



.45-70 at Two Miles: The Sandy Hook Tests of 1879

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THE SHOOTER at the heavy bench rest squinted as he aligned his .45-70 Allin-Springfield Model 1873 Army rifle on the distant target. The rifle fore-stock and barrel was cradled in a rest; the butt was supported by his shoulder. The rear sight was flipped up to its full height, so with no stock support for his head, the rifle tester from Springfield Armory worked carefully to align high rear and low muzzle sight on the speck that was the target - a surveyed 2,500 yards distant. Holding his breath, he squeezed the 7-pound trigger. The rifle fired, and some 15 seconds later, signals from the target indicated that his shot had struck well inside the 6-foot diameter bullseye on a target well over a mile away! The Report of the Secretary of War, 1880, Volume III, under the chapter titled, "Extreme Ranges of Military Small Arms," had this to say:

"The firing was done by Mr. R.T Hare of Springfield Armory who has the enviable distinction, so far as is known, of being the only person in the world who has hit the 'Bull's-Eye' six feet in diameter at 2,500 yards with three different rifles, and who has ever fired at and hit so small a target as that described in this report at 3,200 yards. In comparison with this, all other so-called 'long range firing' pales into insignificance. The gun was held under the arm, a muzzle rest only being used."

The chapter on long range firing begins with a report from the Armory at Springfield, Massachusetts, May 9, 1879. It records the results of long range tests of U.S. Army Model 1873 .45-caliber rifles using 405 and 500-grain lead bullets, including variations in muzzle velocity and penetration of lead bullets through one-inch target boards and into sand. These tests were made at the request of the Chief of Ordnance. His interest had been aroused by reports of long range infantry fire, up to 1½ miles, during the 1877-78 Turko-Russian War. The lineage of the "trapdoor" rifles used in the tests is apparent from the separate lock plate, the massive side hammer, the milling out of a portion of barrel and fitting a breechblock hinged at the front - all clear indications that the rifles were merely breech-loading variations of the traditional muzzle-loading infantry-man's rifle. The Allin conversion of the 1861 and 1863 models Springfield muzzle-loaders came out first in .58 caliber rimfire. Later refinements resulted in the .50-70 rimmed centerfire for the 1866 model. The .45-70 cartridge was first introduced with the Model 1873 single

shot Springfield. Several model changes were made from 1873 through 1889, relatively minor differences being the type of sights, modified and improved breech-blocks and changes in stock furniture.

Summary of results of long-range firing at Springfield, Mass., and Sandy Hook, N. J. (both trials), by Captain John E. Greer, Ordnance Department, U. S. A.

Rifles.	Weights of powder.		Weights of balls.		Initial velocities.		Recoil.	Ranges.	Angles of elevation.*	Times of flight.	Penetration in white pine.
	Grns.	Grns.	Feet.	Foot-lbs.	Yards.	Sec.					
Springfield (service)...	70	405†	1,326.9	9.33	1,500	5° 58' 23"	9.25	1.5.			
					2,000	11° 0' 4"	17.75	1.37.			
					2,500	17° 8' 16"					
					2,800	24° 8' 42"					
					2,950	27° 12' 36"		4 to 5 in sand.			
					1,500	5° 33' 51"	17.77	6 to 8 in sand.			
Springfield, long-range (19 1/2-inch twist).	70	500†	1,220.8	10.83	3,000	20° 37' 28"		10 in sand.			
					3,500	No record.					
					1,500	4° 52' 17"	11.32	3+ sand.			
					2,500	11° 43' 49"		10 in sand.			
					3,500	29° 45' 36"					
	80	500	1,268.5	12.67	1,500	4° 35' 37"		3+ sand.			
					2,000	8° 16' 2"	11.4	5.25.			
					2,500	11° 43' 49"		2+ sand.			
					3,200	20° 51' 37"		10 in sand.			
					3,500	29° 45' 36"					

* Mean of all at both trials; in many instances anomalous.

† Grooved and lubricated.

