Comparison of the Latest Berger and Sierra 155 grain .308 Match Bullets to the 155 Scenar – Real World Results

Background

There has been a lot of excitement lately about the release of Berger's new 0.308 caliber 155.5 Fullbore BT and the soon to be released "improved" Sierra 155 Palma (2156) bullet. A lot of discussion has focused on how these bullets compare to each other and to the popular Lapua 155 Scenar, in terms of their ballistic coefficients (BC). Long range shooters like to focus on this number because, all things being equal, a bullet with a higher BC will drop less and will not be affected by wind as much as a bullet with a lower BC. Ballistics guru Bryan Litz has analyzed each of these bullets and determined that their ballistic coefficients should be quite similar.

The BC of a bullet must be used in conjunction with its velocity in order to be of any use. It's possible for a bullet with a lower BC to perform better than a bullet with a higher BC if it is launched at a higher velocity. The maximum velocity of a load is governed by the pressure limits of the cartridge. In addition to weight, bearing surface plays a role in how quickly pressure reaches that limit, and thus, how fast a bullet can be driven. Seating depth also affects pressure since it affects useable case volume. A bullet's nose profile may determines how far out it can be seated before touching the lands. The length of the boat tail can also limit how far the bullet can be seated out while still maintaining enough contact surface between its shank and the inside the case neck.

Although, these bullets have similar weights and BCs, their lengths, nose profiles and bearing surfaces are considerably different. This should, in theory, affect how fast each one can be driven. The question is how much?

Goals

The first goal of this experiment was to determine the maximum muzzle velocity that could be achieved with each bullet in two common seating configurations. The second goal was to compare the trajectories of these bullets out to 1000 yards when launched at roughly the same velocity, from my rifle, under the same environmental conditions. This data could then be used to derive BCs for each bullet specific to my equipment in order to compare them with other loads that I have developed.

Test Equipment

- -Custom G. A. Precision Remington M700 rifle
    - 26.15", 1-11" Twist Schneider 5P, outfitted with a strain gage)
    - US Optics SN-3 TPAL with 0.1 mil click turrets, mounted 1.95" above the center of the bore.
- -RSI Pressure Trace system
- -IR equipped CED Millennium chronograph.
- -Digital caliper
- -Hornady Lock-n-Load OAL gage
- -Hornady Lock-n-Load Bullet Comparator
- -pocket SharpShooter's Friend ballistics calculator (Palm Freeware)
- -JBM online ballistics calculator
- -OnTarget target analysis program

Components

- Berger 155.5 gr. Fullbore BT Thick
- Lapua 155 Scenar
- Sierra 155 Palma Matchking 2156 (handpicked factory seconds)
- Lapua 308 Win. Cases
- Hodgdon Varget smokeless powder
- Federal 210M primers

Since the new Sierra Palma bullet is not available yet, factory seconds were obtained for this test. These were sorted, with visibly damaged ones being used to work up loads and only the best ones being used to test 1000 yards drops. There was still quite a bit of variation in these, which should be taken into account when examining the results. I do believe that this test still provides a good indication of attainable velocities and of the bullet's ballistic performance.

Preparation

The first step of the experiment was to measure critical parameters for each bullet. These parameters were used to simulate each load in Quickload in order to get an idea of what velocities and pressures I should be seeing.

Bullet Parameters					
Bullet	**Bullet Comparator Reading**	**OAL (approx.)**	**Boat Tail Length**	**Boat Tail Angle**	**Avg. Weight (gr.)**
Berger 155.5 FBBT	0.552"	1.250"	0.150"	8.9 deg.	155.5
Lapua 155 Scenar	0.658"	1.285"	0.200"	7.2 deg.	154.5
Sierra 155 Palma 2156	0.545"	1.220"	0.180"	9.0 deg.	155.2

The OAL gauge was used to determine the distance to the lands for each bullet.

COAL – Touching the Lands		
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**
Berger 155.5 FBBT	2.254"	2.955"
Lapua 155 Scenar	2.176"	2.805"
Sierra 155 Palma 2156	2.234"	2.915"

Working up the loads

Two common seating depths were evaluated for each bullet. The first was with the bullets loaded a fixed distance from the lands, with no consideration for the cartridge overall length (COAL) or the ability to feed from a magazine. A value of 0.020" was chosen. This required the Berger and Sierra rounds to be single loaded, because they were too long for an AICS magazine, which limits COAL to about 2.850".

