

22 Long Rifle Exterior Ballistics

Ever wonder what the trajectory of a 22 Long Rifle bullet looks like? I often have, especially when trying to sight in a rifle. In this series of articles you'll find "thought experiments" conducted with the help of computer software that, among its many useful features, can predict the path, or trajectory, of a bullet in flight. Covered subjects include bullet drop, wind deflection, and the effect of scope cant.

Exterior Ballistics (this page)

[Wind Drift: Cross Wind](#)

[Wind Drift: Head On Wind](#)

[Scope Cant](#)

This page covers how bullet drop varies with distance, and attempts to shed some light on optimum sight settings. Later I'll look at the effect of wind on bullet drift.

How far above point of aim at 25 yards would you sight in your favorite squirrel rifle to stay within a 1" circle with a dead on hold? What would the drop be at 100 yards with that sighting? How many rounds at the range would it take to come up with answers to these questions?

Take it from me, its far easier to calculate the answers with a modern computer program. I use Jim Ristow's [Gun Controller](#) V2.2.7 to take a look at trajectories for Federal's American Eagle discount load, as well as the premium UltraMatch subsonic cartridge. Here's what I found out.*

Gun Controller requires a ballistic coefficient to perform its calculations, but not one of the half dozen ammunition catalogs I reviewed had published that information. Fortunately, Gun Controller has the capability to determine the ballistic coefficient from range data. Federal's catalog lists velocity data for 25, 50, 75, and 100 yards, making this calculation very easy. Table 1 below shows the trajectory results for the American Eagle bargain load, typical of most dime store 22 ammo that sells for about \$2 a box. I assumed that I was going after a target with a 1" diameter vital zone, and asked Gun Controller to determine the optimum sighting in distance so that I could hold dead on the target and still hit within the 1" circle.



CALIBER: 22 LR High Velocity	INCLINE ANGLE: 0 deg.
MUZZLE VELOCITY: 1260 fps	CROSS WIND: from left 15 mph
BULLET WEIGHT: 40 gr.	TARGETSPEED: from right 10 mph
BALLISTIC COEFFICIENT: .1340	ATMOSPHERE: Keyboard Entry
SIGHT HT.: 1.5 in.	68° F./0 ft./29.42 in. HG/30% R.H.
ZEROED AT: 59 yds.	GENERAL 'G1' DRAG MODEL

Range Yards	Vel. fps	Energy ft. lbs.	Drop in.	Path in.	Defl. in.	(Elev.) MOA	Time Sec.	Lead ft.
0	1260	141	0.00	-1.50	0.00	9.22	.000	0.0
5	1244	137	0.03	-1.04	-0.05	19.95	.012	-0.2
10	1227	134	0.11	-0.65	-0.06	6.17	.024	-0.3
15	1212	130	0.25	-0.30	-0.03	1.94	.036	-0.5
20	1197	127	0.45	-0.02	0.02	0.10	.048	-0.7
25	1182	124	0.71	+0.20	0.04	-0.76	.060	-0.9
30	1168	121	1.04	+0.36	0.09	-1.14	.072	-1.1
35	1155	118	1.43	+0.45	0.18	-1.24	.084	-1.2
40	1142	116	1.88	+0.49	0.32	-1.16	.096	-1.4
45	1130	113	2.40	+0.45	0.49	-0.95	.109	-1.6
50	1118	111	2.98	+0.35	0.71	-0.66	.122	-1.8
55	1107	109	3.64	+0.17	0.96	-0.30	.135	-2.0
60	1096	107	4.37	-0.07	1.26	0.11	.148	-2.2
65	1086	105	5.17	-0.39	1.61	0.57	.161	-2.4
70	1076	103	6.04	-0.78	1.99	1.06	.174	-2.6
75	1066	101	6.99	-1.24	2.43	1.58	.188	-2.8
80	1057	99	8.01	-1.78	2.91	2.13	.201	-3.0
85	1048	98	9.11	-2.40	3.43	2.70	.215	-3.2
90	1039	96	10.29	-3.10	4.01	3.29	.229	-3.4
95	1031	94	11.55	-3.88	4.63	3.90	.244	-3.6
100	1023	93	12.89	-4.74	5.30	4.52	.258	-3.8

FOR A VITAL ZONE OF 1 IN., SET ZERO RANGE TO 59 yds.
 MAXIMUM POINT-BLANK RANGE WILL THEN BE 66 yds.
 TRAJECTORY CROSSES LINE OF SIGHT AT 20 & 59 yds.
 PATH IS 0.5 IN. OVER LINE OF SIGHT AT 40 yds.

