The Strasbourg Tests

In early 1991, a privately-funded research group was formed to study the physiological effects of bullet impact on medium-sized mammals. Electroencephalography and arterial transducers were employed to record an animal's responses prior to, during and after bullet impact. The primary objective of the study was to isolate the physical mechanism responsible for rapid incapacitation of man-sized targets and to disseminate these findings along with the test results to the military and federal law enforcement agencies.

These tests resulted in a time-based rating system of commercially available handgun ammunition. At this time, phase one of the testing has been completed and the results are being correlated. The following is a preliminary report only. A complete report may be available as early as the 2nd quarter of 1993.

Methodology

The Strasbourg Tests were initiated on the strength of the premise that briefly amplified systemic pressure of a specific magnitude can cause disorientation and loss of consciousness. It was determined that an accurate means of monitoring this elevated system pressure would be to surgically install a custom-designed peak-hold needle transducer in to the carotid artery of an animal. While this type of transducer is extremely expensive it, is capable of responding from 0 to peak pressure at the rate of 2,000 times per second, fast enough to respond to a bullet violently invading the circulatory system. The signals from such a transducer could be stored into memory using a 486 computer and I later transferred into post-processor/amplifier circuitry and, finally recorded by way of a "Vari-Sync" strip chart recorder.

With this concept firmly in mind, medical members of the research group discussed the merits of a study in which electroencephalograms (EEGs) were used to analyze lowered states of brain activity in anaesthetized animals as the result of projectiles fired into non-vital areas. Unfortunately, EEGs of anaesthetized animals do not show a clear picture of actual incapacitation. To better approximate the real-life situations normally encountered by law enforcement agents and military personnel, a corporate decision was made to
conduct the tests using fully conscious animals.

Test Equipment

Equipment inside the test room consisted of:

(1) A large tripod assembly to which a Ransom Rest was bolted. The tripod was securely fastened to the floor. The tripod head afforded X, Y and Z positioning of the test weapons. This system allowed for accurate bullet placement after adjustments were made for a particular load.
(2) Transducer/computer/strip chart recorder.

(3) Electroencephalograph/strip chart recorder.
(4) Two oscilloscopes.
(5) TV camera./CRT (monitored loading room activity).
(6) One mic-activated, digital timer/buzzer system.
(7) One mic-activated stroboscope.
(8) Two mic-activated, motor driven, 35mm cameras.
(9) Two manually-activated V HS camcorders.
(10) Two manually-activated exhaust fans.
(11) One manually-activated dimmer system.

The Subjects

The animals selected for testing were French Alpine Goats. These animals were chosen Because their weight, lung capacity and thoracic cage dimensions are very similar to those of man. All of the goats were of male gender. These were large, adult animals ranging in weight from 156 to 164 pounds. To reduce the chance of adversely affecting the test results, the goats were certified to be free of a number of serious diseases such as tuberculosis and pneumonia prior to purchase. The health of the animals was continually monitored throughout the tests by an in-house veterinarian.

Procedures

After surgically implanting the transducers, the goats were allowed to recover for several days and then placed in narrow stalls where needle electrodes were inserted into their scalp areas and glued in place. After clipping the electroencephalograph leads to the electrodes, electrodes, the goats were monitored by way of an oscilloscope in an effort to establish a “stable” (many artifacts were recognized and disregarded), baseline recording. Food was supplied to the animals during the monitoring period. If a reasonably consistent baseline recording could not be established regarding a particular subject, the animal was rejected as too high-strung (since a nervous or easily-adrenalinized individual might adversely affect the test results). Each animal producing a stable baseline recording and showing no signs of fever was led to the loading area of the test facility and positioned toward one end of a revolving, stainless steel cubicle chamber where it was confined inside a "rubber fence" (i.e., rubber cords stretched across the entrance). Once confined, the twin-cubicle was turned 180 degrees by way of a large bearing assembly so that the animal was inside the test room itself.

Electroencephalograph and transducer leads were connected to the animal's head and neck area and taped to isolate them from each other. The animal (now facing left) was then allowed to eat heavily salted oats from a stationary, conical-shaped container, the opening of which was of a diameter which forced the goat to remain in one position (this greatly assisted the shooter, as the X-coordinate variables were greatly minimized). At this point, the shooter quickly made any minor weapon-positioning adjustments to align the sights with the target area (a 2-inch circle stamped on the animal's chest).