Loaded 0.020" from Lands				
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**	**Shank Seating Depth**	**Base Seating Depth**
Berger 155.5 FBBT	2.235"	2.935"	0.170"	0.320"
Lapua 155 Scenar	2.156"	2.785"	0.305"	0.505"
Sierra 155 Palma 2156	2.214"	2.895"	0.150"	0.330"

I don't think I would load the Berger or Sierra bullets out any longer since there is already not a lot of the shank being seated into the neck.

The second seating depth was chose with tactical shooting in mind. The Lapua rounds were loaded to 2.820". This is a common COAL value for this bullet in a GAP rifle and the one G. A. Precision recommended for their chamber. This puts the bullets 0.015" into the lands in my rifle. The Berger and Sierra rounds were loaded to a COAL of 2.850" to allow them to be fed from an AICS magazine. Both the Berger and Sierra were loaded shorter, whereas, this made the Lapua longer than with the 0.020" jump.

Loaded to Magazine/Tactical Length					
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**	**Relation to Lands**	**Shank Seating Depth**	**Base Seating Depth**
Berger 155.5 FBBT	2.149"	2.850"	0.105" (off)	0.255"	0.405"
Lapua 155 Scenar	2.191"	2.820"	0.015" (into)	0.270"	0.470"
Sierra 155 Palma 2156	2.169"	2.850"	0.065" (off)	0.195"	0.375"

In both cases, the base of the Lapua was below the bottom of the neck and into the shoulder area, whereas the bases of the Berger and Sierra were still inside the neck. This ended up making a big difference in case capacity. It was also noticeably more difficult to seat the Lapua rounds even with the same fill ratio since part of the case volume was around the sides of the bullet and not only underneath it as was the case with the Berger and Sierra bullets. Powder granules tend not to flow around the bullet as its being pushed down into them.

I reviewed a few manuals and ran some Quickload simulations to get an idea of where to start each load and the expected maximums. I then went to the range and started loading up rounds and testing them with the Pressure Trace system.

The Pressure Trace system allows you to find the top of a load very quickly. I usually load single rounds in 1 grain increments until I start getting close to maximum pressure. This only takes half a dozen rounds, or so. Then a few 3 or 5 round groups are fired to zero in on the maximum. Less than a dozen more rounds total usually gets me there. With slower burning powders, I'm sometimes forced to quit before maximum pressure is found because no more powder can be crammed into the case. A 112% fill ratio is a VERY compressed load and about where I start seeing inconsistent seating depths even when the powder is trickled very slowly down a long drop tube. I like to stop at around 60k psi with temperature stable powders and 58k psi with less stable powders unless case volume limits me from reaching those pressures.

The downfall of this load development method is that detailed velocity and pressure data are only produced for maximum loads, or loads close to maximum. I've discovered that Quickload can be off by a good margin in some cases because the relationship of the bullet to the lands can have a pretty large effect on pressure and velocity. This is difficult to predict without actually firing some rounds, gathering data and calibrating Quickload accordingly.

Warning!!! Your rifle is not the same as my rifle, so don't assume pressure to be the same. Always follow the recipes in your loading manual and DO NOT EXCEED MAXIMUM CHARGES.

These are the velocities I worked up to, with their corresponding pressures and case fill ratios:

Velocities - Fixed Length from Lands						
Bullet	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Fill Ratio**	**Avg. Pressure (psi)**	**Avg. Velocity (fps)**
Berger 155.5 FBBT	2.935"	0.020" (off)	48.9	109.8%	59483	3044
Lapua 155 Scenar	2.785"	0.020" (off)	46.5	112.1%	56296	2958
Sierra 155 Palma 2156	2.895"	0.020" (off)	48.9	109.9%	59724	3065
Ammo Temperature:	46 F					

Velocities - Loaded to Magazine Length						
Bullet	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Fill Ratio**	**Avg. Pressure (psi)**	**Avg. Velocity (fps)**
Berger 155.5 FBBT	2.850"	0.105" (off)	48.0	111.3%	56866	2994
Lapua 155 Scenar	2.820"	0.015" (into)	47.0	111.8%	57913	2992
Sierra 155 Palma 2156	2.850"	0.065" (off)	48.0	109.7%	57885	3009
Ammo Temperature:	46 F					

The Berger and Sierra loads were stopped at the same charge weight for comparison reasons. For both seating depths, it felt like the Sierra loads could take a little more powder than the Berger loads. The Berger loads felt like the powder was at the maximum amount of compression I like to see. The Lapua loads felt over-compressed. You get a really good feel for the amount of compression with the Lee hand press I use for working up loads at the range.

