Loading Information

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Hi all,
An update on my latest project, trying to find a good 600 yard load for my AR. Experimenting with one lot of surplus IMR 4895, lot 95B, purchased from Bartlett's Reloading Supply, Owensboro, Kentucky. Design goals of the loading are to achieve minimum elevation and velocity spread at 600 yards, with a maximum velocity of 2650 FPS. I currently believe that anything over 2650 is probably over designed chamber or port pressure, or BOTH. When I finally strain gauge an AR, I'll know for sure, and will keep you appraised.

The rifle is a Colt, with a Krieger barrel, modified for match work by Accuracy Speaks. The bullet used in this series of tests was a Berger 80 grain VLD, seated to touch the lands (2.393" OAL due to short throat). Bullets were moly coated from the factory.

Extremely limited testing of a trial load of 23 grains in a Winchester military case, with a Winchester small rifle primer developed low (low 2500 FPS velocities). This confirmed Jeff's statement that about 3-4% more powder (compared to the surplus lot of IMR I'm currently using) was needed to reach velocity. Using 23.7 grains filled the case completely (no sound when shaken), but could probably pack in a few tenths more. Velocity is still a little low at 2575, but accuracy seems okay. Depending on the throat configuration of your rifle, you might be able to get more powder and
velocity out.

Using weighed charges, extreme spread for 5 shots consistently stayed in the high 30's to mid 40's (15 shots total), SD for 5 shots was in the mid to high teens. In comparison, a weighed charge of 23 grains of 4895, lot 104452 produced an average velocity of 2618 FPS, with an unacceptable ES of 108 (single 10 shot test) and poor accuracy at 600. Varget produced a high 2732, but had an ES of 61 and an SD of 30 (5 shots), with only fair accuracy at 600. Suspect the Varget load may be over pressure spec as well, currently unable to confirm this as I haven't strain gauged a .223 yet. Neither comparison loading filled the case completely, possibly contributing to the wider spreads.

Test methodology involved separate chronograph firings and accuracy tests. Tests for accuracy were conducted by firing from position at the 600 yard line, and then observing the vertical spread of the resulting shots.

Early conclusions are that with the current throat configuration, I may be pressed to reach 2600

FPS with the Berger 80, although the current accuracy level is promising. Lot 95B appears attractive for use with the Hornady 68 and Sierra 69 due greater filling of the case. My current favorite load of 23.7 grains of 4895, lot 104452 generates 2775 FPS with the Sierra 69 (plain bullet), with an ES of around 100 and lots of unfilled case. The 23.7 load is somewhat milder than an equivalent charge weight of commercial 4895, by the way, and still shoots well enough at 200 yards to clean the target.

Future experiments will attempt to reach 2600 FPS, although it already appears doubtful that the goal is attainable. Development of a load for the new 77 grain Sierra is also in the works, again looking for a max velocity around 2650. Plan on trial loading for the Sierra 69, looking for better accuracy with much lower velocity spreads, though I currently plan on shooting the 77's at 200 and 300 if the load works out. Would prefer to avoid having to tote 3 batches of ammo around if possible, however it's easier to do with the .223 due to the smaller size and lower weight of the round.

Will keep you apprised of progress.

Sierra 77 Loading Data

Called the Sierra Tech line for their recommendations for loading this bullet. They replied:

1. Start with 80 grain loading data, and reduce it one full grain, as the 77 grain bullet seated to 2.260" cartridge OAL severely intrudes on powder volume.

2. Sierra's recommended velocity is 2650 to 2700 FPS. In their tests, this is what gave best accuracy.

3. BC is about .378

Of course I had to go and verify the results, so I loaded up some ammunition using surplus IMR 4895, lot 95B. For those unfamiliar with 95B, it is a noncommercial batch of IMR 4895 manufactured in 1995, and originally intended for use in US military ammunition. Loading with 95B requires about 4-5% more powder by weight than commercial powder. 95B Also has a lower bulk density (fills more of the case). The resulting combination makes the powder roughly similar to N-140 or IMR 4064, so I'm told.

Test batches consisted of 3 rounds loaded with a weighed charge of 23.6 grains, and a 4 round batch of 24.4 grains (certainly NOT a statistically valid sample, but you do have to start somewhere). Components as follows:

Case: WW 88 (not weight sorted)
Primer: Winchester Small Rifle
Bullet: Sierra 77, moly coated
OAL: 2.256" (designed for feeding from the magazine)

Initial impressions: Both powder charges filled the case to at least the bottom of the shoulder. Loads were compressed (clearly demonstrated by the sounds of cracking powder grains on seating the bullet).