Within 10-20 seconds from the time the animal commenced eating, the lights were dimmed and two camcorders were manually activated. Brain wave patterns were again monitored by way of an oscilloscope while the recorder charted a permanent record of the pre-invasive condition of the animal. If the baseline recording was unstable, disconnects were made. The animal was then tagged (rejected) and returned to a holding area. If the baseline recording was stable at the end of this 60-second acclimation period, the technician monitoring the oscilloscope signaled the shooter by way of an LED.

Once the shooter received the signal, the weapon was fired. The muzzle report was picked by a series of microphones. The mics sent separate signals to various devices. One signal activated a digital timer. Another activated a stroboscope (flashing at the rate of one-flash-per-second). The signals from two other mics electronically opened the shutters of two 35 mm cameras which recorded the goat's reaction (body movement) in the form of strobe-sequenced time-exposures. During this 60-second “flash” period, two assistants (each manning a gang of 5 stopwatches) timed each collapse that occurred.

At the end of this 60-second period, an alarm built into the digital timer sounded. At this point, the camcorders were switched off manually (by way of a remote switch), the 35 mm camera shutters were closed (by way of two solenoids attached to electronic cable releases) and the room lights were turned on. At this point, if the animal was still standing or had its head up, two marksmen armed with .22 caliber semi-automatic rifles intervened, humanely terminating the animal by firing rounds into the juncture of head and neck, just below the ear.

Once brain death was confirmed, the electrode and transducer leads were disconnected and the cubicle turned 180 degrees. Personnel in the loading room then wheeled the goat’s body and the backup gelatin to another room where an autopsy was performed. At this point, the cubicle chamber was thoroughly cleaned and rinsed. Fresh straw was scattered on the floor, the food container filled and the stall area generally prepared for the next subject.

Autopsy

During the autopsy, medical personnel searched for signs of entrance rib contact, disease, genetic deformities, tumors, pierced or burst vessels, bullet or bone fragments that pierced the heart or spinal cord – anything which could have incapacitated the animal sooner than a direct shot through the lungs. If any physical conditions were found which may have substantially lowered the incapacitation time, the records reflected this and a retest was scheduled. Additionally, the blood and pulped lung tissue were strained for projectile parts and weighed in relation to those recovered from backup gelatin positioned behind the animal. The wound channels created by the bullet and any bullet fragments were traced. If lung damage was slight, obvious bullet instability was noted. Damage to the individual lung walls was estimated in cubic centimeters.

If the autopsy revealed a valid test, technicians began the painstaking task of "real-time correlation.” This process amounted to comparing the strip chart tracings produced by the transducer signals (systemic pressure) with the electroencephalograph tracings (brain wave patterns). What the technicians looked for was a match between the spiked areas of the transducer tracings (high systemic pressure) and slowed or flat EEG tracings (diminished consciousness or possible brain death). If a spiked pressure tracing corresponded to a flattened or sluggish EEG tracing (which was usually the case), a positive correlation was recorded. It should be understood that the above-referenced correlation process was very time-consuming because the transducer tracings were so highly compressed (in order to correspond to the 1-second vertical chart spacing of the EEG) that they appeared solid in some areas. This was because lines from as many as 2,000 vertical stylus movements were crowded together over a short linear distance.

Target Area

The lung area was chosen as the impact zone in these tests due to the high probability of a bullet striking a human target in this area, regardless of its angle of entry. The goats used in these tests were shot from the side (at a distance of l0' +/- 3"). The bores of the firearms were leveled and every attempt was made to strike the animal as squarely as possible through both lungs. To minimize contact with the heart, the bullets were directed just behind the shoulder and above the centerline of the lungs.

Physiology and Bullet Performance

Ribs are covered with fatty skin. They comprise somewhat of a hemispherical surface. They are slippery and curve in two directions. After penetrating a layer of fat, a nicely lubricated round-nosed bullet does not mate well with a curved surface. In many instances, there was evidence that a round-nosed bullet or a bullet with a large radius at the nose "skidded" off course if the rib was not struck squarely (and sometimes even if it was). This sometimes caused the bullet to turn so that it penetrated the lungs at an angle (exposing more surface area to the tissue). Generally, this caused more lung damage than a similar bullet which slipped through the intercostal space between two ribs and remained stable.

