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Ballistic Characteristics of Shot Shell Buffer

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ABSTRACT: Many modern buckshot and larger diameter bird shot shotgun shells currently contain granulated plastic shot buffer. The presence of granulated buffer at a shooting scene provides valuable and immediate evidence of the general type of weapon and ammunition used.

The ballistic characteristics of the buffer however are not commonly known but could be helpful in determining range of fire. Using felt targets and various types of 12 gauge shotguns and ammunition (2¾ in. shells), we discovered adherent buffer on the targets up to 20 ft (6.1 m) from the muzzle. Surprisingly, buffer would penetrate light cotton cloth (white T-shirt) at ranges up to or nearly up to the maximum range of adherent buffer on the plain felt targets.

The diameter of buffer spread was up to 9 to 10 times that of the pellet spread. The buffer distribution diameter peaked at 3.3 ft (1.0 m) between the 8 to 10 ft (2.4 to 3.1 m) range of fire and remained roughly constant at 28 in. (.7 m) throughout the buffer adherence range beyond 10 ft. Along the ground buffer was demonstrated up to 30 ft (9.2 m) from the muzzle but was concentrated in the 12 to 22 ft (3.7 to 6.7 m) range. Buffer clearly could be deposited on objects not struck by pellets. The presence of buffer, but not its distribution diameter, was helpful in determining range of fire.

KEYWORDS: forensic science, shotguns, shot shell buffer, ballistics, wound ballistics

Examination of criminal firearm shooting scenes can provide a wealth of valuable information. Specifically, a trained investigator can often find trace evidence material pertaining to the questions of range of fire, type of weapon or weapons used, and possible intermediary targets. For both rifled and smooth-bore weapons many of these questions can be answered by an accounting of the material expelled from the muzzle of the discharging firearm, including not only the projectile and projectiles or both, but also powder and powder residue, primer residue, and in shotguns, wadding and shotcuplike devices.

For the last several years shotgun ammunition manufacturers have produced shot shells with shot surrounded by a finely granulated plastic buffer intended to reduce shot deformation and interaction at discharge [*1,2,3*]. In Fig. 1 the buffer is seen admixed with the shot in the clear containers beneath each shell. The shot buffer is found primarily in larger bird shot and in buckshot loads. The buffer is discharged with the shot and could therefore be expected to be found at a shooting scene [*1,2,3*]. Buffer recovered from a

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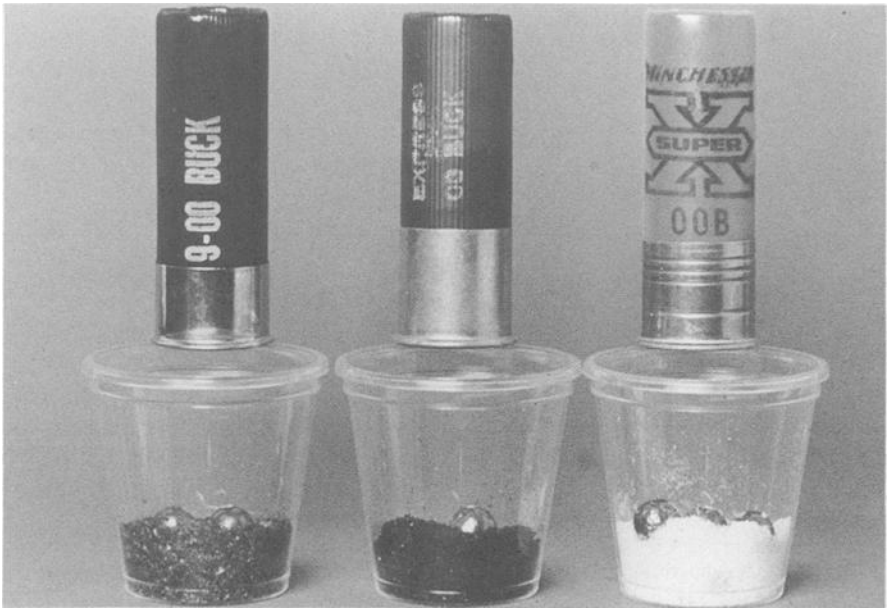

FIG. 1—*Shot shells with pellets and buffer admixed in containers beneath each shell.*

scene or a victim (as shown in Fig. 2) is indicative of the use of shot shell ammunition, most likely using larger bird shot or buckshot pellets.