Test rifle was a Colt Sporter, with a 20" Krieger barrel, Accuracy Speaks throat (i.e. SHORT). Test distance was 300 yards from target to front edge of the bench, rifle barrel protruded 12" or so forward of the bench.

Other equipment used:
Oelher 43 chronograph, with downrange acoustic target.
Chronograph screen spacing: 1ft. Between screens (3 screens)
Distance from bench front to chronograph: 13.7 ft.
Sandbag rests

Test conditions:

Sea level conditions in San Diego today (15ft MSL):
Temperature: 70 Degrees F
Pressure: 29.97" Hg
Humidity: 70% (overcast, due to solid layer of clouds)

Range Altitude: 1500 ft.
Wind: 3-5 MPH, from 9:00

Results are skewed lower (i.e., actual results are higher), as I used sea level atmospherics for the conditions at 1500 ft.

Results:

24.4 grains (4 rounds):
Average instrument velocity: 2610 FPS
Velocity spread: 27 FPS
Average terminal velocity: 2004 FPS
Average BC: .382
Group size: 3.2" x 1.8" (horizontal x vertical)

23.6 grains (3 rounds):
Average instrument velocity: 2538 FPS
Velocity spread: 29 FPS
Average terminal velocity: 1930 FPS
Average BC: .373
Group size: 2.3" x 1.8"

(Group size is a clear indicator that my bench technique requires work. Who said shooting off rests was easy?)

Since I hauled out the chronograph I decided to test some 95B loads with the Berger 80 grain bullet (moly coated, 2.375" OAL. Charge compressed again, accompanied by the sounds of crunching powder grains):

24.4 grains (4 rounds):
Average instrument velocity: 2590 FPS
Velocity spread: 62 FPS
Average terminal velocity: 2052 FPS
Average BC: .434
Group size: 4.1" x 5.6"

24.7 grains (2 rounds):
Average instrument velocity: 2618 FPS
Velocity spread: 59 FPS
Average terminal velocity: 2098 FPS
Average BC: .436
Group size: 0.4" x 4.4"

For comparison, 24.4 grains behind the Sierra 69 bullet (non moly coated, 2.256" OAL, 4 rounds. There was room in the case remaining for more powder) produced:

Average instrument velocity: 2654 FPS
Velocity spread: 60 FPS
Average terminal velocity: 1967 FPS
Average BC: .334
Group size: 4.0" x 6.0"

77 Grain bullet initial conclusions:

1. Sierra's BC data appears to be in the correct range

2. For magazine length rounds, case capacity becomes limited. Powder selection in this instance is vital.

3. The bullet appears to hold elevation well at 300 yards, even at lower than designed velocities.

Powder impressions:

1. In the .223 case, 95B won't give max velocity in a 20" barrel with deeply seated bullets. Use another powder for that (i.e. normal 4895 or Varget).

2. 95B will give consistent velocities and accurate ammo, if you're willing to live with lower velocities (previous small scale tests with the 80 grain bullet and 95B showed better accuracy at 2550 FPS).

All fired cases showed no signs of excessive pressure, though the 80's with 24.7 grains of

powder did flatten the primer considerably more. May plan to repeat the experiment with bare 77's to see if I can get the velocity up, I'm at a dead end with the moly coated ones (can't pack in more powder for more velocity). Don't plan on experimenting with the 80's any more, the velocity increase apparently makes the accuracy worse, may have to settle for 2550 FPS.

Still plan on strain gauging an AR-15 barrel to see what pressures are really generated with the heavy bullets. I don't believe that 2750+ FPS velocities with a 20" barrel and the 80 grain bullet are within the 60,000 PSI SAAMI pressure limit.

.223 Velocity Variations

Fellow shooters:

Conducted yet another experiment today (October 2nd), this time observing the effects of different throat lengths. The conclusion reached is shorter throats in a .223 result in higher velocities, and by inference, higher pressures. Conditions: Approx. 70 F, 50% relative humidity.

Rifles:
Rifle #1:
AR-15 type, 20" Krieger barrel, Accuracy Speaks throat (gauges about a "0" on a Mo's throat erosion gauge)

Rifle #2
AR-15 type, 20" Wilson barrel, factory throat (similar barrels gauged about 2.5-3 on Mo's gauge). NOTE: The Wilson Barrel may be found on Armalite and DPMS rifles.

