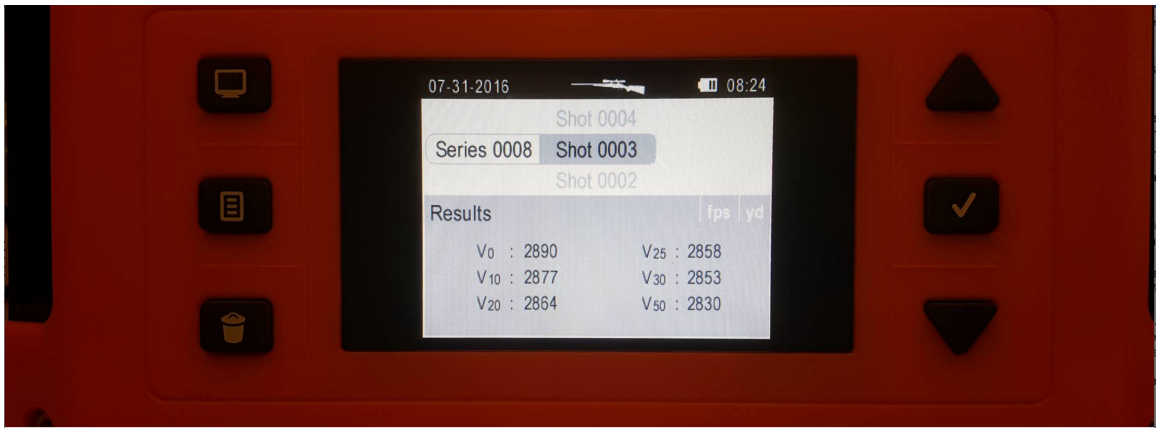

An exploration to find my ideal chronograph.

-Greg Piet (Sin City Precision Member)

Some of you folks who have sat down with me while enjoying a nice adult beverage may have already realized that not only do I like shooting these precision rifles, but I also like hard data to back up statements. A pet peeve of mine are the generic claims that something shoots “lights out” or that a particular combination shoots really well when there is nothing quantitative allowing me to compare their claim to something else. A claim as simple as that it shoots 0.5 MOA regularly with a 5 shot group if the trigger jockey does their part is a great start. You may have seen the long winded write up trying to determine whether a lab grade scale is actually beneficial compared to the automated systems available for a fraction of the price. This write up is a spin off from that test, and has some generic ramblings about the different chronographs I have been using and the journey while using these things. I will discuss what is good, what is bad, and try to back up the observations with some empirical data to help people decide what will work best FOR THEM. Since I am just a free agent in the shooting community, I am not bound to one product however I have been fortunate enough to be surrounded by some really good people in Sin City Precision who have let me use their cool toys to try to learn stuff, and

in this case do some comparisons between products I normally wouldn't have access to.

In today's installment I am doing a comparison between the ShootingChrony Beta Master(SCBM from here out), MagnetoSpeed V3(MS) and the LabRadar(LR) chronographs. Now this is not your typical write up where someone arbitrarily says the product on their team jersey is better or explains why it is so great without discussing the competition. This is written to help the reader decide what is best for their needs. If you are new to the handloading precision rifle game, and don't understand why I am bothering talking about chronographs I will type this as plainly and politically incorrectly as I can. Everyone NEED's a chronograph sooner or later as without accurate info on the speed and spread of a load session one really is just a blind squirrel finding one's nuts. In today's game if one is not using a ballistic calculator (and speed is essential for them to do their job) they are either a caveman, or a true precision rifle Jedi.

The items I want to address are things like "the thing is so sensitive", "It changes depending on the shadow or the sun", and "Putting that thing on the end of your rifle totally messes up your barrel harmonics and you can't do load development with that thing attached to find the best groups." Let us not forget other lovely claims such as "This thing wont pick up any shots" and the ever popular "The thing is useless because it always triggers an error and I have to get off the gun to reset the stupid thing."
This was a long journey and I spent a lot of time and did quite a bit of barrel throat erosion while coming to these conclusions. I spent a lot of time trying to make certain products work, slung a lot of lead seeing if I could actually measure an effect or trend that was present beyond the spread induced by the trigger puller. Let's start off with a run down on the

units and show some general observations with some sprinkles of data to back up my statements(who doesn't love sprinkles?).

