Developing a Load for Competition Shooting

By Mary Clary, BSN and Jim Clary, PhD

Over the years, we have heard or read just about every method used by shooter/reloaders to work up an optimum load for their rifles. It seems like every shooter has their own method that works for them. That said, there has to be a more scientific approach to the problem. One that works for everyone and is based on a repeatable and testable procedure that results in the best accuracy for your rifle.

In the past, reloaders talked with each other and read the reloading manuals in an effort to determine the most accurate load for their bullet. We loaded them up and went to the range for testing. Sometimes it worked, sometimes it didn't. When it didn't, we went back to the reloading bench to load up some more cases.

The method outlined in this article was suggested to us by John Dink, a world class shooter from Albuquerque, New Mexico. John's scientific approach to reloading and shooting is the best way to insure top performance from your equipment. However, it only works if your rifle is built right. In other words, a precision target rifle, not a mass-produced assembly line gun.

We won't include brass preparation in this article, leaving that for a later date. Here, we will focus on how to logically and methodically work up and select the best load for a given rifle/bullet/powder combination. We will use the 6mm BR (.243) caliber as our example. For the record, it was a real test, as we were using a new bullet and powder. As such, we didn't know what load would shoot at a competitive level.

Step 1: Select the weight and type bullet you want to reload. We chose the Berger 105 grain VLD bullet. The K-P barrel on our 6BR really "likes" Berger bullets. Not to mention that they have superb ballistic coefficients. All bullets are not created equal. Variations in the ogive profile of Berger, Sierra, JLK bullets and others guarantees that bullets of the same weight will behave differently in different guns, even with the same powder charge. As such, you will need to repeat this test every time you change bullets, powder and guns.

Step 2: Select a powder that has been tested by other shooters as working best for your caliber, bullet weight and bullet manufacturer. This requires some research, but it's not very difficult. There are several good sources for this information including internet sites, reloading manuals and shooters reference books. In the 6mm BR, the most commonly recommended powders include Hodgdon's Varget, Vihtavuori N540, IMR 4007ssc and Alliant RL 15. We chose Hodgdon's Varget, as it is almost the "standard" for the 6BR.

Step 3: Determine the powder load range for your bullet weight that has resulted in accurate loads in other folk's rifles. We determined that the common range was from 29.2 grains to 30.4 grains.

Step 4: Load three rounds each, starting at each of the following charges: 29.2 grains, 29.6 grains, 30.0 grains, 30.4 grains. The 0.4 grain spread will produce a respectable comparison of loads. Take them to the range and test fire them across a chronograph. We know the average shooter doesn't have a chronograph, but you should. We went for 40 years without one. It was hard to justify a $400 - $500 piece of equipment in the family budget that would be only used a couple of times a year. However, chronograph prices have come down, thanks to solid state electronics. They are available from $120 to $250 from suppliers such as Sinclair International, Midway USA and Sportsman's Warehouse.

You will get no argument from us that the “high end” CED M2 Chronograph is as good as it gets. However, for the average person, a Chrony Alpha Master at $120 will do fine. The latter was purchased by our daughter as a father’s day present for Jim. He finds it easy to use, reliable and very compact (it folds up). However, be aware that there is a saying in the shooting community that there are two kinds of people, those that have shot their chrony and those that will someday shoot their chrony. At present, we are in the last category. In other words, you must be very careful in shooting through the upright sensors, remembering that a scoped rifle will shoot about 2” low at the 10 to 15 foot distance at which your chronograph is positioned. Hit the base and you will see the full effect of a high power round impacting a precision instrument!

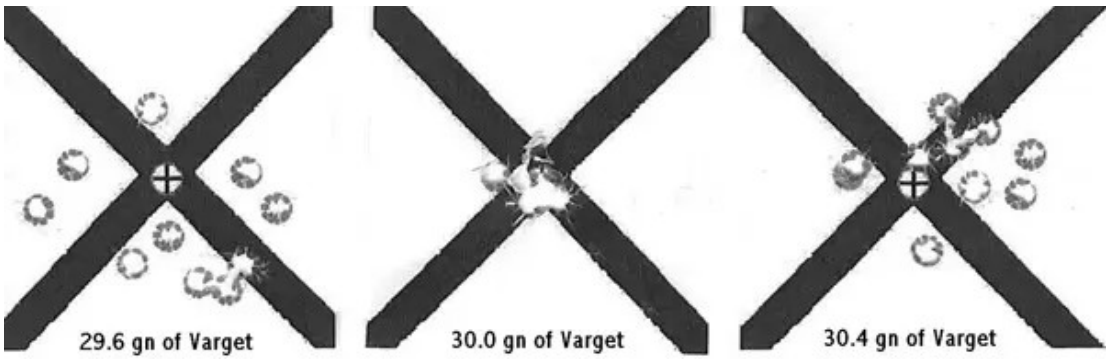
The following table displays the three shot velocities for the charges we loaded:

