How to Use a Chronograph in Load Development

By Brodie Parkinson

Caldwell Ballistic Precision Chronograph. Illustration courtesy of Caldwell Shooting Supplies.

After using a chronograph for a few years, I stumbled onto a "How to" video on the Internet. Specifically, "How to use a Chronograph." I have to admit I was a little bothered by what I was seeing. How could someone who clearly did not know what they wanted from a chronograph make such a misleading video?

I wanted to brush it off as just the downside to anybody being able to post whatever they wanted on YouTube. After a quick search of various people using chronographs, I found that a great many people do not understand what they are trying to achieve with a chronograph. Consequently, I wanted to write my own "How to" article, covering some simple and basic steps with a chronograph that can bring your knowledge and reloading ability to a higher level.

I should write a disclaimer: I am not an expert, nor am I perfect. I have not only blown diffuser rods to pieces, I once shot one of my chronographs with a .264 Winchester Magnum. I am merely someone who wants to understand their equipment in every facet. Especially what happens when a bullet leaves the barrel.

My chronograph set up is simple. I put the unloaded rifle on a shooting rest on a bench rest and then I measure 10 feet from the muzzle. That is where the chronograph is set up, on a tripod with a three axis head.

Then, I sit behind the rifle and peer through the scope. I want to have the chronograph set up as close to perfect as possible, so the rifle is shooting directly over the center of the chronograph. I want to have the height set properly; it should never appear as if you are looking down or up to the chronograph. Both the rifle and the chronograph should be level, not canted. I want the left to right position perfect, as well. In aviation terms, you do not want to introduce roll, pitch or yaw in the

positioning of the chronograph relative to the rifle. You do not want to be shooting over the chronograph at an angle.

You also want to aim at the same spot with every shot, as to not put shots through different areas of the chronograph's sensors. My diffuser rods come in two pieces and connect in the center. I use that as my first aiming point by lining up where the rods connect with my horizontal crosshair. My second aiming point is a weld line directly in the center of the steel frame of the chronograph with which I align my vertical crosshair.

Allowing the barrel to cool completely between shots over the chronograph is also important. The reason you want to let the barrel cool between shots is you want to simulate your first shot in the field. The first shot you make on a deer or elk is the most important and it will be done with a completely cooled barrel, which is what you are trying to replicate.

I try to limit the amount of shooting to three different loads to test with only four cartridges per load. A total of 12 shots per rifle, per range trip. (If bringing two or more rifles to chronograph loads, alternate rifles with each shot.)

I shoot only four cartridges with each load to shorten the amount of time spent at the range. If you have more time you can shoot more cartridges. (Five or 10 cartridges per batch are common.) However, be forewarned: waiting for the barrel to completely cool down becomes increasingly tedious the more cartridges you shoot. Remember, the hotter you get the barrel the longer it will take to cool off. Be patient.

I will use data that I recorded while working up a load with one of my personal rifles, a .270 Weatherby Magnum, as an example. I decided which three powder charges to start with, one at 79 grains, one at 80 grains and one at 81 grains. Everything about these loads is the exact same, except for the powder charge. I make four cartridges using each powder charge and then head to the range.

With a clean rifle I put the first shot of the first load through the chronograph, in this case the 79 grain load. I record the information and wait for the barrel to cool completely. For my second shot, I shoot the first bullet from my second load, 80 grains, record the data and wait for the barrel to cool. My third shot is with the third load, 81 grains and record the data.

I shoot in this order to see the difference in velocities, but mainly to use one shot from each group of cartridges to foul the barrel. Firing all four shots in a row from the same load out of a clean barrel will give you slightly inconsistent data.

Let the barrel cool completely and look at the information you've recorded so far. From this point I shoot the remaining three cartridges in each of the three loads. Start by finishing the load from the third cartridge fired. Below is my recorded data numbered in the order the cartridges were shot.

79 Grains:

1. 3227 fps
10. 3212 fps
11. 3239 fps
12. 3226 fps

80 Grains:

2. 3242 fps
7. 3262 fps
8. 3279 fps
9. 3261 fps

81 Grains:

3. 3297 fps
4. 3309 fps
5. 3305 fps
6. 3303 fps

You do not need to shoot any of these loads on paper. Your chronograph will tell you everything you need to know. You can learn how many shots it takes for your barrel to be sufficiently fouled enough to obtain its optimum accuracy. From a clean barrel this rifle needed three shots to start to perform its best. In my experience, most barrels need just two shots from clean to start performing optimally.

You can calculate your average foot per second velocity. Just divide the sum of the individual velocities by the number of shots.

You can find your feet per second per grain velocity, which you get from dividing your average velocity by your total powder weight (in grains). With this information you can estimate the approximate velocity change resulting from adding or subtracting a single grain of powder.

You can also see the efficiency of the each load. You can get to a point of diminishing returns and when you do it will be clearly portrayed in your information. You will see a drop in the feet per second per grain velocity.

Beyond that, you will see the most important information of all, the deviation of each shot from the average feet per second. This tells you how consistent your load is. The closer each shot is to your average velocity, the more accurate your load is.

I find that if I can get each shot within +/-10 feet per second of the average velocity, it is going to be an accurate load. When loading hunting cartridges, I do not find that it makes much difference to reduce the standard deviation beyond this point.

I write out all of my charts by hand and the finished chart looks like this:

.270 Weatherby Magnum, Winchester Model 70 Custom

Brass: Nosler
Bullet: 150 grain Sierra Game King
Primer: Federal 215
Powder: WC867
Case Length: 2.545"
COL: 3.3"

79 Grains - Average FPS = 3226; FPS per grain = 40.8

1. 3227 fps: +1 FPS deviation from average
10. 3212 fps: -14 FPS deviation from average

11. 3239 fps: +13 FPS deviation from average
12. 3226 fps: 0 FPS deviation from average

80 Grains - Average FPS = 3261 FPS; FPS per grain = 40.7

2. 3242 fps: -19 FPS deviation from average
7. 3262 fps: +1 FPS deviation from average
8. 3279 fps: +18 FPS deviation from average
9. 3261 fps: 0 FPS deviation from average

81 Grains - Average FPS = 3303.5; FPS per grain = 40.7

3. 3297 fps: -6.5 FPS deviation from average
4. 3309 fps: +5.5 FPS deviation from average
5. 3305 fps: +1.5 FPS deviation from average
6. 3303 fps: -0.5 FPS deviation from average

As you can see, the 81 grain load is the most consistent. Notice that I recorded the rifle and all of the cartridge components exactly; make sure to do this, as it is extremely helpful when reviewing loads in the future.

This is a very accurate load. When I took it to the range all of my shots were touching. Five shots in, nearly, a single hole.