Manufacturer Exaggerations of Ballistic Coefficients

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Abstract

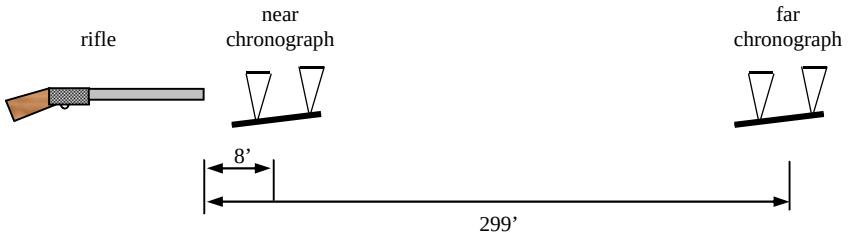
Experimental determinations of ballistic coefficients show that the majority of published ballistic coefficients tested are exaggerated. Exaggerations are found to be as large as 25%.

Introduction

The ballistic coefficient (BC) describes how air resistance slows a projectile in flight. Accurate quantification of this slowing can be important in shooting event reconstructions. Bullet penetration can be used to infer impact velocity, and impact velocity can be used to infer distance between shooter and target if the muzzle velocity and ballistic coefficient are known. Knowing how a projectile slows in flight is also important in determining the time of flight over a given distance. This is important in acoustic reconstructions of shooting events.

The models and equations describing how BC determines velocity loss over flight distance are well known [1]. However, many bullet manufacturers exaggerate their bullet BC specifications for marketing purposes because BC is perceived to be very important by hunters and target shooters. This paper presents the results of careful BC measurements from a number of bullets to demonstrate the need to actually measure the BC if an accurate BC is needed for the forensic reconstruction of an event. Manufacturer published values regarding bullet BC cannot be depended on for accurate forensic investigations.

Method



Two chronographs are used to measure near and far bullet velocities 8 feet and 299 feet from the muzzle. The velocity loss over the separation distance of 291 feet is used along with the relative humidity, air temperature, atmospheric pressure, and altitude to compute the bullet BC using the G1 resistance model [2]. The BC is determined individually for three to six separate shots, and these BC measurements are used to compute the mean measured BC and estimate the measurement uncertainty due to shot-to-shot variations.

Results
The table compares the results of careful BC measurements with the manufacturers' claims.

Manufacturer	Caliber (inches)	Weight (grains)	Style	Published BC	Measured BC	Exaggeration (percent)	Near Velocity (fps)
Hornady	0.224	40	VMAX	0.200	0.199(1)	0.50%	3137
Hornady	0.224	55	SP	0.235	0.218(3)	7.80%	2400
Barnes	0.224	53	XFB	0.231	0.197(10)	17.26%	2874
Nosler	0.308	150	BT	0.435	0.381(7)	14.17%	2570
Hornady	0.308	150	FMJBT	0.398	0.361(23)	10.25%	2656
Winchester	0.308	168	CTBST	0.475	0.421(4)	12.83%	2644
Hornady	0.308	110	VMAX	0.290	0.247(28)	17.41%	3501
Nosler	0.308	125	BT	0.366	0.306(5)	19.61%	2245
Nosler	0.308	125	BT	0.366	0.308(10)	18.83%	2794
Nosler	0.308	125	BT	0.366	0.319(11)	14.73%	3010
Barnes [3]	0.308	150	TSX	0.428	0.349(20)	22.64%	2567
Hornady	0.308	150	RN	0.186	0.163(6)	14.11%	2624
Hornady	0.308	165	SPBT	0.435	0.406(30)	7.14%	2750
Hornady	0.308	220	RN	0.300	0.249(9)	20.48%	2444
Winchester	0.257	85	CTBST	0.329	0.309(9)	6.47%	3449
Berger	0.257	115	VLD	0.523	0.419(4)	24.82%	3148

Numbers in parenthesis represent the estimated uncertainty in the last significant digit(s) of the meaasured BC.

Conclusions
Manufacturers' published values for BC are exaggerated for many bullets, some by nearly 25%. Bullets also exhibit shot-to-shot variations of 1-5% in BC that suggest an inherent accuracy limit in forensic reconstructions. It should be noted that the BC can depend on the muzzle velocity and on the particular firearm in the shooting event. If a forensic investigation needs a BC with less than 5% uncertainty, the BC should be determined with the actual firearm used in the shooting event being investigated.

Footnotes and References:

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[1] McCoy, R.L., Modern Exterior Ballistics: The Launch and Flight Dynamics of Symmetric Projectiles. Schiffer Aviation History, Atglen, PA, 1999.

www.exteriorballistics.com

http://www.recguns.com/Sources/XD5.html

[2] http://www.eskimo.com/~jbm/

[3] Barnes has recently undertaken to more carefully determine ballistic coefficients and have measured the BC of this bullet to be 0.369. www.barnesbullets.com