It is important that those reading this preliminary report realize the degree to which bullet performance was affected when a rib was struck. More often than not, ribs were struck. This is not to say that the ribs were always struck squarely. They were not. Regardless of whether a rib was centrally impacted or impacted off-center, the expansion (or fragmenting) characteristics of most of the bullets tested were severely impaired. If the nose cavities were plugged with hair and./or deformed badly during impact with the ribs, they did not expand well (if at all). In these cases the incapacitation times were almost always longer (regardless of bullet velocity) unless the bullet fragmented or propelled portions of the rib into the lungs.

In almost every instance, expanding bullets performed much better if they missed the ribs and penetrated the intercostals muscles.

The thoracic cage of a goat is generally vertical, whereas, in man, the ribs run in a generally horizontal direction. Normally, the 4th, 5th or 6th rib was contacted to some degree. If a rib was punched, fractured, chipped or grooved, it was recorded (and indicated by a lower case "r"). Because the bullets were directed above the center of the lung and approximately toward the 5th rib, the intercostal spaces were somewhat narrower and the chance of contacting a rib was relatively great. The larger the bullet diameter, the greater the chance of a rib being struck. If the animal was calm and breathing shallowly, the ribs were closer together. While eating, the animals tended not to breath deeply. The shooter ran a 6O% chance of at least contacting a rib during these tests.

Technical Observations

In a substantial number of cases, the subject was incapacitated almost instantly. Each time this occurred, between 2 and 5 pressure spike tracings of high amplitude and short duration were found which immediately preceded and matched corresponding, diffused, or flattened lines (EEG tracings). Normally, the time-lag between the first pressure spike and the beginning of the slowed or flattened lines was between 30 and 40 milliseconds (although there were several cases where this delay lasted as long as 80 milliseconds). How mucho f this delay can be attributed to a slow electroencephalograph response (an equipment limitation) is unknown.

What is known is that:
(1) The taller pressure spike tracings always preceded the slowed or flat line tracings.
(2) The initial spikes had to be of a certain height in order for the animal to collapse immediately.
(3) A secondary group of shorter pressure spikes of diminishing height and longer duration always occurred after the taller spikes occurred. These are believed to be produced by the wake of the bullet and maybe indicative of a raised system pressure caused by a rapid compression of lung material (initiated by temporal cavitation). These subsequent spikes are essentially a continuation of the taller, initial spikes.
(4) A third group of low amplitude pressure spikes of still longer duration occur last and are a continuation of the group two spikes. These spikes tend to blend with the lowest amplitude of the group two spikes. These spikes diminish in intensity and it is believed that they are produced by the violent oscillation of the lungs after impact and cavitations.

What each of these spike patterns contributes to lowering incapacitation time is unknown. However, it is the general consensus of the research staff that the group one and group two pressure spikes work together and act as a catalyst to bring about incapacitation. It is believed that those cases of near-instant incapacitation may be the result of a pressure-related interruption in normal electrochemical activity

Extent Of Testing

Over the course of Phase One testing, 611 goats were terminated. Of this number, 3l were discounted for various reasons. There were 580 valid tests. The results of the valid tests are found in the tables of this report.

Incapacitation

An animal was deemed "incapacitated" if it collapsed and was unable to rise to a standing position.

Animal Reaction

Animal reaction varied greatly and was nearly always dependent on the caliber and particular ammunition used. Some animals collapsed immediately and could not rise. Others collapsed immediately and managed to rise to a standing position only to collapse and rise again (this was recorded up to 5 times with some animals. Animals collapsing two or three times was not uncommon). Many animals faltered shortly after bullet impact and did not collapse until much later. Several animals reacted vigorously by jumping over the rubber fence, resulting in "disconnects" subsequently invalidating the test. Some animals faltered or stumbled repeatedly and then collapsed unexpectedly. Others faltered shortly after bullet impact and collapsed within a relatively short time
Thereafter (it is believed that this common reaction was due to a system pressure level that was near, but below some threshold level required to cause immediate incapacitation)

On three occasions, (two validated) the animals stayed on their feet in excess of 60 seconds. The most notable of these subjects showed only slight agitation immediately after bullet impact, shifting its position in the stall area several times and then becoming relatively stationary until approximately 5l.3 seconds had elapsed - at which time it made a two-second attempt at eating! At this point, this rather determined animal began to falter, but remained on his feet until the marksmen intervened. The projectile was a 158 gr. RNL bullet fired from a 2-inch barreled .38 Special revolver. Average muzzle velocity for this load was 587 fps. The bullet did not strike a rib.