The first long range tests were made at ranges of up to 1,500 yards on the Springfield Armory test range at Long Meadow, Massachusetts. These tests compared the long distance shooting and penetration performance of the .45 caliber trapdoor Springfield and the .45 caliber Martini-Henry rifles. The Springfield rifle weighed about 9.6 pounds, had a rifle barrel 33 inches long with a bore diameter of .450-inch, three grooves and a right hand twist and groove depth of .005-inch. It fired the then standard Service round consisting of the 405-grain bullet in the rimmed straight case 2.1 inches long with 70 grains of black powder giving a muzzle velocity (MV) of 1,350 feet-per-second(fps). With the same weight of bullet and a charge of 85 grains of powder, the MV was 1,480 fps. The British Army .450-577 Martini-Henry lever-operated, drop-block action was far stronger than the Allin trapdoor breech. The Martini-Henry weighed about 9½ pounds, had a barrel 33 inches long with a right-hand twist, seven groove bore. The bore diameter was .450, and the groove diameter was .463. The .450-577 Martini-Henry cartridge was a muscular creation. It was based upon a sharply necked-down and lengthened .577-inch Snider case, loaded with a 480-grain lead bullet of .445 diameter, backed by 85 grains of black powder for a muzzle velocity of 1,253 fps. The following table gives the angles of elevation for these loads from the actual test firings at 1,000 and 1,500 yards. Accuracy firings of the rifles were made at 300, 500 and 1,000 yards.

Though there is no direct relationship between mean radius and group size figures, a mean radius of 18 to 19 inches would probably translate into a group size of between 55 and 70 inches. Old Ordnance records show that when fired from a machine rest the .45 Springfield was expected to group all of its bullets inside a 4-inch circle at 100 yards, in a 11-inch bull's-eye at 300 yards, and inside a 27-inch circle at 500 yards. At 1,000 and 1,500 yards, as expected, the mean vertical figures are considerably larger than the mean horizontal. (See the above table.) This is the result of variations in muzzle velocity, which gives this dispersion at long range, and also the effect of the high trajectory of these rifle bullets since the target is perpendicular to the ground, while the bullet is descending at an angle.

The report of October 15, 1879, covers long range firing at Sandy Hook, New Jersey. This was done along the beach to make the location of the bullet strike easier to find. Also, the long beaches allowed shooting back to 3,200 and even 3,500 yards.

The rifles tested included a special "long range" Springfield chambered for a 2.4-inch shell instead of the standard 2.1-inch case. The 2.4-inch case held 80 grains of black powder behind the new prototype 500-grain lead bullet. The other loads tested were the standard .45-70-405 Army load in the issue M-1873 Springfield, and the .45-85-480 load in the British Martini-Henry rifle.

The report states that a leaf to the rear sight several inches long was prepared in order to obtain the necessary elevation. A combination of the V-notch slide of the regular issue sight and a screw at the bottom of the leaf afforded means of correcting for wind and drift.

The target, which had been 12 feet by 12 feet square at 1,500 yards, was changed to one 44 feet long by 22 feet high. The extended wings had a height of 16 feet. Since one of the test's objectives was to gauge bullet penetration, the huge target consisted of three 1-inch thick boards, separated by 1-inch cleats. The target was supported on 6-inch spruce posts and was constructed partly of spruce and partly pine, since this was the wood at hand. In the tests at 2,500 yards, the target was hit five times in seventy rounds with the .45-70-405 service load, only once with the Martini-Henry in eighty rounds, and four times with the long range Springfield in thirty shots. When the Springfield long range cartridge was fired, the 500-grain blunt nosed lead bullets propelled by 80 grains of black powder in the 2.4-inch cases at about 1,375 fps penetrated right through the three inches of wooden target and buried themselves in the sand. One 500-grain slug pierced three inches of target and buried itself in a supporting six-inch post, giving a total penetration of a measured 5.25 inches. The Service 405-grain bullet gave a penetration of just 1.12 inches, and the Martini-Henry 480-grain bullet, 2.50 inches.

Angles of rifle elevation were: Springfield service .45-70-405 - $17^{\circ}08'16''$; Springfield long range .45-80-500 - $10^{\circ}38'21''$; and Martini-Henry .45-85-480 - $13^{\circ}20'18''$. The angle made by the shot holes with the face of the target appeared to be about 40 degrees for the service Springfield, 45 degrees for the Martini-Henry, and 50 degrees for the long range Springfield. This angle is taken from the vertical and thus the lower angular reading indicates the higher angle of descent. Various kinds of bullets were dug out of the sand

within 45 feet of the target and directly behind it. This shows the great angle of trajectory at this range and how extremely difficult it was for Mr. R.T. Hare to hit a 2,500-yard target the size of the one used. The target 22 feet high by 44 feet long was then placed at 3,200 yards from the firer. The range chosen was fortunate in that it was found to be the extreme for the Martini-Henry. When the firer was instructed to increase his elevation, the range decreased. On decreasing the elevation, the range increased to a certain point. The majority of the Martini .45-85-480 balls fell from 50 to 100 yards short, while the others did not go more than 25 yards beyond. More than 300 Martini-Henry cartridges were fired, but the target was not hit. The long range Springfield's 500-grain bullets hit the target four times - twice where it was one board thick, and twice where it was two boards thick. In each case the heavy blunt nosed lead bullet punched through the wood planks and buried itself several inches into the sand.

