Accuracy Loads For The 22-250 Ackley Improved

By M.L. McPherson

Left: typical plastic tip; right: Nosler 40-grain BT. Note that the plastic insert occupies considerable volume. The plastic tip has many advantages, among these:

- ***For any given total bullet weight, volume is greater — this allows designers to make the bullet shank longer;***
- ***It can form and maintain a sharper point; and,***
- ***It encourages expansion at lower velocity.***

Synopsis: The test gun is an unusual combination, having a relatively short (24-inch) barrel with a 1:14" twist and it was built as a lightweight "walking varminter" rifle. If it were chambered in 223, this combination might seem more reasonable (at least to me). However, it is chambered in 22-250 Ackley Improved, a chambering that suggests the goal of shots on vermin beyond 500 yards; however, it has a 1:14 twist, which significantly limits long-range bullet choices. Hence, I felt it an interesting project to see if it was feasible to develop loads with bullets that it will stabilize and will produce enough accuracy and retained velocity to allow such shots.

History

Several months ago, I developed basic loading data for dozens of bullets and the best available propellants for use in the 22-250 Ackley Improved. However, what I did not do in that testing was make a serious effort to develop accuracy loads in the tested gun, a custom lightweight with a 24-inch barrel. Here, I used that basic data as a place to begin toward the goal of developing long-range accuracy loads for that gun.

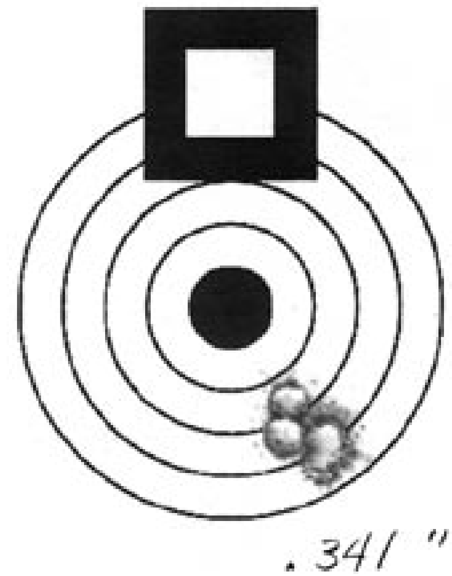
My goal for any varminting combination is a load that will deliver enough accuracy to routinely make hits on vermin to the maximum feasible range. To understand my feelings on the latter, it is necessary to consider external ballistics.

Down-Range Performance

Historically, relatively bigger cartridges needed relatively heavier bullets to deliver the best overall performance. However, availability of plastic-tipped bullets has changed that situation. The reasons are fundamental.

With a conventional bullet, within the "normal" range of weights and with conventional designs, there is not enough material to provide both a long enough shank, for good alignment in the barrel (accuracy potential) and a long enough ogive, for ballistic efficiency. Hence, historically, as bullet weight in any given caliber increased (up to a point), manufacturers could make the nose progressively sharper. Hence, heavier bullets often retained velocity so much better that, well within the usable range of the chambering, the heavier bullet delivered greater impact velocity and, hence, better terminal performance.

Putting plastic tips in bullets changes that situation. Most important, the lightweight plastic insert occupies considerable volume, leaving more material to be placed in the shank portion of the bullet, so that lighter bullets can retain the sharp nose that is so necessary to long-range performance. Second, the plastic tip allows the elimination of the relatively flat nose of the conventional spitzer or the flat meplat of the hollow point (no matter how sharp the nose of a spitzer bullet might be when launched from the gun, at high velocity, before it travels far, it will partially melt and deform into a relatively round nose). With bullets that are otherwise similar in shape, this latter feature improves BC about 10 percent. Now 10 percent might not sound like much but, actually, it is a huge difference. All else being equal, 10 percent increase in BC amounts to a 10 percent increase in useful range!



Fellow VHA member Devrin Heuer prepared a custom Savage in 22-250 Ackley Improved for use in the annual V.H.A. balloon shoot and 600-yard match at the 2007 Jamboree. His quicker-twist barrel works very well with the 69-grain Sierra MatchKing and Hunter. This load generates almost 3,400 fps, with consistently fine accuracy and a very low standard deviation — keys to long-range accuracy.

It was a cool (55 degrees F) and blustery (5- to 15-mph) day but the wind was almost head on, so the conditions were tolerable. However, the author is sure that he could have shot better groups on a warmer day and without so much wind. As is true at most ranges, what seems to be a head-on wind often is not head-on all the way between the shooting line and the target. Several times the author shot when the wind was stronger than usual and noticed that the bullet hit to the right of where the others of that group had hit.

