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.177 Caliber Pellet Classification System and Identification Key*

ABSTRACT: A classification system and identification key for .177 caliber air gun pellets was developed based on a five-class characteristic criterion. Sixty-eight pellet types from 15 companies were examined and compared. A classification system was developed based on the pellets' head shapes, skirt types, lengths, weights, and other markings or observations. In some cases, when a pellet is recovered from a crime scene, product brand identification may aid the investigation. Even though all product brands cannot be identified, various brands of pellets can be eliminated based on a pellet's class characteristics. The pellet producers in this study were located in the following countries: China, Czech Republic, England, Korea, Spain, and the United States. An identification key can be used for possible pellet identification or elimination.

KEYWORDS: forensic science, pellet identification, airgun, class characteristics

In this study, a classification system was developed for the .177 caliber pellet to identify pellet brands based on their class characteristics. Identification and comparison of air gun pellets can facilitate an investigation involving pellet evidence. An estimated 3.2 million air guns are purchased annually in the United States of which 80% have muzzle velocities of 350 fps and 50% have muzzle velocities between 500 and 930 fps (1). Air guns have sufficient energy to cause tissue damage and in some cases, fatal injuries (2–4). Discharged pellets in air guns with rifling have class and individual characteristics similar to bullets discharged in firearms (5).

Methods

An examination of 68 pellets from 15 companies was conducted to determine if the brand of an unidentified pellet could be identified based on the pellet's class characteristics. The pellet producers were located in China, Czech Republic, England, Korea, Spain, and the United States.

The five-class characteristics used in the pellet classification system were the pellets' head shapes, skirt types, lengths, weights, and other markings or observations. The last characteristic was used to distinguish pellets with similar head styles, skirt types, lengths, and weight measurements.

The first division in the pellet classification was pellet head shape. This included: domed or round, wadcutter, pointed, and hollow point. Of the 68 pellets examined, 24 (35%) were domed or round; 21 (31%) were wadcutter; 17 (25%) were pointed; and six (9%) were hollow points.

The second division in the pellet classification was based on the skirt types. Pellet skirts were either plain or ribbed. Of the pointed pellets, 14 (82%) were plain and three (18%) were ribbed. The domed pellets included 16 (66%) plain and eight (33%) were

ribbed; the wadcutters included 20 (95%) plain and one (5%) ribbed. None of the hollow pointed pellets were ribbed.

The third division was based on pellet lengths. Ten pellets from each of the 68 types were measured with dial calipers to determine the average length of each pellet type. Pellets were grouped according to similar lengths but placed in separate categories when the length dimension exceeded 0.010 of an inch. The length for all pellets ranged from 0.199 of an inch to 0.392 of an inch.

The fourth category used to separate the pellets was weight. Ten pellets from each of the 68 types were weighed with a

TABLE 1—*Domed classification key (24) 35% (head, skirt, length, weight, observations, reference number, and brand).*

Group I-D	Pellet Brand
D - P - .220 – 8.0	Champion Powershot
D - P - .221 – 7.9	Benjamin Sheridan Diabolo
D - P - .222 – 7.9	Crosman Accupel (Sampler)
D - P - .223 – 7.8	Crosman Copperhead (Bubble Pack)
D - P - .225 – 7.6	Beeman Trophy Light Weight
D - P - .232 – 8.7	H & N Silhouette Field & Target Trophy
	Beeman Field Target
Group II-D	Pellet Brand
D - P - .244 – 9.5 (nondiabolo)	Logun Penetrator
D - P - .246 – 8.3	JSB Exact Diabolo Fur Luftwaffen
D - P - .347 – 18.2 (nondiabolo)	Pyramydair Predator
D - P - .251 – 8.3	H & N Silhouette Field & Target
D - P - .256 – 8.0	BSA Elite
Group III-D	Pellet Brand
D - P - .266 – 10.4	Crosman Ultra Magnum
D - P - .266 – 10.3	Beeman Kodiak Match Extra Heavy
D - P - .266 – 10.5	Crosman Copperhead (Bubble Pack)
D - P - .268 – 10.4	Beeman Kodiak Extra Heavy
Group IV-D	Pellet Brand
D - R - .224 – 6.4	Beeman Laser (Sampler)
D - R - .228 – 7.5	Winchester (Daisy) Hunting
D - R - .232 – 7.3	Gamo Hunter
D - R - .233 – 7.8	Beeman Bearcub (Sampler)
D - R - .248 – 8.2	RWS Superdome Field Line
D - R - .261 – 8.4	H & N Silhouette
D - R - .264 – 9.5	Beeman Ram Jet (Sampler)
D - R - .304 – 15.9 (3 ring head)	Made in Korea

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digital scale to determine the average weight for each pellet type. The weight for all pellets ranged from 7.0 to 18.2 grains.

