Comparison of 210 grain .308 Bullets in 308 Win. with Reloader 17 Powder

Background

There has been a lot of excitement lately about the new Alliant Reloader 17 powder. It has been shown to give dramatic increases in velocity in many calibers. Some have tried it in 308 Winchester with standard 155-175 gr. bullets. However, they have not seen any appreciable gains in velocity. This powder is relatively slow for this weight of bullet in the 308. Not enough powder can be crammed into the case to realize the powder's full potential. It is a better match to heavier bullets.

The 208 gr. AMAX has been popular among many shooters on the Sniper's Hide forum, who have successfully pushed it in 308 Win. chambered rifles to over 2500 fps. with Vihtavuori N550 powder. I decided to try RL-17 with heavy 208-210 gr. bullets in my GAP rifle to see that this powder was capable of with these heavy bullets. I obtained three other bullets. I chose the 210 gr. Berger Match BT, the 210 gr. Berger VLD and the 210 gr. Sierra Matchking. There were other options also, but these are readily available from numerous distributors and the manufacturers were kind enough to sample some to me for this experiment.

Many would consider this weight of bullet to be far too heavy for the 308 Winchester. However, I believe that with advances in technology, we must continue to push the limits and challenge our pre-conceived notions of what is possible.

Goals

The first goal of this experiment was to determine the maximum muzzle velocity that could be achieved with each bullet using Reloader 17. The second goal was to compare the muzzle velocities obtainable with Reloader 17 and N550 using the popular 208 gr. AMAX bullet. The third goal was to determine the ballistic coefficients of each bullet from drops, when fired out to 1000 yards at similar velocities and under the same environmental conditions.

Test Equipment

- Custom G. A. Precision Remington M700 rifle
    - 26", 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.
- Kestrel 4500NV Weather Meter
- Digital caliper
- Hornady Lock-n-Load OAL gage
- Hornady Lock-n-Load Bullet Comparator
- JBM online ballistics calculator
- OnTarget target analysis program

Components

- Berger 210 BT
- Berger 210 VLD
- Sierra 210 Matchking
- Hornady 308 Win. Match Cases
- Hodgdon Varget smokeless powder
- Federal 210M primers

Hornady cases were chosen due to its high internal capacity. It has the highest internal capacity of any 308 Win. case I have seen, slightly more than Winchester cases. Higher case volume translates to higher achievable velocities when loaded to the same pressure.

Preparation

The first step of the experiment was to measure critical parameters of 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 210 BT	0.776”	1.473”	0.180”	8.9 deg.	210.0
Berger 210 VLD	0.806”	1.475”	0.180”	8.9 deg.	210.0
Hornady 208 AMAX	0.802”	1.532”	0.200”	8.3 deg.	208.2
Sierra 210 Matchking	0.808”	1.492”	0.200”	7.3 deg.	210.2

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 210 BT	2.277”	2.974”
Berger 210 VLD	2.219”	2.888”
Hornady 208 AMAX	2.217”	2.947”
Sierra 210 Matchking	2.197”	2.881”

Working up the loads

Bullets were seated to 0.020” from the lands. This is the value I generally choose when I start a load (when possible). There was no consideration given for the ability to feed from a magazine, as it is just not practical with some of these bullets without modifying the magazines.

Loaded 0.020" from Lands				
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**	**Shank Seating Depth**	**Base Seating Depth**
Berger 210 BT	2.257”	2.954”	0.704”	0.524”
Berger 210 VLD	2.199”	2.868”	0.792”	0.612”
Hornady 208 AMAX	2.197”	2.927”	0.810”	0.610”
Sierra 210 Matchking	2.177”	2.861”	0.836”	0.636”

In all cases, the base of the bullet was well below the bottom of the neck and into the shoulder area. These are very long bullets and my short-throated Palma chamber was perhaps not the ideal candidate for this experiment. I worried that this would limits me from reaching peak pressure as powder granules tend not to flow around the bullet as its being pushed down into them. However, that turned out not to be an issue.

I ran some Quickload simulations to get an idea of where to start each load. Then I went to the range and started loading up rounds and testing them with my RSI Pressure Trace system. I

progressed by firing three rounds in 0.5 gr. increments until each load reached a pressure of around 58k psi.

Warning!!! Your rifle is not the same as my rifle, so don't assume pressures to be the same. I have the ability to monitor my chamber pressure, a luxury that most don't have. All of this testing was done on a cool 60F spring day and no margin whatsoever was given for pressure increase with temperature rise. Pressures could easily increase to catastrophic levels in the heat of summer.

These are the velocities I worked up to along with their corresponding pressures:

Velocities – Reloader 17					
Bullet	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Avg. Pressure (psi)**	**Avg. Velocity (fps)**
Berger 210 BT	2.257"	0.020" (off)	48.5	57661	2589
Berger 210 VLD	2.199"	0.020" (off)	47.5	57888	2594
Hornady 208 AMAX	2.197"	0.020" (off)	47.5	57880	2611
Sierra 210 Matchking	2.177"	0.020" (off)	48.5	58936	2635
Ammo Temperature:	60 F				

Next, I tried N550 to see if could produce the same velocity as RL-17 with the 208 AMAX. I pushed pressure to nearly 60k psi to no avail.