Conclusions

After lengthy discussions between the surgeons and technical personnel involved in these tests, it was concluded that the most effective ammunition available for an unobstructed lung strike is the high velocity type which uses pre-fragmented or fragmenting projectiles or those types that caused immediate expansion on impact. It was found that the more rapid the fragmentation or expansion, the greater the organ damage. Likewise, the more violent the fragmentation or expansion, the higher the system pressure and the more rapid the blood loss. It should be understood that, with few exceptions, most of the ammunition
Currently available does not fragment (or even expand well) at speeds under 1200 fps if a rib is struck. The ability of a particular bullet to cause damage was easily assessed by the size of the permanent cavity created in the entrance wall of the first lung.

Recommendations

Based on the results of these tests, this committee strongly opposes the use of:
(l) All handgun ammunition under .45 caliber which utilizes round nosed bullets.
(2) Any of the so-called, "deep-penetrating" ammunition loaded with “expanding" hollow point bullets. These bullets consistently penetrated not only the animal, but the 6-inch-thick backup gelatin behind the animal. Ammunition employing the two bullet types

mentioned above consistently scored the longest incapacitation times of all the ammunition tested.

Because of the high probability of rib impact, a single handgun bullet cannot be counted on to immediately incapacitate an individual. Multiple rounds should be fired.

The Research Staff

The staff consisted of two retired surgeons, a retired general practioner (M.D.), a former medic, a veterinarian, two diagnostic technicians, a computer programmer, two medical secretaries, an electronics major, and seven additional [classified] personnel.

Time Frame Of The Tests

Phase One testing began on April 8, I99I and ended on September 24, I992. The tests lasted approximately four months longer than originally anticipated due to an insufficient number of test animals. Initially, the group started testing at the rate of I0 animals per cartridge loading. It was quickly realized that the number of test subjects needed at that rate could not be supplied, even from a draw area consisting of several hundred square miles. Regrettably, the number was reduced to 5 per loading. Even at this reduced rate, operations came to a standstill from time to time.

Only by a concerted effort on the part of seven members of the group were we able to locate the number of male animals needed to conclude the tests. It is expected that the group will be faulted for the small number of subjects used in the tests. Under the circumstances, it was the best that could be done. In spite of the numbers, we feel these were the most ambitious tests ever undertaken. It is our hope that the agencies these tests were intended for will find the results useful.

Future Tests

Due to the heavy burden imposed on many of the key members of the research group by an unrelenting test pace over an I8-month period, future tests have not been scheduled. If follow-up tests are conducted, they will be of a limited nature (possibly 70 additional goats). As presently contemplated the tests will consist of re-testing only those loads that scored the lowest incapacitation times. If conducted, these tests should determine a correlation between the consumption of alcohol and incapacitation time.

Due to the sensitive nature of this information, strict anonymity concerning the individuals involved is being maintained. The recipient of this information will be apprised of how to correspond regarding this data by way of various publications.

The Strasbourg Tests Data Tables

Not all the tables from this study have been included in this document. The following tables include the basic incapacitation and ammunition data.

The following abbreviations are use in these tables:

FPS = Velocity, in feet per second
AIT = Average Incapacitation Time
FT-LBS. = Foot/Pounds of Energy
LB.SEC = Pound-seconds of momentum

.380 ACP (3.625 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	MagSafe 60 gr. +P	1338	7.12	238.57	.3566
2	Glaser 70 gr. (Blue)	1313	7.94	268.03	.4083
3	Fed 90 gr. Hydra-Shok	1008	10.94	203.10	.4030
4	Fed 90 gr. JHP	1007	11.06	202.70	.4026
5	Cor-Bon 90 gr. +P	1041	11.12	216.62	.4162
6	Win 85 gr. STHP	980	12.88	181.31	.3700
7	CCI 88 gr. JHP Blazer	965	13.40	182.01	.3772
8	Rem 88 gr. JHP	996	13.46	193.89	.3893
9	Hornady 90 gr. XTP-HP	984	15.58	193.55	.3934
10	Fed 95 gr. FMJ (control round)	934	22.80	184.07	.3941

.38 SPECIAL (2 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	Rem 158 gr. LHP +P	776	15.52	211.32	.5446
2	Fed 158 gr. RNL (control round)	1313	7.94	268.03	.4083