Table 1. Trajectory of a typical 22 Long Rifle high velocity cartridge.

From looking at the table, it might surprise you to see the bullet starting off 1.5" below the line of sight, but remember that the scope is 1.5" above the center line of the rifle bore. At about 12 yards, the bullet crosses into the bottom of our 1" circle, and at 25 yards is .2" above the circle center. When the bullet reaches 40 yards it is at the top of the circle, and at about 67 yards the bullet falls out the bottom of the circle. Way out at 100 yards, the bullet is about 4 3/4" low. Figure 1 shows the trajectory.

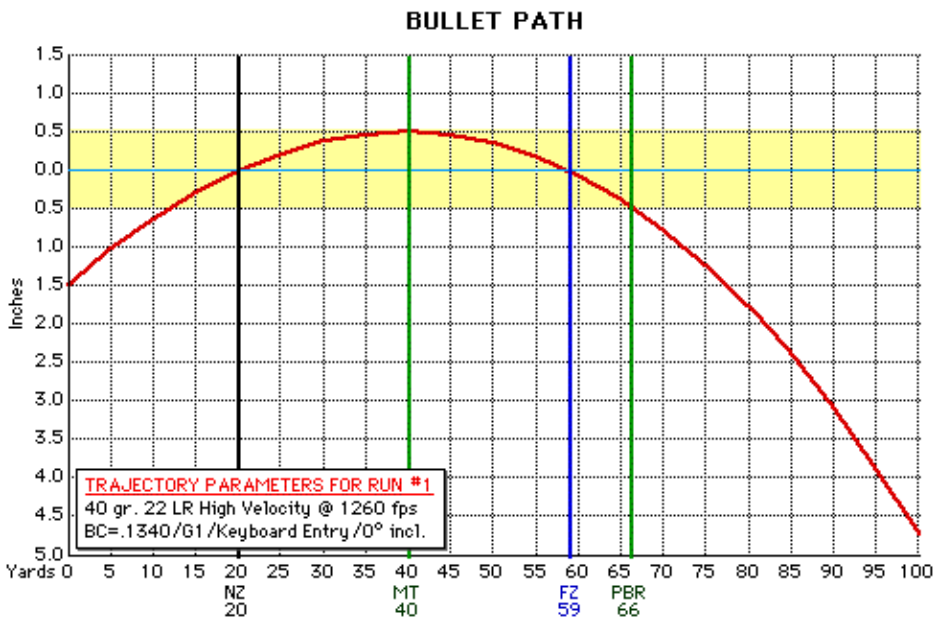


Figure 1. Trajectory plot for 22 Long Rifle high velocity load.

We can do the same thing for Federal's subsonic target load. Match shooters favor this load because the turbulence that accompanies transitioning through the

sound barrier is absent.

CALIBER: 22 LR Subsonic MUZZLE VELOCITY: 1080 fps BULLET WEIGHT: 40 gr. BALLISTIC COEFFICIENT: .1246 SIGHT HT.: 1.5 in. ZEROED AT: 52 yds.				INCLINE ANGLE: 0 deg. CROSS WIND: from left 15 mph TARGET SPEED: from right 10 mph ATMOSPHERE: Keyboard Entry 68° F./0 ft./29.42 in. HG/30% R.H. GENERAL 'G1' DRAG MODEL					
Range Yards	Vel. fps	Energy ft. lbs.	Drop in.	Path in.	Defl. in.	(Elev.) MOA	Time Sec.	Lead ft.	
	0	1080	104	0.00	-1.50	0.00	10.62	.000	0.0
5	1070	102	0.04	-0.98	-0.17	18.74	.013	-0.2	
10	1060	100	0.15	-0.54	-0.31	5.14	.027	-0.4	
15	1051	98	0.34	-0.17	-0.42	1.10	.040	-0.6	
20	1042	96	0.61	+0.11	-0.50	-0.55	.054	-0.8	
25	1033	95	0.96	+0.32	-0.54	-1.23	.067	-1.0	
30	1025	93	1.39	+0.45	-0.55	-1.42	.081	-1.2	
35	1017	92	1.90	+0.49	-0.52	-1.34	.095	-1.4	
40	1009	90	2.50	+0.45	-0.46	-1.07	.109	-1.6	
45	1001	89	3.18	+0.32	-0.37	-0.68	.124	-1.8	
50	994	88	3.95	+0.11	-0.24	-0.21	.138	-2.0	
55	987	86	4.81	-0.19	-0.08	0.33	.152	-2.2	
60	980	85	5.76	-0.58	0.12	0.92	.167	-2.5	
65	973	84	6.79	-1.06	0.36	1.56	.182	-2.7	
70	966	83	7.92	-1.63	0.63	2.23	.197	-2.9	
75	960	82	9.14	-2.30	0.95	2.93	.212	-3.1	
80	954	81	10.46	-3.06	1.30	3.65	.227	-3.3	
85	947	80	11.87	-3.91	1.69	4.39	.243	-3.6	
90	941	79	13.37	-4.86	2.12	5.16	.258	-3.8	
95	936	78	14.98	-5.91	2.59	5.94	.274	-4.0	
100	930	77	16.68	-7.06	3.10	6.74	.290	-4.2	