The last category used to separate the pellets consisted of other markings or observations. These included whether the pellet had a visible seam on the side of the pellet or whether the pellet style was diabolo, a pellet with an hourglass shape, or nondiabolo, a straight pellet along its length. Pellets included in this category also had rings around the head or were manufactured out of plastic or metals other than lead. Any coated pellets were also included in this category.

An identification key was developed utilizing symbols for class characteristics. The symbols used in the classification system for pellet head type were “P” for pointed, “D” for domed, “W” for wadcutter, and “H” for hollow point. Symbols for pellet skirt type were “P” for plain and “R” for ribbed. The length of the pellet was recorded in thousandths of an inch with dial calipers and the weight was recorded in grains. Markings and observations were noted in parentheses. The class characteristics were separated by dashes in the classification system. For example, P - P - .298 - 11.5 (three ring head) indicates a pointed pellet with a plain skirt that is 0.298 inches in length and weighs 11.5 grains and has three rings on its head. Recovered pellets could be compared with the 68 known types to determine a classification and possible pellet identification. This is not an absolute pellet identification system; however, it provides possible product identification of some pellets for the investigator. Also, the system can eliminate numerous pellet brands.

Results and Discussion

After classification, the domed pellets were subdivided into four groups. Group I-D contained seven pellet types; Group II-D, five pellet types; Group III-D, four pellet types; and Group IV-D, eight pellet types. Table 1 presents a summary of the domed pellet types. Figures 1-4 represent examples of the domed pellets that are listed in Groups I-D through IV-D, respectively. The wadcutter pellets were subdivided into five groups. Group I-W had seven pellet types; Group II-W, 10 pellet types; Group III-W, two pellet types; Group IV-W, one pellet type; and Group V-W, one pellet type. Table 2 presents a summary of the wadcutter pellet types. Figures 5-9 represent examples of the wadcutter pellets in Groups I-W through V-W, respectively. The pointed pellets were subdivided into four groups. Group I-P contained four pellet types; Group II-P, seven pellet types; Group III-P, three pellet types; and Group IV-P, three pellet types. Table 3 presents a summary of the pointed pellet types. Figures 10-13 represent examples of the pointed pellets in Groups I-P through IV-P, respectively. The hollow point pellets were subdivided into four groups. Group I-HP contained three pellet types; Group II-HP, one pellet type; Group



FIG. 1—Photograph of domed pellets in Group I-D. Pellets listed from left to right include: Champion Powershot, Benjamin Sheridan Diabolo, Crosman Accupel (Sampler), Crosman Copperhead (Bubble Pack), Beeman Trophy Light Weight, H & N Silhouette Field & Target Trophy, and Beeman Field Target.

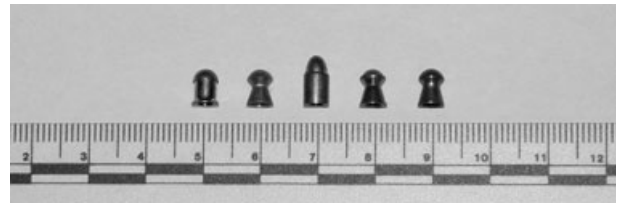


FIG. 2—Photograph of domed pellets in Group II-D. Pellets listed from left to right include: Logun Penetrator (nondiabolo), JSB Exact Diabolo Fur Luftwaffen, Pyramydair Predator (nondiabolo), H & N Silhouette Field & Target, and BSA Elite.



FIG. 3—Photograph of domed pellets in Group III-D. Pellets listed from left to right include: Crosman Ultra Magnum, Beeman Kodiak Match Extra Heavy, Crosman Copperhead (Bubble Pack), and Beeman Kodiak Extra Heavy.

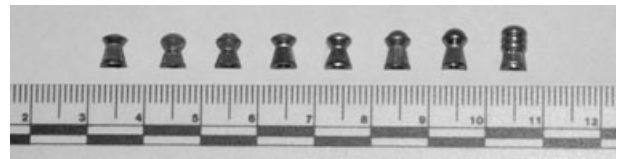


FIG. 4—Photograph of domed pellets in Group IV-D. Pellets listed from left to right include: Beeman Laser (Sampler), Winchester (Daisy) Hunting, Gamo Hunter, Beeman Bearcub (Sampler), RWS Superdome Field Line, H & N Silhouette, Beeman Ram Jet (Sampler), and Made in Korea (3 ring head).