1000 yard testing

Magazine length loads were chosen for the 1000 yard test since that is how I plan to load these bullets. I attempted to normalize the velocities to 2950 fps for all three loads, in order to do a better comparison. This is also a common velocity people like to fire the Scenars at. Unfortunately, my estimates were a bit off with the Sierra load and it ended up being a little faster than the other two.

Weather conditions were not the best for load testing, but they were good enough. There was some very light snow. Wind was light and I estimated it to be 4MPH, coming at me from the left at roughly a 45 degree angle. It was fairly consistent, but occasionally died down and appeared to change directions on a couple occasions. I wasn't about to wait until sprint to complete my testing, so I proceeded with it anyway.

Weather Conditions	
Temperature:	18F
Pressure:	29.9 inHg
RH:	52%
Wind:	4 MPH / 45 deg.

I started off by firing 6 rounds of each load at 100 yards, in order to determine precise velocities and zeros of each load (after a few foulers, of course).

Velocities - Loaded to Magazine Length							
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Avg. Velocity (fps)**	**SD**	**ES**
Berger 155.5 FBBT	2.149"	2.850"	0.105" (off)	46.8	2942	13	30
Lapua 155 Scenar	2.191"	2.820"	0.015" (into)	46.3	2945	21	45
Sierra 155 Palma 2156	2.169"	2.850"	0.065" (off)	46,6	2975	25	67

I then proceeded to work my way out to 1000 yards on the steel gongs. I shot a 5 round group with each load at 300 yards, just for comparison.

300 Yard Groups (5 shot)		
Bullet	**Size (")**	**Size (MOA)**
Berger 155.5 FBBT	1.872	0.596
Lapua 155 Scenar	2.216	0.706
Sierra 155 Palma 2156	2.346	0.747

The purpose of the test wasn't to evaluate accuracy or group size. That wouldn't be a fair comparison given that the Sierra bullets were factory seconds, COAL lengths were chosen arbitrarily and no work at all done to shrink group size with any of these loads. But, I thought it would be interesting to see how they grouped anyway.

Once I got on the 1000 yard gong with each load, I noted the scope settings. I then proceeded to fire three sets of 5 shot groups using a round robin sequence of firing for each set. I did this to try and eliminate any bias from wind and fouling. Between each set, I inspected the targets and marked the holes for that set. The first and second sets were fired with more than seventy rounds already down the tube without cleaning. The third set of 5 round groups was fired after cleaning and fouling the barrel again. The same individual scope settings were used for each load throughout the test. No attempts were made to compensate for changes in wind or any other condition.

The targets were then retrieved and analyzed using OnTarget. This program does a pretty good job of finding the center of the group, while filtering any flyers. Group center offsets, relative to the point of aim, were subtracted out of the scope settings in order to determine net bullet drops and horizontal drift due to wind. The individual groups were analyzed, in addition to all fifteen shots of each load.

Berger	100 Yard Zero		1000 Yard Settings		Come-ups			
	V (mil)	H (mil)	V (mil)	H (mil)	V (mil)	H (mil)	V (")	H (")
	-0.1	0.2	9.50	1.00	9.60	0.80	345.6	28.8
	Location from Center		Groups Size		Path (deviation from 100 yard zero)			
Group	V (")	H (")	(")	(MOA)	V (")	H (")	V (mil)	H (mil)
1	9.40	3.74	20.53	1.96	-336.2	25.1	9.3	0.7
2	10.28	8.13	10.74	1.03	-335.3	20.7	9.3	0.6
3	8.67	1.11	11.17	1.07	-336.9	27.7	9.4	0.8
All	**9.40**	**4.33**	**21.56**	**2.06**	**-336.2**	**24.5**	**9.3**	**0.7**

Lapua	100 Yard Zero		1000 Yard Settings		Net Come-ups			
	V (mil)	H (mil)	V (mil)	H (mil)	V (mil)	H (mil)	V (")	H (")
	-0.2	0.2	9.50	1.00	9.70	0.80	349.2	28.8
	Location from Center		Groups Size		Path (deviation from 100 yard zero)			
Group	V (")	H (")	(")	(MOA)	V (")	H (")	V (mil)	H (mil)
1	8.26	5.50	15.92	1.52	-340.9	23.3	9.5	0.6
2	6.83	7.66	19.08	1.82	-342.4	21.1	9.5	0.6
3	5.50	5.97	22.25	2.13	-343.7	22.8	9.5	0.6
All	**6.56**	**6.93**	**27.53**	**2.63**	**-342.6**	**21.9**	**9.5**	**0.6**