FOR A VITAL ZONE OF 1 IN. , SET ZERO RANGE TO 52 yds.
 MAXIMUM POINT-BLANK RANGE WILL THEN BE 59 yds.
 TRAJECTORY CROSSES LINE OF SIGHT AT 18 & 52 yds.
 PATH IS 0.5 IN. OVER LINE OF SIGHT AT 35 yds.

Table 2. Trajectory of a 22 Long Rifle subsonic cartridge.

The slightly lower velocity shifts the midpoint trajectory and circle crossing points closer to the muzzle: 35 yards at circle top, about 57 yards at circle bottom, and .32 high at 25 yards. At 100 yards, the load is down more than 7 inches. The 25 yard distance is actually higher than that of the high velocity load in order to compensate for the lower velocity. And the range within which a dead on hold is good goes from 54 yards with the high velocity load to about 49 yards with the target fodder. At 100 yards the high velocity load is down by about 4 3/4", while the target ammo drops 7".

These figures will be close for most rifles (including 10/22 rifles) shooting high velocity and subsonic loads. Federal's velocity data was obtained with a 24" test barrel. Velocity for the 22 Long Rifle peaks with barrel lengths of about 20 inches, and actually drops off with longer or shorter barrels. Test barrels usually have chambers cut to minimum dimensions, which tend to produce slightly higher velocities than those found in sporting or even target arms. These two factors work against each other for Federal's setup, but may not entirely offset each other. The difference between these calculated trajectories and those obtained with your rifle will, however, be fairly small.

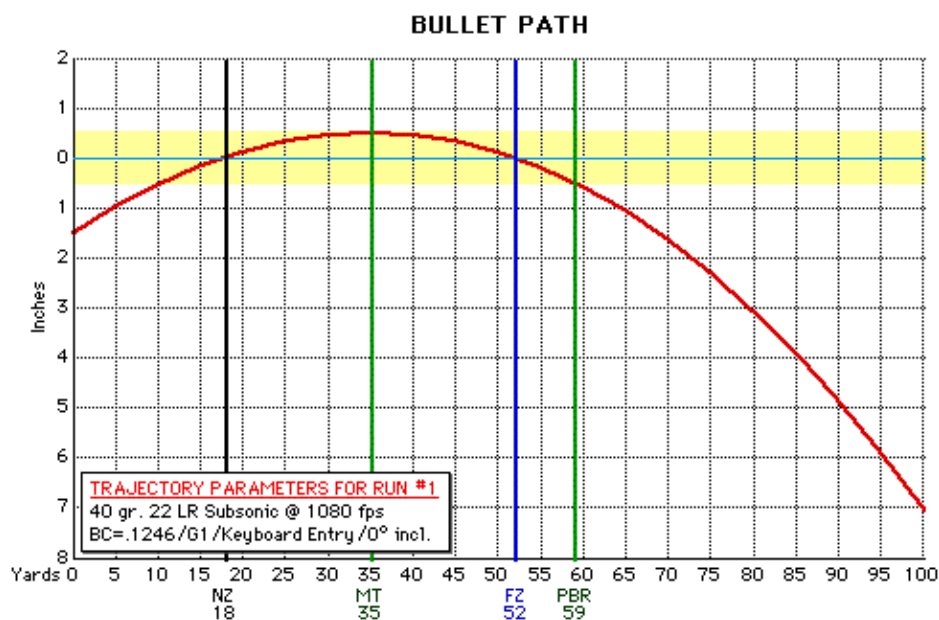


Figure 2. Trajectory plot for 22 Long Rifle subsonic load.

The tables above also contain drift data calculated for a 15 mph wind crossing the bullet path from the left at 90 degrees. The data also shows the lead necessary to hit a target moving from right to left at 10 mph. Since the target is moving into the wind, the bullet path first leads the target, then falls behind it as distance increases. Under these conditions, it takes a lead of almost 4 feet to hit the target at 100 yards. Now that would be some shot!

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