Varget Powder	29.2gn	29.6gn	30.0gn	30.4gn
	2738 fps	2857 fps	2889 fps	2905 fps
	2826 fps	2867 fps	2900 fps	2945 fps
	2792 fps	2863 fps	2898 fps	2920 fps
Average:	2785 fps	2862 fps	2896 fps	2923 fps
Std Dev:	44 fps	5 fps	6 fps	20 fps

Obviously, a sample size of three does not yield a statistically significant standard deviation. However, it does give us an indication as to the consistency of velocity for each load. If we were to guess at this point, as to which load would be the best, our money would be on either the 29.6 or 30.0 grain loads. However, don’t make that assumption and stop your testing.

Step 5: Due to the fact that most 6BR's prefer loads above 2800 fps, we excluded the 29.2 grain load from further testing. Load ten rounds each of the other three charges. Go to the range, set your target up at 200 yards and fire each, *without* making windage or elevation adjustments to your scope (after you get on paper, of course). If all goes well, you will see a somewhat circular (scatter) pattern on loads that are on either side of your optimum load. The windage and elevation will “close up” toward center with your best load. You can’t get this kind of data with the three round or five round groups that most shooters use.

Step 6: Analyze the three targets, measure the spread (vertical and windage). You are looking for the load that gives you ½ “MOA vertical, or less, at 200 yards. Our results are shown below. The winner was 30.0 grains of Varget behind the Berger 105 VLD bullet. That is a half inch group, ¼” MOA at 200 yards. You gotta love the 6BR, it makes everyone a hero! However, using a Nightforce NXS 12-42x56 scope sure helps.



6BR load development test targets. Photo by Jim Clary.

The average shooter might burn over 100 rounds to get (hopefully) the same results. The method outlined in this article requires less than 50 rounds to obtain great results. If your 200 yard test group isn't as tight as ours, you might decide to tweak the load by +/-0.2 grains. However, we decided to take our results and shoot with them.

Once you have determined the optimum load for your rifle, plug the velocity information from the chronograph into a ballistic program to account for all the other factors that impact your shooting. The question now is, how does the load shoot at long range?

Two days after our test, we traveled to Capitan, NM for a Palma match to get some practice. The winds were nasty, but Susannah shot a 149/150 at 800 yards. Not perfect, but good enough to convince us that the load was right for that rifle with the Berger bullet and Varget powder.

As a side note, the Nightforce ballistic program "called" for an elevation adjustment of 14.00 MOA for 800 yards. Her first sighter shot was a nine (9) and the second was a ten (10), so she went for record. That just about says it all for John's load development method as well as the accuracy of the Nightforce ballistic program, which was written by Gerald Perry.

Finally, we would like to remind everyone of the words of Brad Sauve, U.S. National Champion F-TR shooter (2004, 2006 and 2007): "Spend more time shooting than loading "perfect" ammunition or cleaning. Squeezing the last ¼" out of your groups won't do you any good if you can't hold one MOA or you can't read wind conditions."

In Part 1, we outlined the six steps in developing a good competition load:

1. Select the weight and type of bullet you will use.
2. Select a powder that has been tested successful by other shooters.
3. Determine the range of powder loads what have been successful with others.
4. Load three rounds at each load and chronograph them at the range.
5. Load ten rounds of the most promising loads and test for accuracy
6. Analyze the targets for spread (vertical & windage) and select the best, then tweak the best load, if necessary, to maximize your accuracy.

Those steps were very easy with our 6BR, as that rifle had a "history" of preferring Berger bullets. Varget powder was virtually the standard and the load range was fairly well established. With the arrival of Susannah's new Savage M12 F-Class rifle, in 6.5x284, things became more complicated.

Bullets: We had no idea as to what bullet would work best in this gun. The 142 grain Sierra Match Kings, 139 grain Lapua Scenars and 140 grain Berger VLDs are used by competition shooters around the world, but which one would work best in our gun? Since we already had a good supply

of 139 grain Lapua Scenars we decided to try them first. If the results are not acceptable, we will buy a batch of Bergers or Sierras and start testing all over again. Although our choice of bullets was not scientific, you have to try what you already have before buying something new.

Brass: This choice was easy. We use only Lapua brass for all of our competition shooting. If there was a better brass, we would buy it. Lapua is the choice of most champion shooters, so we picked up seven boxes of new 6.5x284 brass.

Powder: Hodgdon's H4350 and H4831SC are commonly used in the 6.5x284. A lot of shooters prefer Vihtavuori N160, N165, N170 and there are just as many who prefer Reloader 22, Reloader 25 and Hodgdon's H1000. Since we already had two-eight pound kegs Hodgdon's H4350 on hand, we decided to use it for our tests. We are admittedly partial to Hodgdon's powder, having used it in our hunting rifles for over 40 years.