Velocities – N550					
Bullet	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Avg. Pressure (psi)**	**Avg. Velocity (fps)**
Hornady 208 AMAX	2.197"	0.020" (off)	45.5	59570	2543
Ammo Temperature:	60 F				

Velocity and pressure data was plotted in MS Excel. In the charge range the loads where developed in, all of the data was very linear. In both the "Velocity vs. Charge Weight" and "Pressure vs. Charge Weight", the lowest R^2 value was 0.983. Most were better than 0.99 (very linear). To the layperson, this means that the relationship is proportional (i.e. a fixed increase in powder gives a fixed increase in pressure and velocity). From the trend line equations, the following velocities would be produced at 58k psi:

Velocities – Reloader 17 (58k psi)			
Bullet	**Pressure (psi)**	**Powder Charge (gr.)**	**Velocity (fps)**
Berger 210 BT	58000	47.6	2627
Berger 210 VLD	58000	47.3	2596
Hornady 208 AMAX	58000	47.5	2626
Sierra 210 Matchking	58000	48.2	2619

Velocities – N550 (58k psi)			
Bullet	**Pressure (psi)**	**Powder Charge (gr.)**	**Velocity (fps)**
Hornady 208 AMAX	58000	45.1	2525

RL-17 does indeed have a velocity advantage over N550, which itself has an advantage over Varget and RL-15 with these heavy bullets.

1000 yard testing

Only RL-17 was used for my long range testing. I had noticed during load development that all four bullets seemed to group well in the 2540-2580 fps. range (all under 0.75 MOA), so I decided to load all four to 2560 fps. I had a limited number of bullets to complete the testing with, so the charge weights were selected based on calculated values from the charts derived earlier. Since they were not tested beforehand, the velocities did not all hit that target as accurately as I had hoped.

This testing was performed in the spring and the weather did not want to cooperate. I began testing twice, only to quite because the wind was strong and changing too often. This caused many of the rounds to miss my targets completely when I attempted to print my 1000-yard groups. On my third attempt, the wind was still rather strong, but consistent enough to get good results. I measured it at several locations along the range and took an average. I also took several environmental readings.

Weather Conditions	
Temperature:	60F
Pressure:	29.6 inHg
RH:	45%
Wind:	8 MPH / 225 deg.

Velocities - Loaded to Magazine Length					
Bullet	**Bullet Comparator Reading**	**COAL (approx.)**	**Relation to Lands**	**Powder Charge (gr.)**	**Avg. Velocity (fps)**
Berger 210 BT	2.257”	2.954”	0.020" (off)	48.5	2579
Berger 210 VLD	2.199”	2.868”	0.020" (off)	47.5	2532
Hornady 208 AMAX	2.197”	2.927”	0.020" (off)	47.5	2549
Sierra 210 Matchking	2.177”	2.861”	0.020" (off)	48.5	2560

I started off by firing 5 rounds of each load at 100 yards, in order to determine precise velocities and zeros for each load (after a few foulers, of course). I then proceeded to work my way out to 1000 yards on the steel gongs.

Once I got on the 1000-yard gong with each load, I noted the scope settings. I then proceeded to fire two 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 sets, I inspected the targets and marked the holes for the first set. 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 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. Both groups were analyzed individually as well as together as a single group. The data for the combined groups were used to determine the BC.

Berger	**100 Yard Zero**		**1000 Yard Settings**		**Come-ups**			
210 BT	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (")**	**H (")**
	0.5	0.1	10.80	1.20	10.30	1.1	370.8	39.6
	Location from Center		**Groups Size**		**Path (deviation from 100 yard zero)**			
Group	**V (")**	**H (")**	**(")**	**(MOA)**	**V (")**	**H (")**	**V (mil)**	**H (mil)**
1	10.73	0.51	12.29	1.17	-360.1	39.1	-10.0	1.1
2	17.02	-5.52	13.42	1.28	-353.8	45.1	-9.8	1.3
All	**14.25**	**-2.79**	**19.68**	**1.88**	**-356.5**	**42.4**	**-9.9**	**1.2**

Berger	**100 Yard Zero**		**1000 Yard Settings**		**Net Come-ups**			
210	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (")**	**H (")**
VLD	0.5	0.1	10.8	1.20	10.30	1.10	370.8	39.6
	Location from Center		**Groups Size**		**Path (deviation from 100 yard zero)**			
Group	**V (")**	**H (")**	**(")**	**(MOA)**	**V (")**	**H (")**	**V (mil)**	**H (mil)**
1	-6.23	5.44	20.07	1.92	-377.0	34.2	-10.5	0.9
2	-2.11	-5.85	8.63	0.82	-372.9	45.4	-10.4	1.3
All	**-4.17**	**-0.19**	**28.13**	**2.69**	**-375.0**	**39.8**	**-10.4**	**1.1**