.38 SPECIAL (2 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	Glaser 80 gr. +P (Blue)	1667	4.72	493.76	.5924
2	MagSafe 65 gr. +P+	1841	4.76	489.30	.5316
3	Cor-Bon 115 gr. JHP +P	1243	8.98	394.64	.6350
4	Win 158 gr. LHP +P	996	10.76	348.12	.6990
5	Fed 158 gr. LHP +P	982	10.80	338.40	.6892
6	Fed 129 gr. Hydra Shok +P	951	10.84	259.12	.5449
7	Rem 158 gr. LHP +P	924	10.86	299.61	.6485
8	PMC 125 gr. Starfire +P	946	10.88	248.45	.5253
9	Fed 125 gr. JHP +P	998	10.92	276.52	.5441
10	Win 110 gr. JHP +P+	1136	11.02	315.29	.5551
11	CCI 125 gr. JHP Lawman	947	11.36	248.98	.5258
12	Rem 95 gr. JHP +P	1138	11.38	273.25	.4802
13	Win 110 gr. JHP +P	999	11.66	243.82	.4881
14	Win 125 gr. JHP +P	938	11.70	244.27	.5208
15	Rem 125 gr. JHP +P	935	11.74	242.71	.5192
16	Hornady 125 gr. XTP-HP	936	14.82	243.23	.5197
17	Fed 158 gr. RNL (control round)	708	33.68	175.90	.4969

9mm (4.25 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	MagSafe 68 gr.+P	1747	4.74	460.95	.5277
2	Quik-Shok 115 gr. +P+	1301	4.82	432.32	.6646
3	Glaser 80 gr.(Blue)	1555	7.42	429.64	.5526
4	Fed 115 gr.JHP +P+	1311	8.90	438.99	.6697
5	Cor-Bon 115 gr. JHP +P+	1333	8.92	453.85	.6809
6	Fed 124 gr. Hydra-Shok +P+	1267	8.96	442.11	.6979
7	Rem 115 gr. +P+	1290	8.98	425.04	.6590
8	Win 115 gr. JHP +P+	1288	8.98	425.04	.6590
9	PMC 115 gr. Starfire	1181	9.02	356.25	.6033
10	Fed 124 gr. Hydra-Shok	1126	9.28	349.18	.6202
11	Fed 124 gr.LHP-Nyclad	1105	9.28	336.28	.6087
12	Fed 115 gr. JHP	1175	9.30	352.64	.6002
13	Win 115 gr. STHP	1199	9.36	367.19	.6125
14	Rem 115 gr. JHP	1166	9.36	347.26	.5956
15	Fed 147 gr. Hydra-Shok	958	9.58	299.64	.6256
16	Hornady 90 gr. XTP-HP	1286	9.62	330.58	.5141
17	Cor-Bon 124 gr. XTP-HP +P	1258	9.66	435.85	.6929
18	Win 147 gr. Black Talon	962	9.68	302.15	.6282
19	CCI 115 gr. JHP Lawman	1149	9.80	337.20	.5870
20	Fed 147 gr. JHP	979	9.84	312.92	.6393
21	Cor-Bon 147 gr. XTP-HP	1093	9.86	390.04	.7137
22	Win 147 gr. JHP	890	9.90	258.61	.5812
23	Hornady 115 gr. XTP-HP	1134	12.02	328.45	.5793
24	Win 115 gr. FMJ (control round)	1163	14.40	345.47	.5941