ShootingChrony Beta Master:
This is the unit I started out with and I would say I purchased it before I knew any better. The best thing about this unit is the price. I am a techy guy in general, however I found this unit to be a giant pain to change settings. Looking back at the 30 page manual, I get the impression that an Electrical Engineer designed it while in graduate school, and decided to put the prototype to market. It makes perfect sense to the programmer, and the options work, but translating the symbols to English is likely not for the faint of heart. I finally got it to a setup that worked best, and left it alone. After the setup was locked I used paper and pencil to write down all the values and I used an external program to do all the statistics.
The SCBM operation was spurious at best. I was stuck shooting at the local county range so it was all off a bench, I had to align the SCBM in front of the line during a cease fire, eyeball it to the target and once live fire started I could get behind the gun and make sure… it was a giant pain. One good thing was the long wire allowed me to have the display at the table and that was convenient.

As I got more and more data, and I burned up more and more of my barrel, I kept seeing variance in speed numbers,. I saw much more variance in speed than I expected as the day warmed up, my zero was holding and for just a factory 20" 308Win Remington barrel it was shooting consistent and tight groups (1.0 to 0.75 MOA 5 round strings was the norm). I was shooting in Vegas, so a 20 degree change throughout the morning was pretty normal for me, but the speed changes were much more than I anticipated from just temperature. These speed changes were enough to

concern me for drops out at 800 yards with temperature changes throughout the day.

When I was new to precision reloading, I was not confident in my work, looking at my results and reading about all these single digit standard deviation values I was convinced I had no business touching a reloading press… EVER! I wound up using a good factory load as my control to see if it was my loads or the SCBM and environmental conditions were changing the data. I did quite a few tests with 175gr Federal Gold Medal Match as my control group and looked to see if my loads trended the same leaning towards equipment/weather being the problem in large spreads in speed numbers.

By putting these lights on the sunshades it greatly improved the reliability and repeatability of this design however it still does not compare to the other units.

What I found was that the suns position in the sky was causing spread, and the device itself inherently had more spread, and it was more sensitive than I expected regarding where the bullet crossed the light beam path. To improve this I found the rather pricey light packages for the sun shade and I built my own using some LED lights and a 12V battery. The light assembly greatly improved the consistency throughout a mornings shoot, however the system still showed quite a bit of spread compared to what I expected to see with quality match ammo, and my own hand loads that I was meticulously loading at the time.

When it was all said and done, I came to the personal conclusion that the problem was most likely the measuring device and not the rifle or hand loads. I got home from a particularly frustrating range day, turned on the computer and was ready to buy the biggest baddest chronograph my Visa card would allow. At the time LabRadar was in pre-production but I was not going to wait so I plunked down the money for a Magnetospeed V3, and the next chapter of my chronograph journey was ready to begin.

Once the MS arrived I wanted to see immediately how far off my data was between the SCBM and MS so during some of the first sessions I used both the SCBM and MS at the same time. As you can see below the results show the variation between the two measuring devices, and the huge variation between the devices as far as consistency.
For Federal Gold Medal Match 175gr rounds SCBM showed an average speed of 2564fps with an Extreme Spread of 244fps while the MS showed on the exact same firings an average speed of 2575fps and an Extreme Spread of just 30fps.

MagnetoSpeed V3

Almost immediately after using this device I was feeling better about my loads, and I was energized to get good data on what I was using so I could have accurate info for my ballistic computer. I also purchased the adapter to grab data on my mobile phone so I could log lots of test runs and even start plotting data on my phone if I so desired. There really isn't much to say about the Magnetospeed, you clamp the thing on(with the proper spacers), turn it on, and shoot. If it doesn't work there are only a few things you can do to check its operation.

With regards to design features, it is a pretty slick idea, and extremely easy to use. I tried fiddling with the overall sensitivity but it was completely unnecessary. Personally I prefer to shoot with a suppressor so with the can the worst thing is that I have to slide the mirage cover off to mount it and I get some mirage on the second half of some of my strings. The MS uses a piece of plastic that needs to get snapped off of it (like an old model kit) to lock the nylon strap in place and it has slipped out a few times on me. Other than having to re-thread the nylon strap and making sure you don't blow up straps with brake ports(if you use that sort of thing), or if you shoot the device by having the wrong spacers on the system itself the unit is pretty solid. The phone adapter can be a bit touchy for volume levels to transfer the data but it is completely trivial to adjust.

My rigs are running mostly Remington Sendero profile barrels, and almost exclusively have a suppressor weighing about 20oz on the end. I never really thought much about having the MS attached to the end of my rifle, as there was plenty of other mass on the barrel that should mask the contribution of the MS. In the last article I specifically looked at whether the MS is a detriment when doing load development and how it affected accuracy and precision in my tests(yes there is a difference between the two).