However, all else is not equal! The plastic tip encourages expansion at lower velocity. What that means is that manufacturers can use heavier jackets and still assure expansion at longer ranges. With a conventional bullet, it was formerly necessary to offer two bullets of any given type: one with a thin jacket, for use in smaller cartridges; and one with a thicker jacket, for use in larger cartridges. The thin-jacketed version would not tolerate use at full velocity in large (long-range) chamberings; conversely, the thick-jacketed version would not expand at low retained impact velocity! The plastic tip gives us the best of both worlds: a bullet that will tolerate very high muzzle velocity and that will still expand at relatively low impact velocity.

With modern bullets, I consider 2,000 fps retained velocity as a reasonable limit for dependable terminal performance — perhaps not explosive but certainly effective. The interesting thing is that with bullets of any given type, so long as ogive and other features are similar, when loaded in any given cartridge to the same pressure using the best propellant, all bullets with similar nose profiles (regardless of weight) will travel to just about the same range before retained velocity drops below 2,000 fps, which is a curious accident of nature. Within these restrictions, heavier bullets certainly will deliver more energy but that does not matter for smaller targets.

The following table lists feasible 24-inch barrel muzzle velocity with top loads using best propellants and resulting sea level trajectory.

Trajectory Comparisons: Best Bullets, Best Loads

Range (yards)	Velocity (f/s)	Energy (ft lbs)	Drift (10 mph)	Drop (inches)
40-grain Nosler BT				
0	4,450	1,759	0.0	0.0
525	2,031	366	30.9	42.6
550	1,944	336	34.5	48.3
52-grain Berger Match HP				
0	3,978	1,827	0.0	0.0
500	2,012	468	27.6	44.5
525	1,935	432	30.8	50.4
55-grain Berger Match HP				
0	3,900	1,857	0.0	0.0
500	2,064	520	25.9	44.8
525	1,990	484	29.0	50.6
55-grain Nosler BT				
0	3,895	1,853	0.0	0.0
525	2,015	496	28.4	50.3
550	1,943	461	31.5	56.5
60-grain Berger Match HP				
0	3,773	1,896	0.0	0.0
525	2,020	544	27.4	52.2
550	1,952	508	30.5	58.6

These data represent expected sea level results under normal atmospheric conditions but the surprising similarity in distance where velocity drops below 2,000 fps will hold, regardless of elevation or atmospheric conditions.

The data clearly show that the 40-grain BT reaches almost precisely the same range as the 55-grain BT before velocity drops below 2,000 fps. However, for any given crosswind, it will have about 13 percent more wind drift but it also will have about 31 percent less total drop.

A critical difference, to me, is that the load using the heavier bullet generates much more recoil, as is shown in the following table. Regardless of the efficiency of the muzzle brake the difference is startling.

Foot Pounds of Recoil Energy: 8-Pound Gun

Load	Bullet	Bullet plus gas
40-grain @ 4,450 via 40.5-grains H322	2.72	5.06
55-grain @ 3,985 via 46.6-grain Hunter	3.49	6.83
Increase for Heavier Bullet Load	28 %	35 %*

*Part of this difference results from the fact that the best load for the 55-grain bullet happens to use a significantly heavier powder charge.

The real advantage that the heavier bullets offer is reduced wind drift, which certainly is a consideration. However, the lighter bullets shoot flatter, which allows for more latitude in elevation (or ranging) error, which I consider more important. To compensate for a crosswind, I can hold off 11.3 inches just about as easily as I can hold off 10 inches; conversely, correctly ranging any target is often difficult, and sometimes it simply is not feasible. For me, the reduced recoil of the lighter bullet, which allows me to see impacts at much closer range, is the determining factor; hence, I prefer lighter bullets. To each his own.

Berger and others recently have made some effort to mitigate the short-bullet problem in conventional hollow-point bullets simply by using a shorter core within the same jacket with the same shape. This approach has merit but it also has problems. This moves the center of mass rearward and that is problematic, with regard to long-range accuracy potential; and, compared with the plastic-tipped bullets, these bullets still suffer a significant BC disadvantage, because of the flat point.

Making the hollow-point opening smaller is of limited potential for various mechanical and physical reasons. The inserted tip (plastic or otherwise) is the future. I expect that, eventually, everyone who wants to stay in the long-range accuracy game will offer such bullets.