TABLE 2—Wadcutter classification and identification key (21) 31% (head, skirt, length, weight, observations, reference number, and brand).

Group I-W	Pellet Brand
W - P - .199 - 7.3	Diabolo Match “P”
W - P - .200 - 7.1	RWS Dynamil Nobel
W - P - .200 - 7.0	RWS Geco
W - P - .201 - 7.2	JSB Match Diabolo Fur Luftpistolen
W - P - .206 - 8.0	Crosman Super Match
W - P - .206 - 7.9	Crosman Copperhead Match (Bubble Pack)
W - P - .206 - 7.9	Crosman Copperhead (Bubble Pack)
Group II-W	Pellet Brand
W - P - .214 - 8.1	RWS Meisterkugeln
W - P - .215 - 8.1	RWS Dynamil Nobel
W - P - .216 - 7.9	JSB Match Diabolo Fur Luftgewehr
W - P - .218 - 7.9	Diabolo Match “R”
W - P - .219 - 8.2	JSB Match Diabolo S100 Fur Luftgewehr
W - P - .220 - 8.1	Beeman Laser Sport (Sampler)
W - P - .220 - 8.4	Diabolo LUX
W - P - .221 - 7.7	RWS Dynamil Nobel
W - P - .221 - 8.0	JSB Fur Luftgewehr, Luftpistolen, Luftwaffen
W - P - .224 - 8.8 (3 ring head)	Beeman Silver Ace (Sampler)
Group III-W	Pellet Brand
W - P - .228 - 9.2	RWS Supermag
W - P - .230 - 9.3	Beeman Supermag (Sampler)
Group IV-W	Pellet Brand
W - R - .199 - 7.6	Gamo Match
Group V-W	Pellet Brand
W - P - .219 - 7.2 (Red)	Beeman Plastic WC (Sampler)

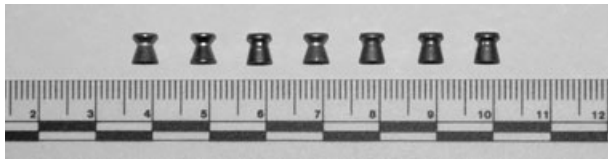


FIG. 5—Photograph of wadcutter pellets in Group I-W. Pellets listed from left to right include: Diabolo Match “P,” RWS Dynamil Nobel, RWS Geco, JSB Match Diabolo Fur Luftpistolen, Crosman Super Match, Crosman Copperhead Match (Bubble Pack), and Crosman Copperhead (Bubble Pack).



FIG. 6—Photograph of wadcutter pellets in Group II-W. Pellets listed from left to right include: RWS Meisterkugeln, RWS Dynamil Nobel, JSB Match Diabolo Fur Luftpistolen, Diabolo Match “R,” JSB Match Diabolo S100 Fur Luftpistolen, Beeman Laser Sport (Sampler), Diabolo LUX, RWS-DynamilNobel, JSB Fur Luftpistolen, Luftpistolen, Luftpistolen and Beeman Silver Ace (Sampler) (3 ring head).



FIG. 7—Photograph of wadcutter pellets in Group III-W. Pellets listed from left to right include: RWS Supermag and Beeman Supermag (Sampler).

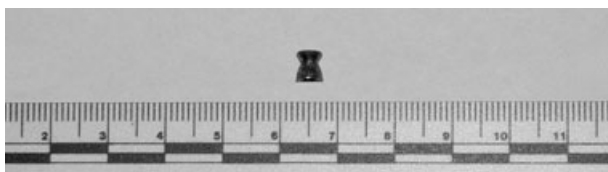


FIG. 8—Photograph of wadcutter pellet in Group IV-W, a Gamo Match.

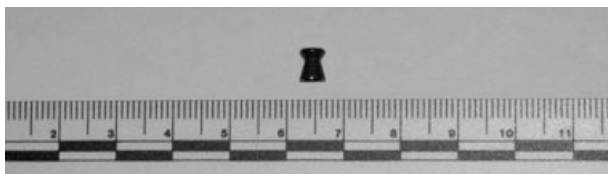


FIG. 9—Photograph of wadcutter pellet in Group V-W is a Beeman Plastic WC (Sampler) and is red in color.