UPDATE: After writing the core of this article I removed the can (and a piece of my soul left at the same time) and put on a Little Bastard Gen2 brake and did some load development. Consistent with my last articles findings the MS changed the POI but did not adversely affect any of the group sizes during load development(and had a SD of 8 fps compared to the last session where the nay-sayers poo-poo'ed the findings due to the SD values). So either I have a Remington 700 action on an AICS chassis with a 26" #13 Bartlein barrel that has magical powers brought on by DMR_LLC who cut the barrel for me and therefore group sizes are unaffected, or I am just mounting the MS bayonet consistently and in a fashion that doesn't muck with groups nor does it induce "flyers."

Labradar

I have been lusting after a LabRadar for a while now as I love the idea of having a device to measure bullet speed accurately without anything attached to the rifle. The concept of plopping something next to my rifle and sending off a few rounds to verify speed is extremely appealing to me. Fortunately for me I was handed a LabRadar unit by a member from Sin City Precision and asked to give it a go. Of course I was supposed to geek out with it and get it working as it was reported as being a bit finicky. Unfortunately I have the least amount of experience with this unit compared to the other devices so as far as providing useful information this may be a bit lacking for some people looking for the in's and out's of the LR.

The system works, and it works well… when it works. Configuration is little a bit more involved than the MS. There are default configuration settings and they seem pretty general, however I normally am outside the box so default settings rarely work for me. In short the system is using radar at a

few pre determined distances and extrapolating back to muzzle velocity. It does this calculation extremely well using the tools at my disposal. Namely comparing my MS with the LR , and then seeing whether the speed matches up with my calculated drops for other distances. The LR and MS are very close to each other, and the deviations are consistent. During the last test session average muzzle velocities were within 5fps. I can't say for certain that one's data is better than the other however the LR as cool as it is there are some issues I have not worked through fully due to time constraints.

I was finally able to use the system to determine my rounds ballistic coefficient based on the units data. I used the JBM Ballistics online calculator to determine a G7 coefficient with the data from the LabRadar, and my Kestrel 4500. I then matched the B.C. up to my ballistic software to see if everything lined up. From the LabRadar data I took the average from about 10 shots for muzzle velocity and the furthest distance acquired for all ten rounds(60 to 70 yards for my 6.5mm depending on aiming). The G7 value was used in my ballistic solver (Strelok Pro) and using the LabRadar speeds the drops lined up in the ballistic solver all the way out to 900 yards.

The biggest handicap of the LR can be the triggering and pickup. I have been able to use a few different units now and each unit has behaved slightly differently. Just prior to writing this I happened to meet up with another shooter who had their LabRadar as well. We were separated by about 20feet under a metal shade structure(lots of echo and reverb), and there were zero accidental triggers. So if you are shooting around someone else my experience shows that you will probably be fine if you have some distance between shooters, and the system is not one of the extra sensitive ones that reportedly are floating around. With the first unit I used the built

in microphone pickup which caused triggers from neighboring shooters and false reads were frequent and easy to have in normal range conditions. The second unit which I purchased was an absolute dream to use without false triggers unless I was trying to make it happen. The false triggers can cause errors where a button needs to be pressed to continue resulting in constantly getting off your rifle. In order to press the continue button you likely have to get off the gun, press the button, then get back on the gun and try again. For those of you wanting to get speeds and shoot groups at the same time for load development this is unacceptable. As a redesign I could see LR going the same route as the new GoPro cameras where there is virtually no display at all and almost all controls and info is designed to be done through your mobile phone either with Bluetooth or a peer to peer WiFi network. Having a button available to “click OK to continue” without getting off the rifle would help.

There is a sensitivity setting which I had to adjust so my suppressed rifle would pick up, and that worked well(mostly). One annoyance was that with my can (which works really well) the LR unit had to be at the end of the barrel in order for it to get triggered. Any “press enter to continue” requirement would result in completely getting off the rifle and destroying consistency. The major downside with increasing the sensitivity was with the first unit tested I was with a shooting buddy who was using a brake 20 feet away and he triggered the system and induced an error or it logged his shot. Now when he used the LR with his sensitivity setting it was possible to have my suppressed rifle not trigger the unit. I have an idea utilizing their external microphone and adjusting the sensitivity which may allow it to work around neighboring shooters, however there are a few other issues in that basic idea that may need to be resolved. The unit I recently acquired was not getting triggered by a rifle just three feet away under a metal roof shade structure but still working fine for my rifle, so I would

conjecture that they have adjusted the settings, done a slight redesign, or there was something awry with the first LabRadar pickup that I tested.