We undertook this study to develop guidelines as to the maximum muzzle distance at which buffer could be recovered, the maximum diameter of buffer distribution, the distribution of buffer along the ground beyond the firearm, and the ability of buffer to penetrate light clothing.

Methods

Two .12 gauge shotguns were used in the study, one with a 27 in. (.69 m) barrel and a full choke, and the other with an 18 in. (.45 m) barrel and a cylinder bore.

Winchester and Federal ammunition (lead shot with white buffer) were used in four buckshot and BB bird shot sizes and with normal hunting and "magnum" powder loads. Targets were fiberboard or cardboard sheets covered with black felt (Fig. 3). White cotton T-shirts were occasionally used as intermediary targets immediately in front of the felt targets.

Shooting was done both indoors and outdoors with outdoor winds representing a 90° crosswind component. The maximum range of buffer adherence to the targets was arrived at by trial and error with the different combinations of weapons and ammunition. Shooting trials were done at 1 ft (.30 m) intervals beyond 10 ft (3.1 m). Determination of buffer diameter spread was undertaken at an indoor range using 4 by 3 ft (1.2 by .9 m) black, felt-covered cardboard sheets. Ranges of fire were arbitrarily chosen from previous test firings. The ground distribution of buffer from a shoulder fired weapon was observed on black paper sheets stretching up to 30 ft (9.2 m) beyond the muzzle. Five to ten shot averages were used at each station.

FIG. 2—*Shirt of shooting victim illustrating adherent shot shell buffer material.*

Results

The results of our study indicated that buffer could be consistently deposited on the targets up to 15 ft (4.5 m) from the muzzle (range 15 to 20 ft [4.5 to 6.1 m], mean 17 ft [5.1 m]) with the short barreled weapon and lighter loads and 16 ft (4.9 m) (range 16 to 20 ft, mean 18 ft [5.4 m]) with the longer barreled weapon and heavier loads: Re-