III-HP, one pellet type; and Group IV-HP, one pellet type. Table 4 presents a summary of the hollow point pellet types. Figures 14–17 represent examples of the hollow point pellets in Groups I-HP through IV-HP, respectively.

TABLE 3—Pointed classification and identification key, pointed (17) classification (head, skirt, length, weight, observations, reference number, and brand).

Group I-P	Pellet Brand
P - P - .237 - 7.9	Crosman Copperhead
P - P - .238 - 7.6	Daisy
P - P - .238 - 7.8	Remington
P - P - .239 - 8.4	H & N (Haendler & Natermann)
Group II-P	Pellet Brand
P - P - .251 - 7.9	Crosman Super Point
P - P - .252 - 5.3	Daily Lead Free
P - P - .259 - 5.9 (blue sabot)	Skenco Hyper-Velocity Type II
P - P - .265 - 8.6	Qiang Yuan
P - P - .271 - 8.4	Diabolo BOXER
P - P - .274 - 8.3 (Seam on side)	JSB Straton Diabolo Fur Luftwaffen
P - P - .274 - 8.1	RWS Superpoint Extra
Group III-P	Pellet Brand
P - P - .298 - 11.5 (3 ring head)	Beeman Silver Arrow
P - P - .352 - 5.5 (orange sabot)	Skenco Hyper-Velocity Type I
P - P - .392 - 8.3 (gold sabot)	Skenco Hyper-Velocity Type III
Group IV-P	Pellet Brand
P - R - .275 - 7.7	Gamo Master Point
P - R - .275 - 8.0	Gamo Magnum
P - R - .270 - 8.6	Beeman Silver Sting (Sampler)

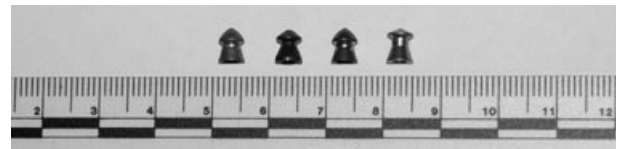


FIG. 10—Photograph of pointed pellets in Group I-P. Pellets listed from left to right include: Crosman Copperhead, Daisy, Remington, and H & N (Haendler & Natermann).



FIG. 11—Photograph of pointed pellets in Group II-P. Pellets listed from left to right include: Crosman Super Point, Daily Lead Free, Skenco Hyper-Velocity Type II (blue sabot), Qiang Yuan, Diabolo BOXER, JSB Straton Diabolo Fur Luftwaffen (Seam on side), and RWS Superpoint Extra.

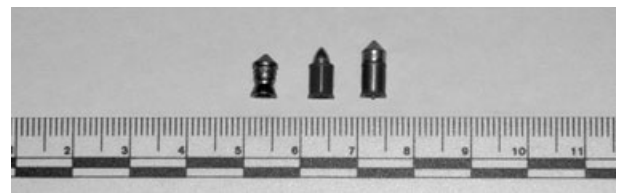


FIG. 12—Photograph of pointed pellets in Group III-P. Pellets listed from left to right include: Beeman Silver Arrow (3 ring head), Skenco Hyper-Velocity Type I (orange sabot), and Skenco Hyper-Velocity Type III (gold sabot).

In conclusion, the pellet classification system and identification key would assist investigators in the identification of some pellet brands and the elimination others. After subdividing the pellets, the largest category was the wadcutter type. This subdivision

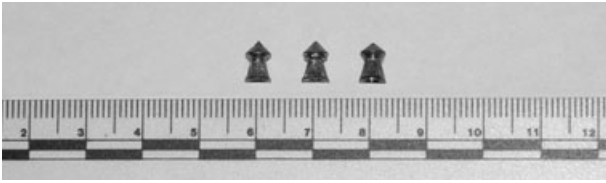


FIG. 13—Photograph of pointed pellets in Group IV-P. Pellets listed from left to right include: Gamo Master Point, Gamo Magnum and Beeman Silver Sting (Sampler).

TABLE 4—Hollow point classification and identification key (6) 9% (head, skirt, length, weight, observations, reference number, and brand).