Hornady	**100 Yard Zero**		**1000 Yard Settings**		**Net Come-ups**			
208	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (")**	**H (")**
AMAX	0.5	0.1	10.8	1.20	10.30	1.10	370.8	39.6
	Location from Center		**Groups Size**		**Path (deviation from 100 yard zero)**			
Group	**V (")**	**H (")**	**(")**	**(MOA)**	**V (")**	**H (")**	**V (mil)**	**H (mil)**
1	3.26	5.37	12.52	1.20	-367.5	34.2	-10.2	1.0
2	9.22	-5.01	10.21	0.98	-361.6	44.6	-10.0	1.2
All	**5.88**	**0.75**	**19.87**	**1.90**	**-364.9**	**38.8**	**-10.1**	**1.1**

Sierra	**100 Yard Zero**		**1000 Yard Settings**		**Net Come-ups**			
210	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (mil)**	**H (mil)**	**V (")**	**H (")**
	0.5	0.1	10.8	1.20	10.30	1.10	370.8	39.6
	Location from Center		**Groups Size**		**Path (deviation from 100 yard zero)**			
Group	**V (")**	**H (")**	**(")**	**(MOA)**	**V (")**	**H (")**	**V (mil)**	**H (mil)**
1	4.39	5.19	15.80	1.51	-366.4	34.4	-10.2	1.0
2	11.47	-0.74	14.08	1.35	-359.3	40.3	-10.0	1.1
All	**7.05**	**2.95**	**24.32**	**2.32**	**-363.8**	**36.7**	**-10.1**	**1.0**

Group size is not indicative of the accuracy potential of these bullets. Accuracy was not the intent of the test and minimal load workup was done.

BCs were estimated based on the ten shot group centers using a trial-and-error method to find a BC that matched the drops using the online JBM ballistic calculator.

Derived BC					Bryan Litz BC	
Bullet	MV (fps)	Path (“)	G1 BC (JBM)	G7 BC (JBM)	G1	G7
Berger 210 BT	2579	-356.5	0.631	0.318	0.626	0.323
Berger 210 VLD	2532	-375.0	0.622	0.315	0.631	0.320
Hornady 208 AMAX	2549	-364.9	0.635	0.321	0.633	0.324
Sierra 210 Matchking	2560	-363.8	0.627	0.317	0.619	0.316

I ended up with values very close to Bryan Litz’s numbers. The one notable exception was the Berger VLD, which was quite a bit lower than his. The samples I was given had very large metplats compared to the other Berger bullets. Bryan confirmed that this was not the norm and probably accounted for the difference.

None of these bullet showed any signs of key holing when fired from my 1-11” twist barrel, which was also not the most deal test platform. A 1-10” twist barrel would be better suited. Using the Miller stability formula, and compensating for velocity and environmental conditions, I found that this twist rate would stabilize them down to 0F when fired at 2600 fps. A 1-9” twist barrel would stabilize them in the worst of conditions.

Using the data

Using the BCs and velocities I obtained, it’s possible to compare these loads to other loads.

Trajectories - RL-17 @ 58,000 PSI			
Bullet	Muzzle Velocity	1k Drop (")	1k Windage (" - 10 MPH)
Berger 210 BT	2627	-343.1	74.4
Berger 210 VLD	2596	-354.8	76.8
Hornady 208 AMAX	2626	-341.6	73.5
Sierra 210 Matchking	2619	-346.2	75.1

**** JBM, Std. Conditions***

Trajectories – Hot 308 Win. loads with lighter bullets			
Bullet	Muzzle Velocity	1k Drop (")	1k Windage (" - 10 MPH)
Lapua 155 Scenar	3000	-305.4	91.3
Sierra 175 Matchking	2800	-354.2	98.4
Berger 175 VLD	2800	-340.9	91.5

**** JBM, Std. Conditions***

Trajectories – Common 260 Rem. loads			
Bullet	**Muzzle Velocity**	**1k Drop (")**	**1k Windage (" - 10 MPH)**
Lapua 139 Scenar	2850	-302.0	75.7
Berger 130 VLD	2950	-279.7	72.5

**** JBM, Std. Conditions***

When loaded to peak velocities with RL-17, all of these heavy bullets best lighter offerings in the wind. They are in fact, on part with a 260 Rem., but loose out in drop.

Although, they would not be my choice for situations where I was going head-to-head with other calibers, they do offer a considerable advantage over lighter 308 bullets in situations where other calibers are not permitted. This does come at the cost of considerably higher recoil. However, recoil is still nowhere near that of a 300 WM.

Conclusion

Alliant's new Reloader 17 powder does offer new levels of performance in 308 Win. with heavy bullets as peak pressure can be reached without running out of room in the case. A better understanding of the temperature stability of the powder is needed though to ensure that loads are still safe in hotter temperatures. Hopefully, component manufactures will take notice and offer data for these bullets and RL-17 in the next revisions of their manuals.

Special Thanks

Special thanks to Carroll Pilant of Sierra Bullets for providing me samples of the 210 SMK and to jhuggans on "the Hide" for getting me some additional factory seconds. They shot so well in my rifle. Thanks to Bryan Litz and Eric Stecker of Berger for providing me with samples of their bullets for this test. My apologies to all of them; running the test and writing up this report took far more time that it should have.