Tested Loads: Bullets

When considering potential bullets to test, I reviewed the preliminary accuracy results to find bullets that had shown promise. With that as background, I chose the following bullets for this test, for the noted reasons:

➢ 40-grain Nosler BT — highest BC of any 40-grain bullet and a fine reputation for accuracy and long-range performance

➢ 52-grain Berger Match HP — very good BC and phenomenal accuracy potential

➢ 55-grain Berger HP — very good BC and good accuracy potential

➢ 55-grain Nosler BT — highest BC of any bullet that is certain to always be accurate when launched from a 1:14 twist barrel

➢ 60-grain Berger HP — very good BC and good accuracy potential (these bullets might not be accurate in some 1:14 twist guns, particularly when used at lower elevations and on cold days).

Note that Berger makes two versions of each weight of bullet. For this study, I used the 52-grain Match version, which features a smaller hollow-point and a significantly higher BC than the "hunting" version; I used the hunting version of the 55- and 60-grain bullets because those are what I had on hand. The Match bullets are apt to show similar accuracy with similar loads (requiring possibly a minor adjustment in overall length). The Match versions maintain velocity about 5 percent better but will not expand as violently at any given impact velocity — the classic Catch 22. As my goal was to develop loads that allow good hits at the longest feasible ranges, I would be happy to trade a bit of terminal performance for a bit better external ballistics — I will use the Match version.

I certainly could have looked at the Hornady and Sierra plastic-tipped bullets but those do not have as high a BC as the Nosler (the 55-grain Sierra is very similar to the 55-grain Nosler) and developing accuracy loads with those often requires more work. The same fact stands behind both considerations — the Nosler bullet has an unusually thick "solid" base of relatively tough jacket material. Because this material is lighter than the core material, Nosler bullets of equal weight occupy more volume and, therefore, with any given nose and base design can have a longer shank. The solid base also makes the bullet base significantly tougher so that it is less apt to asymmetrically deform during the crucial rifling-engravement stage — such deformation destroys accuracy. A higher BC makes all the difference at long range; easier accuracy load development saves me time and money. However, please note that either a Hornady or a Sierra might be more accurate in any given gun. Here, I chose the path of least resistance.

Tested Loads: Seating Depth

Based upon long experience with this sort of (conventional) load, with the heavier bullets, I tested loads with bullet-to-rifling jump set at: twenty-thousandths, fifteen-thousandths, ten-thousandths, and five-thousandths inch. My experience suggests that if none of those works, the combination probably will not show good accuracy — to get an accurate load with that bullet might require a charge adjustment, use of a different primer, or use of a different propellant, or it just might not work at all.

Throating on this rifle is just short enough that I could seat the heavier bullets to place at least two-thirds caliber (about 0.150-inch) of bullet shank in the case neck. With the 40-grain BT, it was not feasible to seat the bullet close to the rifling so I tested seating depths in ten-thousandths inch increments where the bullet was seated deeply enough to place about 0.150-inch of bullet shank in the case neck. The good news is that the BTs are particularly forgiving toward long bullet-to-rifling jumps and often give great accuracy, regardless of that fact (the thick, tough base is behind this — all puns are always intended!).

Tested Loads: Propellants

This was the easy choice. First, I had the preliminary test results and an internal ballistics program to suggest which propellants might give the best velocity with any given bullet. Because I was interested in long-range performance, only fast loads were interesting loads. So, I simply looked at the preliminary data and chose propellants that produced nearly maximum velocity, along with good accuracy.

I then adjusted the charge, to develop the maximum pressure that I am comfortable using in this chambering in this rifle. As it worked out, with Norma cases, this pressure showed just a bit of case head expansion on new cases and it showed slight case head marking from the bolt face — just the slightest hint of shiny areas where the bolt face and ejector rubbed the case as I unlocked the bolt.

It is quite apparent that it would be hard to beat the velocity generated by H322 with the 40-grain BT. Similarly, Hunter (a Ramshot product from Western Powders Inc.) developed amazing velocity with the 55- and 60-grain bullets. VN550 velocity with the 55-grain Nosler was disappointing. VarGet worked well with the 52-grain Berger Match HP but Hunter is apt to produce significantly more velocity and is worth considering.

Tested Loads: Primers

Again, I took the easy way out. I used the well-proven BR-2 for most tested loads and I also did one test where I compared otherwise identical loads using the BR-2 and the 210M, just to see if Hunter might work better with a "hotter" primer. Pressure testing suggested that little if any charge correction was necessary to maintain similar peak pressure. The good results in that test load suggest that I should retest several of these loads using the 210M.

The folks in the ballistics lab at Western Powders (Western markets the Ramshot line) have shown good results with Hunter (and many other slower-burning Ramshot products) using relatively hot primers. Likely, I should have considered a hotter primer for the Hunter loads — using the 215M to ignite less than 50 grains of propellant is unusual but that might be just the ticket to best accuracy — another test for another day.