At this extreme surveyed range, the angle of fall of the Martini 480-grain lead bullets was about 65 degrees to 70 degrees judging from the holes in the moist sand. Bullets were found in the sand behind the 22-foot-high target at a distance of only 35 feet. It was evident that they struck the sand point on, as the lead noses were always found rough.

In the case of the long range Springfield, the angle of the shot hole with the face of the target was about 30 degrees and the heavy bullet in punching through two one-inch boards actually penetrated a total of 2.5 inches. Those lead slugs that struck in the sand generally penetrated to a depth of 8 to 10 inches, sometimes more.

In this respect the Armory's 500-grain balls surpassed the Martini's 480-grain balls, which did not penetrate more than 6 inches into sand. In trying to get the correct 3,200-yard elevation, the long range bullets were thrown over 300 yards beyond the target. These were then dug out of the beach and all were found to have struck point on.

For the .45-80-500 2.4-inch case Springfield long range rifle at a MV of about 1,375 fps, the angle of elevation was $20^{\circ}51'37''$. For the .45-85-480 Martini-Henry at 1,253 fps MV, the angle of elevation was $26^{\circ}51'$.

The report of November 13, 1879, lists the results of firing tests made at 3,500 yards distance with two long range Springfields. One had a rifle barrel with a 1-in-18 rifling twist, the other .45-80-500 had a 19 5/8-inch twist. Two different loads were used: .45-70-500, and .45-80-500. The Martini-Henry .45-85-480 and the service .45-70-405 Springfields were again tested against a Sharps-Borchardt using the same loads as in the long range M-1873 Allin-Springfields. After firing many rounds, the service Springfield and Martini-Henry rounds failed to reach the target at 3,500 yards.

In these firing experiments, two telephones provided with Blake transmitters were used for timing the bullet's flight. One was placed within a few feet of the rifle, to receive and transmit the sound of the shot. The other Blake unit was nearly two miles downrange in the shelterproof, which was located about 30 feet in front of the right edge of the target. At the instant the sound of the discharge was heard over the telephone, a watch ticking fourth-seconds was started. At the sound of the bullet striking target or sand, it was

stopped. Average time of flight for the .45-70-500-grain load was 21.2 seconds. With the more powerful .45-80-500-grain cartridge the time-of-flight was 20.8 seconds.

For 3,500 yards distance, angles of elevation ran from 27 degrees to 29 degrees. This varied drastically from day to day due to the effects of head and tail winds. The quicker-twist rifles required less elevation than the others at the same range. The greatest distance obtained with the .45-caliber long range, 1-in-18 twist Springfield rifle was 3,680 yards. Angle of elevation didn't exceed 32 degrees on a day when an angle of about 25 degrees placed bullets all around the target at 3,500 yards range.

While these tests may be considered mere oddities today, they proved extremely useful at the time. The fact that the 500-grain bullet penetrated through the three-plank target and eight inches into sand meant that it could kill or wound enemy troops at extreme distances, even if they were partially protected and that was significant military information in a period when it was quite usual for large masses of troops to form up within view of defenders. Although no average infantryman could be expected to equal Mr. Hare's accuracy, a large number of defenders shooting from barricade rests and given the proper sight adjustments for the range could severely harass companies and larger bodies of enemy troops at previously unheard-of ranges. It may have been these tests, and this line of thinking, that caused military theoreticians to employ machine guns for indirect, high trajectory fire in the same manner as artillery during the earlier stages of World War I.

Since the tests showed that the 405-grain service bullet failed to perform as well as the 500-grain, and that the 500-grain bullet showed relatively little difference when propelled by either 70 or 80 grains of black powder, the .45-70-500 load in the service 2.1-inch case was adopted as standard for rifles. Thus those little-remembered Sandy Hook tests of 1879 had a lasting impact on firearms history without them; the gun companies might have recently resurrected the .45-80.