Ammunition:

Test Load #1:
Sierra 69 bullet (non-moly coated)
24.0 grains Accurate Arms 2520
Winchester Small Rifle Primer
LC Case
Muzzle Velocity: 2830 FPS (Rifle #1)

Test Load #2:
Sierra 69 bullet (non-moly coated)
25.4 grains IMR 4895, lot 95B (noncommercial, GI surplus powder)
Winchester Small Rifle Primer
WCC Case
Muzzle Velocity: 2775 FPS (Rifle #1)

Summary:
Load #1 was fired through both rifles twice (20 shots per rifle), load #2 fired once (10 shots per rifle). In each case, Rifle #1 maintained approximately a 135 FPS velocity edge over rifle #2. In

my experience, this difference is roughly equal to a 1-1.5 grain variation in charge weight. While other factors may also be present, the fact remains that throat
length is the major variable present.

Impact Analysis:

There are several throat dimensions available in the US for .223/5.56 mm rounds. The general trend is for mass produced barrels (i.e. factory rifle barrels) to be chambered with longer throats, while custom barrels for match work are turning towards shorter throats. Problems may arise for the shooter that changes barrels, but who insists on shooting the same load as before. Another potential problem is the sharing of loading information, especially if throat profiles differ by such a large degree. In either case, the result is the same: the shooter with the tighter throated rifle may experience pressure signs or case failures from a previously "safe" loading. The problem is further compounded by the varying lengths of barrels employed by shooters. The general rule is, of course, that longer barrels will reach higher velocities than shorter ones. Problems naturally arise when shooters attempt to reach higher velocities while stubbornly clinging to shorter barrels. Even loading manual data may be suspect, I have at least four manuals which give lower velocities than rifle #1 when reported velocities are corrected for use with a 20" barrel.
Another variable present is the bore diameter. The Wilson barrel appears to have a looser bore diameter than the Krieger, but only by about .001". This might increase pressures some as well, however the throat geometry difference is far greater.

Remedies:

1. Common sense: Do not blindly employ loading data obtained from other shooters, unless you know the throat profile in your rifle is considerably looser. Even then, it is prudent to work up to the recommended load, instead of diving in.

2. If you own a tight throated rifle, a chronograph is a wise investment. While peak pressure remains a problem, the velocity of a bullet is a method to indirectly measure the work function of the powder (i.e. area under the pressure/time curve). Reducing the powder charge decreases the total work available from the powder; this usually results from a lowering of the peak pressure.

3. Reduced accuracy may result from driving bullets too fast, especially in 20" AR barrels. This may be due to bullet tip-off from the still-expanding propellant gas. I have actually disintegrated 69 grain match bullets by driving them too fast (estimated 3100-3200 FPS). The following velocities are recommended maximums for Sierra match bullets out of fast twist, 20" barreled AR's:

All weights: 3000 FPS (due to bullet disintegration)
69 grain: 2800 FPS (due to gas tip-off effects)
77 grain: 2700 FPS (due to peak pressure and case volume limits)
80 grain: 2650 FPS (due to peak pressure)

For the listed bullets, Sierra recommends the following velocity ranges for accuracy:

69 Grain: 2700-2800 FPS (for the long throat barrels, good accuracy has been observed at as low as 2600 FPS).
77 Grain: 2650-2700 FPS.
80 Grain: 2500-2550 FPS.

4. If you have any control over the matter, chamber all your barrels using the same throat reamer. This will help you avoid most of the problems associated with switching ammo between different rifles. Failing that, use the looser barrel for practice (wear it out earlier), and load as if you were shooting the faster rifle only.

5. With the Sierra 69 grain bullet, Winchester small rifle primers, and LC or Winchester cases, the following loads should yield about 2800 fps for tight throated rifles. Caution should be exercised once these load levels are
approached:

- AA 2520: 23.7 grains
- IMR 4895 (commercial): 23.5 grains. H4895 loads should be further reduced, surplus 4895 loads may be increased by .2 grains (except for lot 95B)
- Varget: 25 grains
- 748: 23.7 grains

Good luck

Load data, part umpteen 1/2

Loaded some ammo for a friend recently, here's what we found:

Rifle: Armalite DCM rifle, Wilson barrel (looser barrel), NATO spec throat

Short range load: "Navy" load shoots well, velocity a little low (24.7 grains Varget, measured MV of 2650 FPS from this rifle). Might bump it to 25 grains Varget when the brass is loaded next.

Long Range: Sierra 80, loaded to touch the throat (2.545" OAL). 24.6 Grains Varget, Winchester primer and casing. Estimated MV of 2600-2650 FPS

The above was loaded for a loose chambered rifle, a custom barrel (i.e., Krieger, or one chambered by Frank White or Derrick Martin) won't chamber the specified long range load due to shorter throats.

Good Palma load with the .30 caliber, 155 Berger (moly coated, no wax added):

46 grains Varget, Winchester COMMERCIAL case (Palma preferred), Winchester primer. Seat to touch the rifling, as there isn't enough neck tension with molyed bullets.