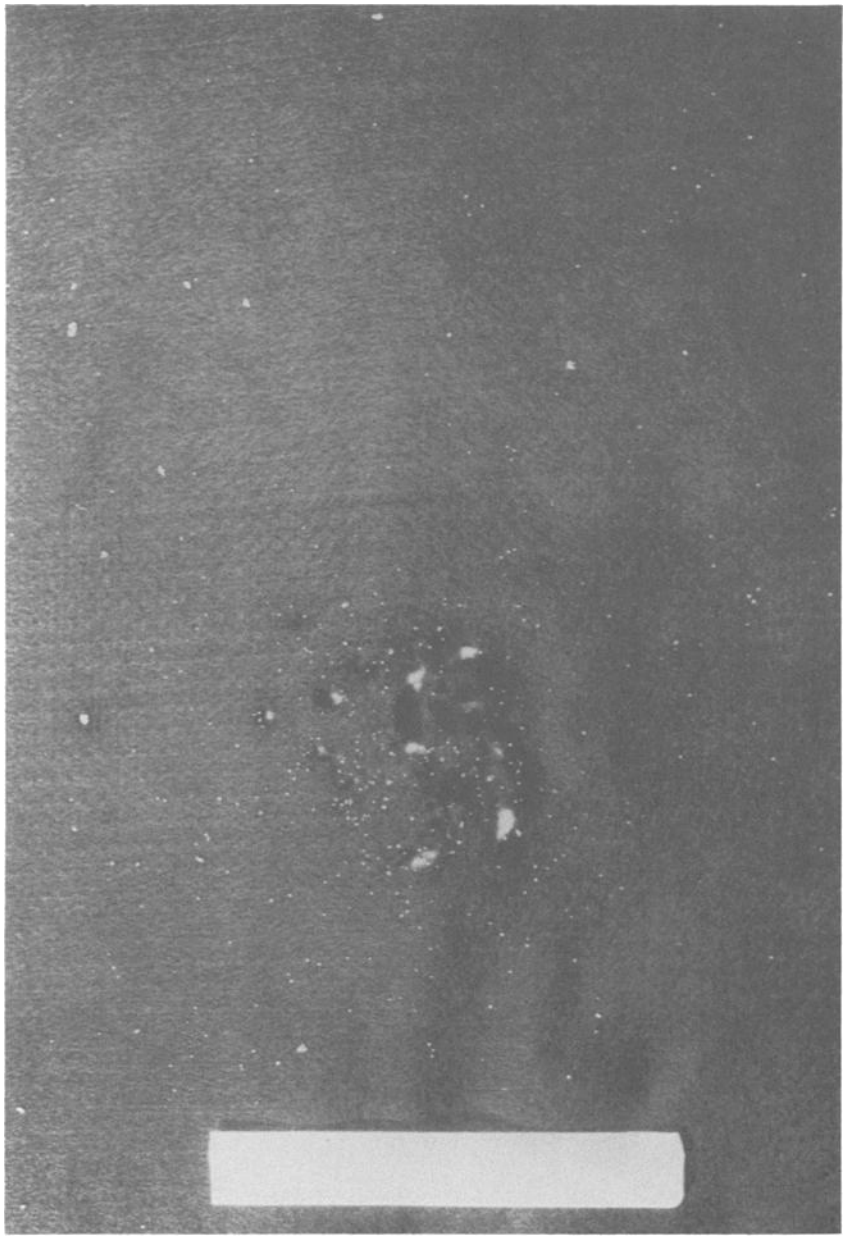

FIG. 3—*Felt target with adherent white buffer material and central pellet defects. Note the variability in buffer particle size (white bar = 6 in. [.15 m]).*

gardless of weapon and ammunition, inconsistent target buffer deposition could be seen up to 20 ft from the muzzle. The long barreled weapon and heavier loads did produce a slight extension of the buffer range, but the results were inconsistent and not statistically significant. Outdoors, crosswinds produced significant distortion in the buffer distribution.

Buffer would penetrate a commercial white T-shirt and be deposited on the felt target at essentially the same distance as if the T-shirt was not present. The presence of the T-shirt actually appears to enhance the recovery of buffer in some instances by trapping buffer particles on the felt target that might otherwise have rebounded and been lost.

The rapid incremental loss of buffer beyond 8 to 10 ft (2.4 to 3 m) made accurate estimation of buffer distribution diameters difficult beyond those ranges. The average buffer distribution diameter from 10 ft and beyond remained largely constant at approximately 27 in. (.7 m) with rare outlying buffer particles. Representative distribution diameter averages are 27 in. (.69 m) at 10 ft, 28 in. (.71 m) at 12 ft (3.7 m), 27 in. at 15 ft (4.6 m), and 29 in. (.73 m) at 17 ft (5.1 m). The range for the maximum, well defined buffer distribution diameter was 8 ft with a resulting 38 in. (1.0 m) distribution diameter (Fig. 4). The diameter at 5 ft (1.5 m) was 20 in. (.49 m) and 34 in. (.82 m) at the 7 ft (2.1 m) range.

Along the ground from a shoulder fired weapon a light distribution of buffer could be observed starting at 4 ft (1.2 m) from the muzzle (range 3 to 4 ft [.90 to 1.2 m]) and extending up to 30 ft (9.2 m) from the muzzle (range 23 to 30 ft [6.9 to 9.2 m], average 27 ft [8.2 m]). Heavier distributions of buffer were seen at the ranges of 7 to 26 ft (2.1 to 7.8 m) with the heaviest deposits in the 12–22 ft (3.6 to 6.7 m) range (subjective observation).

Discussion

This project has shown that with appropriate targets shot shell buffer can be reliably deposited up to 15 to 20 ft from the shotgun muzzle, consistent with previous reports [2]. Along the ground the distribution of buffer may be seen up to 30 ft (9.2 m). Buffer therefore should be a sought after component of a shotgun shooting scene investigation.

