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TM-05-1999

12 GAUGE BEAN BAG AMMUNITION PENETRATION

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TECHNICAL MEMORANDUM

Submitted by
Canadian Police Research Centre

March 1999

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12 GAUGE BEAN BAG AMMUNITION PENETRATION

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Abstract

Following manufacturer's safety recommendations, Ottawa-Carleton Regional Police discharged two rounds of Deftech Model 23BR bean bag ammunition in an attempt to subdue a person intent on self-mutilation. The individual subsequently died as a result of one of the bean bags penetrating the heart. Questions concerning the ability of this ammunition to penetrate human tissue arose.

Twelve-gauge bean bag ammunition was test fired into 10% ordnance gelatin, gelatin with embedded pigs' ribs, and gelatin with fresh pigs' skin covering the entrance surface. The orientation of the bags at entrance and penetration depths were observed and recorded.

Police work is unpredictable and circumstances may arise where bean bag ammunition fired from 12-gauge shotguns may result in death. Therefore, this ammunition should only be used when lethal force is justified.

Introduction

On February 24, 1997, Ottawa-Carleton Regional Police officers responded to a call to a residential apartment dwelling. It was here they confronted an individual, who had already severed his penis with a pair of scissors and was bleeding profusely. When he did not respond to the officers' commands to drop the scissors, one of the responding officers fired two rounds of Deftech Model 23BR bean bag ammunition from a 12-gauge Remington Model 870 shotgun in order to subdue him.

Mr. Marin¹ from the office of the "Ministry of the Attorney General for the Province of Ontario" summarized the intent of responding officers, stating:

"The use of the beanbag was meant to inca-

pacitate [...the subject] to prevent him from further harming himself."

The subject was subdued and transported to a local hospital where he later died. Although initially the cause of death was thought to be suicide as a result of self-inflicted wounds, further examination revealed both fired bean bags had struck within the same general area. The orientation of the bean bags was determined from the transfer of gunshot residue from the bean bag to the skin. One of the bean bags was found on the floor with skin adhering to its surface while the other bean bag had penetrated the chest between his arm and left nipple and lodged in the heart.

As a result of this event, the Royal Canadian Mounted Police were requested by the Special Investigations Unit, Province of Ontario, to examine the exhibits and events surrounding the incident and determine how and why the "bean bag" projectiles penetrated human tissue at a distance of 21 feet.

Methods and Materials

All tests were conducted using one of two Remington Model 870 12-gauge pump action shotguns.

The 18 chronographed readings and first two test events were shot using a Remington Model 870 pump action 12-gauge shotgun with an 18" barrel and cylinder bore choke, Serial Number V693133V.

The last test was shot with a Remington Model 870 pump action 12 gauge shotgun with a 20" barrel and cylinder bore choke, Serial Number S400356V.

The ammunition used in all tests was Deftech Model 23 BR, 12-gauge "Bean-bag" shotshells. The first 18 rounds used in chronographing data were submitted by the Ottawa-Carleton Regional Police

Service. The last 11 rounds were purchased from Mr. Murray Charleton in British Columbia, Canada, and there was no indication of lot numbers; they were submitted and purchased as loose rounds.

The Deftech 23BR 12-gauge bean bag ammunition is a red "cotton canvas" bag 4.7 cm square. It is filled with 1¼ oz. of #9 lead shot and has stiff sewn edges. The bean bag is loaded into a shotshell by rolling the bag.

Kind and Knox 250A ordnance gelatin was used as the tissue simulant for all tests. The preparation and calibration of the 10% ordnance gelatin has been described in a previous work². Only variations will be discussed here. Calibration of all gelatin blocks was conducted with an Archer Model 87 pneumatic air rifle, Serial Number E3291, firing a copper-coated BB. The calibration showed that the gelatin was reasonably close to standard in all cases (between 9.0 and 9.4 cm BB penetration at 590 ft/sec). This is important because penetration correction of such atypical projectiles in non-standard gelatin would be very uncertain. The penetration corrections for these projectiles in this gelatin are probably about one centimeter; the accuracy of this estimate is not critical because this correction is too small to affect the basic conclusions.

Eighteen rounds of Deftech Model 23BR 12-gauge bean bag ammunition was initially chronographed through an Oehler Model 4040 chronograph at an instrumental distance of 13 feet and their orientation at a distance of 21 feet was observed and recorded.

Three test events were conducted at a distance of 21 feet:

Test Event I: five rounds of ammunition were fired into bare gelatin

Test Event II: three rounds of ammunition were fired into gelatin with pigs' ribs embedded 1-2" from the entrance surface

Test Event III: three rounds of ammunition were fired into gelatin with fresh skin from the belly of a pig draped over the entrance surface

Prior to Test Event III, the V-50 penetration threshold velocity of the pig skin was tested to ensure similarity between the test tissue and human skin. This was accomplished using a Crosman Model 781 pellet rifle, Serial No. B28840, firing both copper-coated BBs weighing 5.5 grains and round nose diabolo .177 pellets weighing 7.5 grains, and comparing the penetration values with those reported by MacPherson³. (These measurements correlate closely with those reported by MacPherson. An extensive discussion of the importance of the calibration of skin will be reported in a subsequent paper).