Tested Loads: Cases

I used Norma cases that weigh between 159 and 160 grains. These cases have proven to be somewhat more concentric than those of other manufacturers and are otherwise of very high quality.

In the future, I might consider revisiting accuracy loads in this gun using a batch of nickel-plated Winchester cases that I have. This gun tolerates neck-sized loads quite

Left-to-right: 40-grain Nosler BT, 52-grain Berger Match HP, 55-grain Nosler BT, 55- and 60-grain Berger HPs (recommended for varminting) — note larger meplat, compared with 52-grain Match HP.

Left: cross-section of 30-grain Berger HP showing the unusually short core. Right: 30- and 40-grain Berger HP, demonstrating that only the core differs — the slight visual difference in nose length, and resulting meplat diameter, is typical of what is commonly seen in nominally identical HP bullets. Berger makes many similar sets of bullets of different weight by using different cores with the same jackets and forming die.

well (many loading cycles without any chambering problems), so those cases are quite easy to use (full-length resizing of nickel-plated rifle cases often is difficult). The plating process thickens the neck about one-thousandth-inch, which reduces neck-to-chamber clearance about one-thousandth-inch on each side. The thicker neck could significantly improve bullet-to-bore alignment and thereby reduce bullet damage during rifling engravement, and thereby improve accuracy.

Tested Loads: Tools

I used the following tools for loading this ammunition:

➢ Redding Competition neck sizing die
➢ RCBS APS hand priming tool
➢ RCBS Charge Master Propellant Dispenser
➢ Midway Funnel (for swirl-charging)
➢ Redding Competition seating die
➢ Redding UltraMag Press

Equipment matters and while many excellent products exist, I believe that this is a fine combination for this chambering. I would only note that most of the tested propellants meter accurately from the Johnson Quick Measure. With the new swirl-charging adapter for that tool, metering is splendidly accurate, simple, and fast. The granule packing scheme is extremely uniform within each charge and it is similar from one load to the next — these factors improve ballistic uniformity and accuracy.

Range Testing

It was springtime in the Rockies and, unfortunately, global warming has not kicked in here yet (as I write this preliminary text, it is the middle of April and well below freezing outside!). The wind tends to blow in this region this time of year but generally I had good conditions for this testing.

All reported accuracy is for an average of several five-shot groups at 100 yards. I repeated groups with called fliers. Velocity data is for ten-shot strings, as recorded by the Oehler 35P with a four-foot screen spacing.

Tested Rifle

Darrell Holland (Holland's Gunsmithing, PO Box 69, Powers, OR 97466. Phone: [541] 439-5155. Web: www.hollandguns.com) built this rifle. It uses a fully blueprinted short-action Remington Model 700. The barrel is a 1:14" twist, 24-inch long Pac-Nor, with a relatively light contour — the gun, with scope mounts, weights only 7 1/4 pounds; complete with the relatively light Leupold scope it weighs only 8 pounds.

The barrel is fitted with a Holland Quick-Discharge muzzle brake. This device proved to be extremely efficient at reducing recoil; the included muzzle brake "blank" might be handy when the shooter is more concerned about noise at the shooting line than about recoil reduction.

I tested one factory load and one of my 22-250 handloads, while fireforming cases, both with the brake and with the blank, to see how similarly the gun shot in each condition, in terms of group size and zero. Results of that test are shown in the following table.

Brake versus Blank

	f/s	Accuracy	Zero
Winchester 45-grain HP (USA222502)			
Brake	3,798	0.6	0.1 Right, 0.1 Low
Blank	3,779	1.4	0.2 Left, 0.2 Low
40-grain BT, 42-grains VarGet, BR-2			
Brake	4,128	0.6	0.6 Right, 0.5 Low
Blank	4,118	0.6	0.9 Right, 0.1 High

For whatever reason, the blank did not match the muzzle brake perfectly with regard to barrel vibrations and resulting zero — at least not with these loads. The velocity advantage for the brake is as expected — with the brake, the bullet does not have to pass through as much high-density propellant gas and therefore loses less velocity.

The Leupold, 16x, fine cross hair with dot reticle, scope proved adequate for bench testing but I am unsure that I would find this a good choice in the field. It is a lightweight and durable scope but I prefer a variable, so that I can more easily use the gun for spotting (so that I do not have to carry a binocular) and the unusually fine cross hair easily fades to obscurity in deep shadows.

The Talbot QD mounts are a fine option and performed as expected — perfectly.