Sierra	100 Yard Zero		1000 Yard Settings		Net Come-ups			
	V (mil)	H (mil)	V (mil)	H (mil)	V (mil)	H (mil)	V (")	H (")
	-0.2	0.3	9.10	1.00	9.30	0.70	334.8	25.2
	Location from Center		Groups Size		Path (deviation from 100 yard zero)			
Group	V (")	H (")	(")	(MOA)	V (")	H (")	V (mil)	H (mil)
1	-3.42	5.05	28.81	2.75	-338.2	20.2	9.4	0.6
2	-3.37	4.80	23.29	2.23	-338.2	20.4	9.4	0.6
3	-2.98	0.82	18.54	1.77	-337.8	24.4	9.4	0.7
All	**-3.26**	**3.57**	**29.50**	**2.82**	**-338.1**	**21.6**	**9.4**	**0.6**

BCs were then estimated based on the fifteen shot group centers using a trial-and-error method to find a BC that matched the drops. I did this with the online JBM ballistic calculator as well as the "pocket Sharpshooter's Friend" (pSSF) software I run on my Palm Pilot.

Derived BC					
Bullet	MV (fps)	Path (")	BC (pSSF)	BC (JBM)	Bryan Litz BC
Berger 155.5 FBBT	2942	-336.2	0.486	0.471	0.464
Lapua 155 Scenar	2945	-342.6	0.473	0.461	0.459
Sierra 155 MK 2156	2975	-338.1	0.466	0.454	0.449

The difference in the values derived from each calculator illustrates a point: deriving a BC value in this way is dependent on the ballistics calculator being used (among other things). Keep this in mind when someone gives you their derived BC value for a bullet. The differences can even be greater since their come-ups were determined using a different scope that has different errors than yours and is mounted at a different height. That person's velocities were likely also measured on different chronograph than you are using, which introduces further errors. This is

why BC numbers must be determined for your actual load, rifle, scope, and the ballistics calculator you use. I don't claim that my BCs are true BCs (Bryan's are true BCs), but rather numbers that are specific to my equipment and the ballistic calculators I'm using.

Using the data

Now that I have some BC numbers that have been validated in my equipment and ballistics calculators, I can compare these bullets using the velocities I was able to achieve while working up the loads.

Estimated Trajectories - Fixed 0.020" from Lands, Max. Loads							
Bullet	**COAL**	**Powder Charge**	**Fill Ratio**	**Avg. Pressure**	**Avg. Velocity**	**Drop (")**	**Windage (" - 10 MPH)**
Berger 155.5 FBBT	2.935"	48.90	109.8%	59483	3044	-293.6	87.9
Lapua 155 Scenar	2.785"	46.50	112.1%	56296	2958	-320.1	94.6
Sierra 155 MK 2156	2.895"	48.90	109.9%	59724	3065	-297.4	91.7

** JBM, Std. Conditions*

Calculated Trajectories - Loaded to Magazine Length, Max. Loads							
Bullet	**COAL**	**Powder Charge**	**Fill Ratio**	**Avg. Pressure**	**Avg. Velocity**	**Drop (")**	**Windage (" - 10 MPH)**
Berger 155.5 FBBT	2.850"	48.0	111.3%	56866	2994	-301.9	89.5
Lapua 155 Scenar	2.820"	47.0	111.8%	57913	2992	-311.4	93.0
Sierra 155 MK 2156	2.850"	48.0	109.7%	57885	3009	-311.0	94.3

** JBM, Std. Conditions*

The Berger and Sierra bullets have a slight advantage over the Scenars, in terms of achievable velocity when loaded long in my chamber. That would not be the case for those who have long factory throats where the Lapua can be seated out further All three bullets pretty much give the same velocity when loaded to magazine length. However, the Sierra load can still be stoked up a bit more and the Lapua could be pushed out a bit more if my throat was longer. In this case, I believe both would be identical to the Berger in terms of ballistics. The choice of 155 grain bullet will come down to other factors like accuracy, consistency, cost and availability.

Conclusion

In the end, each bullet's performance is nearly identical when they are loaded to their distinct maximum velocities. I learned a lot and have fun going thought the exercise. Hopefully other will find some of this data useful. I look forward to comparing other bullets in a similar manner.

Special Thanks

Special thanks to jhuggans on “the Hide” for getting me factory seconds of the new Palma bullets before they were released and to Bryan Litz and Berger for providing me with samples of their bullets for this test.