Testing for Temperature Sensitivity - Part 1 The Powder.
By Doc Beech

When reloading you should be asking yourself a couple of questions about your powder.

1. Is this load summer time safe?
2. Is my powder choice temperature insensitive?
3. What is my average variation (fps per degree shift)?
4. Is temperature variation linear? No.

Just for reference, there are 3 types of commonly used gun powder. Flake, Ball, and Stick. Single base powder has nitrocellulose alone, double base has nitrocellulose and nitroglycerine giving double base powder more energy.

So what are we interested in today? Managing MV with temperature change. Nitrocellulose (the foundation of smokeless powder) burns differently based on its temperature. The warmer it is, the better it performs. This is important to us as shooters for a couple reasons. The first and always most important is safety. If you develop a load in the winter time, that is just barely under a safe threshold, then you run the risk when the temperature warms up of over pressure. You always want your loads to be safe, for the hottest conditions you will experience. Once we have a safe load, the next important thing is managing your muzzle velocity shift. Or temperature sensitivity. Some powders are more sensitive than others. Most powders will fall inside of a range of 0.3 - 3.0 FPS per degree.

Simply getting a muzzle velocity once, then calling it good, is not enough. Just like it's important to have good dope for different ranges, it's important to have good muzzle velocity information for different temperature ranges. This is important for both hand loaders and factory ammunition users. Factory ammunition tends to be much more temperature sensitive than hand loaders, because a lot of factories opt to go with easy to meter powders. Factory ammunition is usually metered, so they need powders that are meter friendly. Some factory ammunition has as much as 3 fps/degree variation. This means that over 10 degrees Fahrenheit it can have a shift of 30 fps (about a 3 moa vertical spread at 1000 yards). You can see how quickly that can cause problems. On the other hand, temp-insensitive powders can have a shift as small as 0.3 fps/degree Fahrenheit. Under that same 10-degree temp swing, you would only have a MV Shift of 3 FPS or 1/3rd of an MOA at 1000 yards. Some factory loads are loaded with temp-insensitive powders. Berger Ammunition uses temp-insensitive powders like VihtaVuori & Hodgdon Extreme. One reason why a lot of factories don't use it, is because it doesn't meter well, and metering is much faster than weighing. This holds true across the board, so Applied Ballistics Ammo hand weighs every charge. This allows them to load with powders that are not highly effected by temperature change.

Temperature sensitivity is not linear. This is why you need multiple data points. Powders will have sweet spots where they are less sensitive. Think of it like an S-Curve and not a bell Curve. Where the areas of high and low stability can fall anywhere in the data. At certain points you might have very little shift over many degrees, while at other points you may find

very rapid changes. The most stable point in the curve can be anywhere, and you need to know where that point is.

So what does all this come down to? As you can see from the difference in shift at 1000 yards, this is important information to the shooter. As a shooter you should be gathering data on your velocity shifts with temperature swings. Just like when you do a ballistic calibration, you do not want to gather velocities too close together. You generally want about 30 degrees Fahrenheit (10 degrees Celsius) between data points. You want the highs and lows of course to be your hottest and coldest points of the year. Also remember that lot to lot variations happen, even with powders. So it's always good to double check that your new lot of powder is following the same trend as the old lot of powder did. You want a minimum of 4 data points. Powders can and do sometimes have a sweet spot where they are less temp sensitive. So you might find a powder that has higher velocity swings in 40-degree temp, than it does in 80-degree temp. This information is good to have on hand, even if you are using factory ammunition.

One more important side note to bring up here. This is all in relation to the physical temperature of the powder, not necessarily the environment. Artificial heating/cooling (like leaving your ammunition in the hot sun) will have an effect. Air temperature/environmental play a role here. However, the key is that it's the powders actual temperature that determines the change, which for many reasons might not be the same as the air temperature.

This is part 1, of a 2-part series. For now, understand that gun powder goes through a physical change which gives you different velocities at different temperatures. As a shooter you need to know how your specific load is effected by these temperature swings, for not only safe reloading practices, but also for managing firing solutions.