Group I-HP	Pellet Brand
H - P - .214 - 7.0	Beeman Silver Bear (Sampler)
H - P - .217 - 7.9	Crosman Hunting Pellet
H - P - .219 - 7.2	RWS Super - H - Point
Group II-HP	Pellet Brand
H - P - .246 - 8.8	Beeman Crow-Magnum
Group III-HP	Pellet Brand
H - P - .217 - 7.2 (Gold)	Beeman Gold Coated
Group IV-HP	Pellet Brand
H - P - .260 - 8.0	JSB Predator



FIG. 14—Photograph of hollow point pellets in Group I-HP. Pellets listed from left to right include: Beeman Silver Bear (Sampler), Crosman Hunting Pellet, and RWS Super - H - Point.

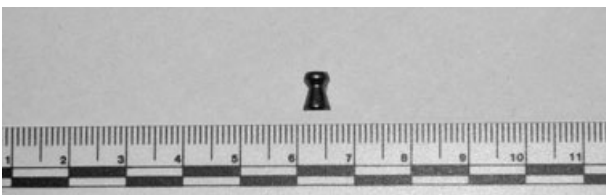


FIG. 15—Photograph of hollow point pellet in Group II-HP is a Beeman Crow-Magnum.



FIG. 16—Photograph of hollow point pellet in Group III-HP is a Beeman Gold Coated (Gold).

contained 10 (17%) of the pellets. Even though individual pellets could not be identified in this wadcutter group, 58 (83%) of the other pellet types could be eliminated. The smallest category was the hollow point pellets. This subdivision contained 7 (10%)

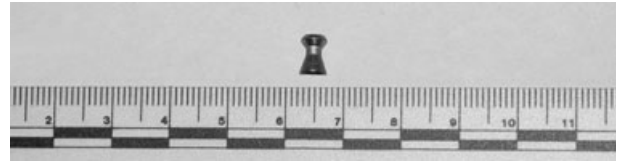


FIG. 17—Photograph of hollow point pellet in Group IV-HP is a JSB Predator.

TABLE 5—Analysis of possible matches and eliminations based on class characteristics.

	Possible Brand Matches	Brands Eliminated
Domed Classification		
Group I-D	7 (10%)	61 (90%)
Group II-D	5 (7%)	63 (93%)
Group III-D	4 (6%)	62 (94%)
Group IV-D	8 (12%)	60 (88%)
Wadcutter Classification		
Group I-W	7 (10%)	61 (90%)
Group II-W	10 (15%)	58 (85%)
Group III-W	2 (3%)	66 (97%)
Group IV-W	1 (1%)	67 (99%)
Group V-W	1 (1%)	67 (99%)
Pointed Classification		
Group I-P	4 (6%)	62 (94%)
Group II-P	7 (10%)	61 (90%)
Group III-P	3 (4%)	65 (96%)
Group IV-P	3 (4%)	65 (96%)
Classification H. P.		
Group I-HP	3 (4%)	65 (96%)
Group II-HP	1 (1%)	67 (99%)
Group III-HP	1 (1%)	67 (99%)
Group IV-HP	1 (1%)	67 (99%)

of the pellets. Of the 68 pellets examined, 12 (18%) had unique class characteristics which permitted individual identification based on visual comparison with known pellets. Of the pellets with unique class characteristics, three were domed, three wadcutter, five pointed, and one was a hollow pointed pellet.

In an examination of 100 unidentified pellets, 98% were correctly identified based on an examination of the head type, skirt type, length, and weight. The classification and identification of a pellet into a specific group limits the number of possible pellet matches and eliminates a portion of other pellets that do not match. For example, Group I-D, domed pellets, limits the pellets to seven (10%) of the 68 brands and eliminates 61 (90%) of the 68 brands. A selection in Group II-D of the domed pellets limits the pellets to five (7%) of the brands and eliminates 63 (93%) of the 68 brands. Two pellets, the Daisy Lead Free classified as Group II-P - P - .252 - 5.3; and the Beeman Kodiak Match Extra Heavy classified as Group III-D - P - .266 - 10.3; were incorrectly identified in the trial. Although the Daisy pellet resembles a domed pellet, it is marketed as a pointed pellet. The Beeman Kodiak Match Extra Heavy pellet resembles a pointed pellet; however, it is marketed as a domed pellet. Group IV-W, Group V-W, Group II-HP, Group III-HP, and Group IV-HP resulted in a single pellet and 67 (99%) of the other pellets were eliminated. Table 5 summarizes the possible types of pellets and the number of brands eliminated when a pellet is identified with a specific group. As additional pellets are added to the pellet classification system, the classification groupings will need modifications. All product brands cannot be identified; however, various pellet brands can be eliminated based on pellet class characteristics.

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