Accuracy And Velocity Results

The load table on page 22 includes the results of this accuracy test. Note that this was not intended to represent the last increment in accuracy load testing for all 22-250 AI rifles or even for this particular rifle; the goal here was to develop adequately accurate loads without destroying the barrel in the process!

The listed overall lengths are nominal for a typical bullet. Within any given group of any given type of bullet the length varies because the nose shape varies. Using typical HP bullets, cartridge overall length with the same bullet-to-rifling jump will vary by several thousandths inch. Using plastic-tipped bullets, cartridge overall length with the same bullet-to-rifling jump will vary by about half as much.

Accuracy data represents typical five-shot, 100-yard groups. Where the groups were usually more or less round, the single listed number is the group size — on-centers; where the groups were usually strung significantly, the listed numbers are for group height (H) and width (W).

Conclusions

With several tested loads, this rifle has significant potential as a long-range "Walking Varminter," where the convenience of a relatively light rifle and the ranging potential of this top-end chambering suit the user's needs. For those interested in a bench-type gun, a different configuration in the same chambering would be a better choice; likely differences would include: a heavier and longer barrel and a stock with a wide, flat-bottomed fore-end. Those interested in target shooting or dedicated long-range varminting might consider a quicker twist rate, as needed to stabilize heavier bullets. For varminting, I would prefer a variable scope with a reticle that was a bit easier to see in dim light.

Supplemental Data From V.H.A. Member Devrin Heuer

Savage M12; Custom 26-inch, 1:10 twist barrel:

69-gr. MK @ 2.424-inch OAL, Fed-GM 210M, Ramshot Hunter, Winchester cases

Charge	Velocity @ 10-feet (f/s)	Standard Deviation	100-Yd Group	Comments
41.0	3,356	23	0.341	Round cluster
41.5	3,369	25	0.261	Round cluster
42.0	3,388	23	0.312	Slightly vertical

Note: the relatively great standard deviation suggests that, perhaps, a different primer might give better results.

Tested Loads with properly moly-plated bullets

(average size of five-shot, 100-yard groups, average velocity, and standard deviation for ten shots)

Accuracy Test Results

Bullet	Crtg. OAL	B-R Jump	Propellant	Charge (grains)	Primer	Muzzle Velocity	Std. Dev.	Accuracy (inch)	Comments
Nosler 40-gr. BT	2.41	---	H322	40.5	BR-2	4,404	38	0.9	Seating depth matters because it alters barrel time.
	2.42	---				4,390	37	0.5	
	2.43	---				4,378	40	1.1	
	2.44	---				4,360	13!	0.7 H, 0.3V	
Berger 52-gr. MHP	2.475	0.020	VarGet	41.1	BR-2	3,852	24	1.3	
	2.480	0.015				3,864	12	0.5	
	2.485	0.010				3,865	12	0.9	
	2.490	0.005				3,855	10!	0.7	
Berger 55-gr. MHP	2.445	0.020	Hunter	47.0	BR-2	3,859	53!	0.3H, 0.7V	Great for vertical targets!
	2.450	0.015				3,882	11	0.9H, 0.2V	
	2.455	0.010				3,876	24	1.3H, 0.5V	
	2.460	0.005				3,875	26	0.6	
	2.445	0.020			210M	3,865	136!!!	0.9	
	2.450	0.015				3,860	22	0.3	0.1 without fliers!
	2.455	0.010				3,866	7!	0.9H, 0.0V	
	2.460	0.005				3,868	10!	1.0	
Nosler 55-gr. BT	2.505	0.020	VN550	41.5	BR-2	3,650	15	0.6	
	2.510	0.015				3,651	16	0.8H, 0.3V	
	2.515	0.010				3,669	11	0.7	
	2.520	0.005				3,654	20	0.1H, 0.5V	
	2.505	0.020	Hunter	46.6	210M	3,830	33	0.4	
	2.510	0.015				3,836	25	0.6	Try 25/1000 jump.
	2.515	0.010				3,819	28	1.2H, 0.7V	Try a hotter primer.
	2.520	0.005				3,824	19	0.9H, 0.2V	
Berger 60-gr. MHP*	2.445	0.020	Hunter	46.4	BR-2	3,587	14	0.6	
	2.450	0.015				3,600	15	1.5H, 0.3V	
	2.455	0.010				3,602	18	0.7	
	2.460	0.005				3,577	19	0.5	

* 60-grain Berger bullets might not stabilize in 1:14" twist guns when used at lower elevation, especially on a cold day.
The 210M tests suggest that testing the other loads with this primer is apt to be worthwhile.