TABLE 1
Chronographed Velocities
(at an Instrumental Distance of 13 Feet)

Round #	Velocity (ft/s)	Projectile Orientation
1	321	A
2	357	A
3	301	C
4	323	C
5	352	A
6	358	B
7	267	C
8	303	B
9	399	A
10	296	B
11	319	B
12	343	C
13	309	B
14	389	B
15	370	B
16	391	A
17	272	B
18	293	B

Average: 331 feet/sec

Extreme Variation: 132 feet/sec

Projectile Orientation Legend:

- A. Projectile open, contacting target surface flat
- B. Projectile open, contacting target surface with sewn edge of the bag as leading edge
- C. Projectile still rolled up, contacting target surface with sewn edge of the bag as leading edge

TABLE 2 - Test Event I

Gelatin calibration data
 9.4 cm at 600 ft/sec ⇒ equivalent to 9.6 cm at 590 ft/sec
 8.9 cm at 603 ft/sec ⇒ equivalent to 9.2 cm at 590 ft/sec
 Temperature = 6°C

Round #	Velocity (ft/sec)	Penetration Depth	Contact Orientation
1	301	6.2 cm	B
2	323	8.5 cm	C
3	352	9.0 cm	B
4	358	5.2 cm	A
5	267	5.0 cm	A

TABLE 3 Test Event II

Gelatin calibration data
 8.9 cm at 604 ft/sec ⇒ equivalent to 9.2 cm at 590 ft/sec
 8.9 cm at 596 ft/sec ⇒ equivalent to 9.0 cm at 590 ft/sec
 Temperature = 6°C

Round #	Velocity (feet/sec)	Penetration Depth	Contact Orientation
1	309	2.5 cm	B
2	389	5.1 cm	A
3	370	7.6 cm	B

Round 1 broke rib, did not penetrate ribs, bag broke open inside gelatin

Round 2 penetrated between ribs

Round 3 broke 3 ribs (rib diameter: .353-.398")

TABLE 4 Test Event III

Gelatin calibration data
 8.9 cm at 607 ft/sec ⇒ equivalent to 9.2 cm at 590 ft/sec
 8.5 cm at 605 ft/sec ⇒ equivalent to 8.8 cm at 590 ft/sec
 Temperature = 6°C

Round #	Velocity (ft/sec)	Penetration Depth	Contact Orientation
1	322	6.7 cm	A
2	333	6.4 cm	A
3	321	6.4 cm	A

TABLE 5

Calibration Threshold Measurements
 of Pigs' Skin with BBs

Velocity (ft/sec)	Penetration
348	Yes
352	Yes
354	Yes
331	No
327	No
405	Yes
357	No HNP*
403	Yes
365	Yes
363	Yes
350	No
286	No
278	No
357	Yes
349	Yes
345	Yes
345	Yes
335	Yes LP**
323	BB stuck in tissue (non-penetrating)
338	Yes
298	BB stuck in tissue and fell out (non-penetrating)
298	BB stuck in tissue and fell out (non-penetrating)

*HNP - highest non-penetrating velocity

**LP - lowest penetrating velocity

V-50 340 feet/sec

Zone of mixed results (difference between the highest velocity shot that did not penetrate and the lowest velocity shot that did penetrate) (357-335=22)

TABLE 6

Calibration Threshold Measurements of Pigs' Skin with .177 pellets

Velocity	Penetration
239	just stuck in back of tissue (penetrating) LP**
222	No
249	No
294	just stuck in back of tissue (penetrating)
249	No
303	just stuck in back of tissue (penetrating)
330	Yes
267	No
294	No HNP*
349	Yes
337	Yes

*HNP - highest non-penetrating velocity

**LP - lowest penetrating velocity

V-50 278 feet/sec

Zone of mixed results (294-239= 55)

Test Event III was chosen to determine what effect skin may have as a barrier on penetration of the bean bag.

In all test events, the orientation of the projectile at contact with the target surface as well as the penetration depth of the projectile was observed and recorded.

Results and Discussion

In all test events, bean bag ammunition pene-

trated soft tissue simulant regardless of the orientation of the bag at contact. Penetration depth was less when the bean bag hit flat as opposed to having a sewn edge as the leading edge, either opened or rolled. The bean bags hit flat in only 38% of the 29 test shots fired.

Although there was no way of knowing what lots the individual rounds were acquired from, Table 1 shows a significant variation in measured velocities.

Neither skin nor ribs appears to have an appreciable affect on tissue penetration. Orientation of the bag is the most important variable for the penetration of soft tissue and is an extremely erratic variable which cannot be predetermined at a distance of 21 feet.

Conclusions

Because police work is unpredictable, situations can arise where ammunitions are used even though the conditions are not recommended by the manufacturer. Deftech has recommended in their instructors' training key that one should never aim at the head or hit in the spine, and also that the ammunition can be lethal under 10 feet.

For this reason, the ammunition must be treated as capable of causing serious bodily injury or death to a person and should only be used when lethal force is warranted.

References

- 1) The *Ottawa Citizen*, Tuesday, May 27.
- 2) Dahlstrom, D. B. and Powley, K. D., *Comparative Performance of 9 mm Parabellum, .38 Special, and .40 Smith and Wesson Ammunition in Ballistic Gelatin*, Canadian Police Research Centre Technical Report, TR-01-95, September, 1994.
- 3) MacPherson, D., *Bullet Penetration: Modeling the Dynamics and the Incapacitation Resulting from Wound Trauma*, Ballistic Publications, El Segundo, CA, 1994.