safe threshold the FSS concluded that this would be 1 joule for fully automatic fire and 2 joules for single shot.

2.

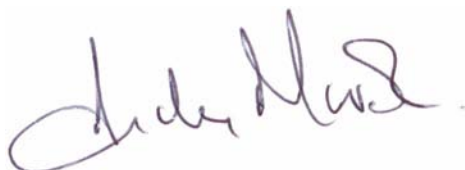
Of course, the testing indicates considerable margins are available in terms of the energy level and, reflecting the experience derived from current practice, it is my observation that it would be pragmatic and sensible to continue to work with arrangements that would see fully automatic airsoft firearms operating at 1.3 joules or less and those engaging in single shot modes of fire at 2.5 joules or less as not being items that we would ordinarily consider as potentially engaging the lethality threshold. Even these figures give a reasonable margin in respect of the outcome of the testing.

It is important to be aware that the law makes no distinction in this area in respect of the method by which the air or gas pressure is generated, so these considerations are equally applicable to airsoft guns that use a battery powered piston, a spring powered piston or a gas cartridge.

It should also be noted that the legislation pertinent to realistic imitation firearms applies to guns firing "paintball" missiles, such as the widely used .43" paintball. The "permitted activities" within the Violent Crime Reduction Act 2006 (Realistic Imitation Firearms) Regulations 2007 means the "acting out of military or law enforcement scenarios for the purposes of recreation". The nature of the realistic imitation firearm used for the activities is not defined, so is not automatically limited to airsoft guns. So whilst this provision is often referred to as the "airsoft defence", that title could misleadingly suggest that only airsoft guns could be covered by it. Whilst this defence might be applied to paintballing as an activity, no testing to establish the lethality threshold of a paintball missile has yet been commissioned by ACPO FELWG. Nonetheless it is clear that paintball guns are covered by the restrictions in relation to realistic imitation firearms.

In summary, I offer that it will be safe to conclude that fully automatic airsoft guns operating at 1.3 joules or less and single shot (or semi automatic) airsoft guns operating at 2.5 joules or less would not engage the lethality threshold crossing over into stricter controls under the Firearms Act. This would mean that airsoft firearms that are also realistic imitation firearms operating at or below these thresholds would, nonetheless, not be required to be sold by a Registered Firearms Dealer but that the other control provisions provided by the Violent Crime Reduction Act would apply.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'Andy Marsh', with a small flourish at the end.

Andy Marsh
Deputy Chief Constable
Chair, ACPO FELWG