Range of Powder Loads: Here again, depending on the powder, the possibilities were mind boggling. Most F-Class shooters recommend keeping your velocities between 2,950 fps and 3,000 fps. The 6.5x284 barrels burn out fast enough, without pushing the bullets to their maximum velocity and accelerating the process. *(2950 fps is at or beyond the top maximum load listed in every reloading manual I own! -Ed.)*

The literature we reviewed suggested loads from 48.6 grains to 49.8 grains for H4350. We decided to start at 48.6 grains and work our way up in 0.4 grain increments to 49.8 grains.

We loaded three rounds each at the following charges: 48.6 grains, 49.0 grains, 49.4 grains and 49.8 grains. The bullets were "jumped" rather than jammed into the lands and grooves. Our chronograph tests were conducted at 5,232' above sea level at a temperature of 90^{o} F. As such, your velocities will vary in accordance with the environmental conditions in your area, as well as how you seat your bullets. We were looking for consistency and velocities above 2900 fps.

The following table displays the chronograph results of three shot velocities for the charges we loaded:

Lapua 139 grain Scenar

H4350 Powder	48.6gn	49.0gn	49.4gn	49.8gn
	2969 fps	3033 fps	3038 fps	3054 fps
	2983 fps	3028 fps	3037 fps	3052 fps
	2964 fps	3039 fps	3033 fps	3041 fps
Average:	2972 fps	3033 fps	3036 fps	3049 fps
Std Dev:	10 fps	6 fps	3 fps	7 fps

Once again, do not assume that a small standard deviation with a sample size of three is going to be significant. It simply gives you a good starting point to run your 10-shot accuracy test.

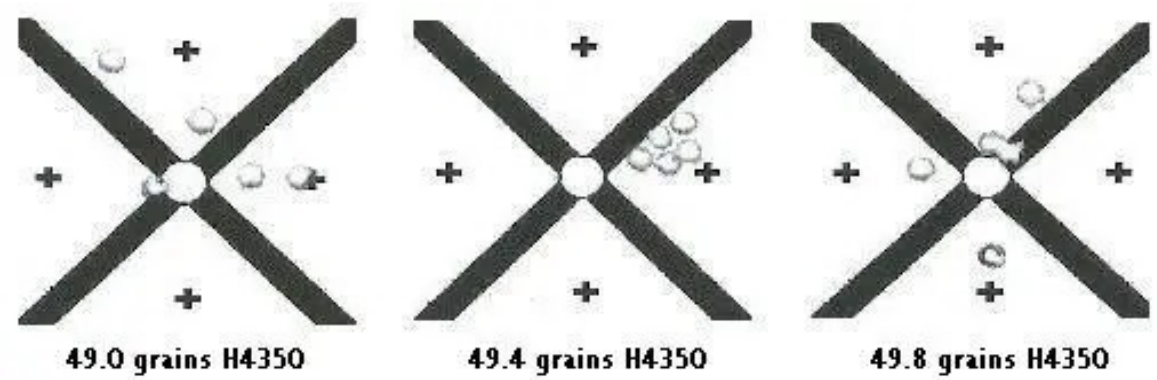
Because the velocities of the loads at 49.0 to 49.8 grains were more consistent, we made the

arbitrary decision to exclude the 48.6 grain from further testing. This was a judgment call in an effort to save some barrel life on the new 6.5x284. We loaded up ten cartridges at each of the three loads and headed for the range.

We also changed our testing procedure. We decided to shoot five rounds of each load to check for grouping or scattering. If the initial five rounds showed pronounced vertical and/or windage deviation for any load, we will not fire the additional five rounds. Again, this was a decision that was based on preserving barrel-life in the 6.5x284. Unlike the 6BR, which can have a competitive barrel life of 2,000 to 3,000 rounds, a 6.5 barrel may be "shot-out" in as few as 800 rounds, although the norm is more in the 1,000 to 1,200 range. It is easy to do the math and figure out that if you are testing many bullet/load combinations, you could rapidly use up a significant percentage of your barrel's competitive life.

All three loads produced meaningful results after five rounds, so we ended our tests after expending only fifteen rounds. There was too much vertical and windage with the 49.0 and 49.8 grain loads, but the group with the 49.4 grain load was very nice. The five shot 49.4 grain group measured ¾" in size, which equates to less than ½ MOA at 200 yards.

The results of the accuracy tests are illustrated in the following targets:



6.5mm-284 load development test targets. Photo by Jim Clary.

It is possible that with minor adjustments of the 49.4 grain load, we might be able to tighten the group up even more. However, we decided to use it in Susannah's next match. After that match, we will make a decision on whether we need to adjust the load before the U.S. Nationals.