.357 Magnum (4 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	Quik-Shok 125 gr. HP	1409	4.40	551.17	.7824
2	MagSafe 68 gr.	1757	4.62	466.24	.5307
3	Glaser 80 gr.(Blue)	1687	4.82	505.68	.5995
4	Rem 125 gr. JHP	1458	7.34	590.18	.8096
5	Fed 125 gr. JHP	1442	7.44	577.29	.8007
6	Cor-Bon 125 gr. JHP	1419	7.66	559.02	.7879
7	Fed 110 gr. JHP	1351	7.72	445.92	.6601
8	Win 125 gr. JHP	1382	7.76	530.25	.7674
9	CCI 125 gr. JHP Lawman	1367	7.78	518.80	.7590
10	Fed 158 gr. Hydra-Shok	1213	7.84	516.34	.8513
11	Win 145 gr. STHP	1285	7.86	531.78	.8277
12	Rem 110 gr. JHP	1334	7.90	434.77	.6518
13	Rem 125 gr. JHP	1277	7.94	400.91	.7091
14	Win 110 gr. JHP	1281	7.98	543.43	.8221
15	CCI 140 gr. JHP Lawman	1322	8.06	543.43	.8221
16	Fed 158 gr. JHP	1205	8.28	509.55	.8457
17	Rem 158 gr. JHP	1220	8.30	522.32	.8563
18	Win 158 gr. JHP	1246	8.34	544.82	.8745
19	Fed 158 gr. Nyclad HP	1188	8.42	523.17	.8570
20	CCI 158 gr. JHP Lawman	1221	8.48	523.17	.8570
21	Hornady 125 gr. XTP-HP	1314	10.88	479.35	.7296
22	Rem 158 gr. JSP (control round)	1224	12.80	525.75	.8591

.40 S&W (4 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	MagSafe 84 gr.	1753	4.52	573.32	.6541
2	Glaser 105 gr.(Blue)	1449	5.34	489.65	.6758
3	Win 155 gr. STHP	1210	7.86	504.03	.8331
4	Fed 155 gr. JHP	1142	7.90	448.97	.7863
5	Fed 180 gr. Hydra-Shok	991	8.32	392.62	.7923
6	Rem 155 gr. JHP	1136	8.40	444.27	.7822
7	Cor-Bon 150 gr. JHP	1183	8.42	446.25	.7882
8	Cor-Bon 180 gr. JHP	1044	8.66	435.74	.8348
9	Win 180 gr. Black Talon	989	8.86	391.04	.7908
10	Rem 180 gr. JHP	988	8.90	390.25	.7900
11	CCI 155 gr. JHP Blazer	992	8.92	338.77	.6830
12	Hornady 155 gr. XTP-HP	1157	10.38	460.84	.7966
13	Win 155 gr. FNJ-TCM (control rnd)	1277	7.94	400.91	.7091

10 mm (4.25 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	MagSafe 96 gr.	1729	4.48	637.41	.7373
2	Fed 155 gr. JHP	1311	7.56	591.69	.9027
3	Glaser 105 gr.(Blue)	1624	7.60	615.06	.7575
4	Cor-Bon 150 gr. JHP +P	1286	7.66	550.97	.8569
5	Win 175 gr. STHP	1267	7.92	623.95	.9849
6	Cor-Bon 180 gr. JHP +P	1155	7.94	533.33	.9235
7	Fed 180 gr. JHP Hydra-Shok	995	8.22	395.80	.7956
8	Rem 180 gr. JHP	1202	8.26	577.61	.9611
9	PMC 180 gr. Starfire	1367	7.78	518.80	.7590
10	Fed 180 gr. JHP	1018	8.46	414.31	.8140
11	Win 200 gr. Black Talon	986	8.76	431.86	.8760
12	Rem 180 gr. JHP	996	8.88	396.59	.7964
13	CCI 180 gr. JHP	1133	8.96	513.20	.9059
14	Hornady 200 gr. XTP-HP	1121	10.22	558.21	.9959
15	Win 155 gr. FMJ-TCM (control)	1103	13.98	418.83	.7594

.45 AUTO (5 INCH BARREL)

	LOAD	FPS	AIT	FT-LBS.	LB.SEC
1	MagSafe 96 gr. +P	1644	4.68	576.28	.7011
2	Glaser 140 gr.(Blue)	1355	4.72	570.90	.8427
3	Rem 185 gr. JHP +P	1124	7.98	519.11	.9237
4	Fed 230 gr. Hydra-Shok	847	8.40	366.48	.8654
5	Cor-Bon 185 gr. JHP	1156	8.56	549.09	.9500
6	Win 185 gr. STHP	1004	8.82	414.19	.8251
7	PMC 185 gr. Starfire	924	8.88	350.81	.7593
8	CCI 200 gr. JHP	936	8.92	389.17	.8316
9	Win 230 gr. Black Talon	829	9.14	351.07	.8470
10	Cor-Bon 200 gr. JHP	1043	9.22	483.23	.9266
11	Fed 185 gr. JHP	1011	9.24	419.98	.8308
12	Hornady 185 gr. XTP-HP	939	10.66	362.29	.7717
13	Fed 230 gr. FMJ (control round)	839	13.84	359.59	.8572