Velocity Decay between Muzzle and Chronograph

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Measuring the average Muzzle Velocity (MV) of your bullets accurately is important when predicting long range trajectories. For example, a 10 fps error in MV modeling can result in 5" or more error in calculated drop at 1000 yards. Long range shooting is difficult enough as it is without inducing unnecessary error.

One challenge of measuring muzzle velocity is that the chronograph doesn't actually measure *muzzle* velocity, it measures the bullets' velocity at some small distance from the muzzle. The velocity lost by the bullet between your muzzle and the chronograph is typically small, but should be accounted for if you . This short paper will help you figure out how much velocity your bullet is losing between the muzzle and chronograph so you can correct your measurement. Here's how to use the plot:

1) Find your G7 BC on the horizontal axis
2) Follow it up till you hit the line that matches most closely to your muzzle velocity
3) Follow that over to the vertical axis to find the fps/foot of velocity decay

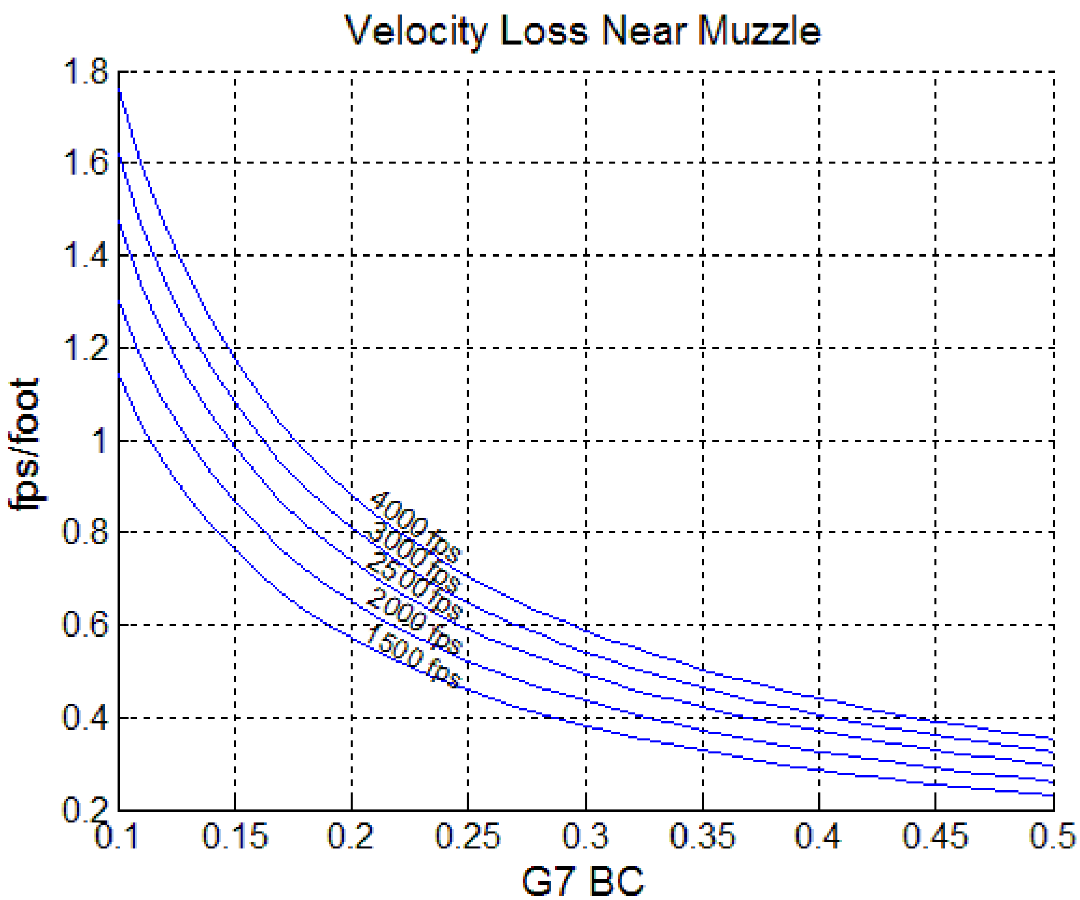

Figure 1. Velocity decay plot

Once you've found the fps/foot number from Figure 1, simply multiply that by the distance from your muzzle to the chronograph (in feet). Here's an example; suppose you're shooting a bullet with a G7 BC of .300 at 2500 fps. According to Figure 1, this bullet loses velocity at a rate of .49 fps/foot. Now suppose your chronograph is set 20 feet in front of the muzzle. The velocity decay in this case would be: .49 fps/foot times 20 feet = 10 fps. So your corrected muzzle velocity would be 2510 fps.

The difference may seem small, but these kinds of errors add up and can put you off target with your long range trajectory predictions.

To further simplify the calculation, you can refer to Table 1 to see what your total velocity decay is for a given decay rate and distance.

		Distance From Muzzle to Chronograph																		
Yards		1			2			3			4			5			6			7
feet		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		Total Velocity Decay																		
Velocity Decay Rate (fps/foot)	1.8	5	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36	38
	1.7	5	7	9	10	12	14	15	17	19	20	22	24	26	27	29	31	32	34	36
	1.6	5	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32	34
	1.5	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	27	29	30	32
	1.4	4	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28	29
	1.3	4	5	7	8	9	10	12	13	14	16	17	18	20	21	22	23	25	26	27
	1.2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24	25
	1.1	3	4	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22	23
	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	0.9	3	4	4	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19
	0.8	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17
	0.7	2	3	4	4	5	6	6	7	8	8	9	10	11	11	12	13	13	14	15
	0.6	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12	13
	0.5	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11
	0.4	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8	8
	0.3	1	1	2	2	2	2	3	3	3	4	4	4	5	5	5	5	6	6	6
	0.2	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4

Table 1. Velocity decay table.

Using the Figure and Table above it's very quick and easy to figure out how much velocity your bullet loses between the muzzle and chronograph.

Atmospheric Correction

For the sake of completeness, we should consider atmospherics. The exact temperature, pressure and humidity have little effect on velocity decay in the short distance between muzzle and chronograph. For this application, it's suitable to consider air density ratios and apply them as multipliers to the BC. The velocity decay shown in Figure 1 is for standard sea level conditions. Technically an air density correction is necessary to account for non-standard conditions. Table 2 shows what air density ratio you can apply to your BC to correct for conditions.

Altitude (feet)	Air Density Ratio
0	1.00
2,500	0.93
5,000	0.86
7,500	0.80
10,000	0.74

Table 2. Air Density Ratio

To use Table 2, divide your BC by the air density ratio for your altitude. For example, if your G7 BC is .300 but you're at 5,000 feet, your effective BC is .300/0.86 = .349. Since you're only looking at velocity decay over a short distance, this correction doesn't have to be exact. Just pick the air density ratio from Table 2 that corresponds closest to your altitude within 2,500 feet and it'll be close enough (meaning within 1 fps).