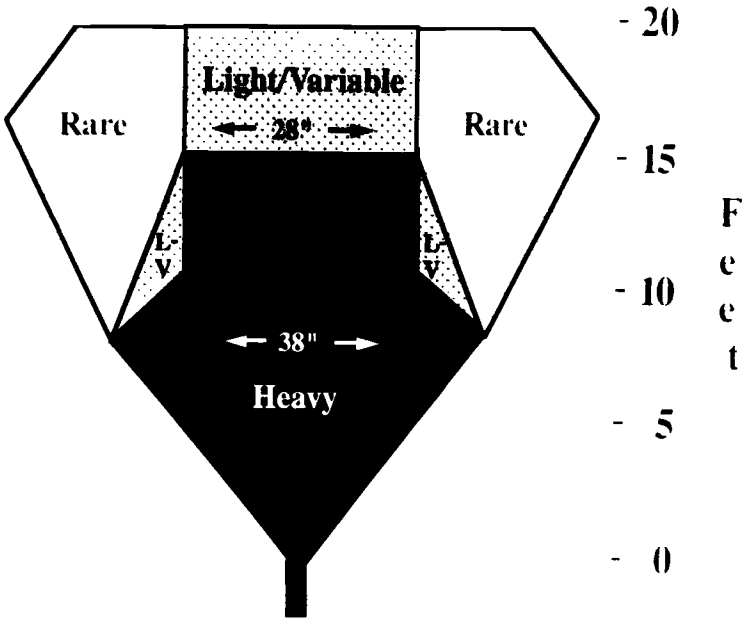

FIG. 4—*Relationship between buffer distribution diameter and range of fire.*

Buffer can be expected to assist the criminalist/death investigator in reconstruction of the shooting incident.

The presence of buffer at a scene would be potentially helpful in determining the type of weapon and ammunition used, range of fire, potential intermediary targets, and possibly even wind conditions at the time of the shooting.

The presence of buffer at a shooting scene obviously indicates the use of a weapon firing a buffer-filled shot shell (usually seen in larger diameter bird shot and buckshot loads). The physical characteristics of the buffer may be helpful in determining type of ammunition (different manufacturers may use different colored buffer materials for example). However, we did not see significant variation in buffer distribution as a function of ammunition type or barrel length.

Range of fire estimations based on buffer distribution should be approached cautiously. We were surprised to note that the distribution diameter of buffer did not show the same linear expansion as a function of range of fire as does the pellet distribution. Beyond 10 ft (3 m) the buffer distribution remains largely constant. The constancy of the buffer distribution diameter undoubtedly is a function of a selective peripheral attentuation and loss of buffer particles; perhaps as a result of the greater distance traveled by the peripheral particles plus an apparent peripheralization of the smaller buffer particles. Using a "best fit" approach to determining buffer distribution diameter also would tend to exclude the rare outlying particle(s) tending to keep the diameter estimates constant and reduced from the "actual" diameter. The buffer distribution diameter expands at a rate far in excess of the pellet distribution diameter and may be 9 to 10 times greater than the pellet spread. From this observation we would expect that buffer would be deposited at a shooting scene on objects and people not necessarily struck by pellets.

From the onset we realized that there were a tremendous number of permutations of weapon, shot size, and powder load combinations available for test firing. This project was undertaken only to provide very general guidelines as to the expected behavior of shot buffer at a shooting scene. The ballistic characteristics of shot buffer in specific circumstances, of course, can be addressed only by test firing the exact weapon and ammunition under identical conditions of the shooting incident.

Conclusions

1. Shot buffer may be deposited on a target up to 15 to 20 ft from the muzzle. 2. The buffer may penetrate light clothing at nearly its maximum range of adherence. 3. Ambient winds may distort the distribution pattern of the buffer. 4. Buffer from shoulder fired weapons will be concentrated in the 12 to 22 ft range along the ground but may be found in a 4 to 30 ft range. 5. Although the target diameter of buffer spread undoubtedly increases with increasing range of fire, the loss of peripheral particles results in a near constant buffer distribution diameter beyond 10 ft. The maximum diameter is seen in the 8 to 10 ft range and may be 9 to 10 times the pellet distribution diameter. Buffer therefore may easily be deposited on targets not struck by pellets.

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