An item for discussion is about a report I read stating the LR was "incorrectly" calculating standard deviation. I experienced this by just tossing the numbers into the excel script for standard deviation and the values did not match up. I was sure a simple firmware upgrade will solve any formula glitch, but it was a bit disheartening seeing the data not match initially. I did some comparisons with a few statistical variants and I determined that the LR and MS is assuming the calculated standard deviation is a sample of the population of data and not "all" the data population available. For the Excel guys out there stddev.s versus stddev.p. As long as you are consistent in your methodology the values should prove useful, but switching back and forth is not good practice, and if you want to compare to others stddev.s is what the big two seem to be using..

I am not entirely sure what happened but I had some power issues one time out. The battery gauge read half way or higher, but it stated it did not have enough power to activate doppler radar. I plugged in a gigantic USB power supply that was fully charged to keep the LR running. A few strings later it gave me the same error about not enough power. I jiggled the USB cable and it ran until the end of the day. In all fairness I was not familiar enough with the display at the time to check for an icon of a power cord to determine if the unit was utilizing the external power pack.

I didn't see any setting for beam divergence/steering which is typically a limitation on antenna design but the ability to narrow the effective radar cone could reduce false reads by my neighbors slinging lead, or just induce more error messages. In addition the aiming notch on the top of unit is rather low tech for such a high dollar piece of equipment. If you are trying

to stretch out distances you are measuring speed to get a good B.C. calculation a better aiming system would be really nice. I have seen some people put a spent case on the notch to help, someone did a set up for a red dot, and a few other little tricks but we can save that for a later day.

Data quality between the Big Boys:

I will briefly touch upon the idea whether one product is superior over the other in terms of data quality. For the tests themselves there were 5 shot groups so the LR has twice the data. I did get some additional data while making sure I had the LR unit working prior to filling up the target and I will have that raw data available as well. To isolate variance in strings I also calculated individual averages for the LR data. In short summary, the two units give the same data and the same data quality. One should pay close attention to the LR STR1 compared to the MS as that data was taken at the same time by the "same bullets" for the most part. The STR2 data was taken when the MS was disconnected so that data is not generated by the exact same firings as the MS data.

AMAX LabRadar		AMAX Magneto	
SD	23.122	SD	35.273
AVG	2878	AVG	2873
ES	89	ES	91
SD STR1	35.246276	AVGSTR1	2870.6
SD STR2	9.1214034	AVGSTR2	2879.8
ES STR1			89
ES STR2			19

RCBS LabRadar		RCBS Magneto	
SD	15.231	SD	13.292
AVG	2873	AVG	2871
ES	38	ES	31
SD STR1	12.055428	AVGSTR1	2866
SD STR2	15.840349	AVGSTR2	2880.75
ES STR1			28
ES STR2			34

LabScale LabRadar		LabScale Magneto	
SD	12.822	SD	8.261
AVG	2872	AVG	2876
ES	34	ES	19
SD STR1	8.6554414	AVGSTR1	2872.25
SD STR2	17.559423	AVGS2	2871.5
ES STR1			20
ES STR2			34

Just a little analysis on the raw data. STR1 calculations were made from the same string as when the MagnetoSpeed was used for direct comparison. These numbers have omission of shots discussed in previous articles.

Of particular note you will notice that the AMAX data between the MS and LR give different results. That discrepancy is because the LR unit has different amounts of measurements so those calculations are running off different amounts of data. In the same table however the MagnetoSpeed statistics are calculated using the same shots as the LabRadar STR1 data. Note the values match up between the two showing that you essentially get the same data from the LabRadar compared to the Magnetospeed.

Another factor is just reliability of data acquisition. The MagnetoSpeed got configured initially, and after that the hardest thing is to press enter before shooting to collect data. The LabRadar requires considerable setup between rigs if sensitivity is an issue, the time out settings can catch you off guard if you are not ensuring you make a follow up shot quickly enough, and you have to re-aim the LabRadar if you go from target to target. Below is the raw data of collected speeds allowing anyone to look at shot for shot direct comparison of speeds.

AICS 6.5 Creedmoor Razor G2 TBAC 30P-1 Bartlein 26" Timney 510 Rem700action

AMAX		RCBS		LabScale		42.4 OLD LOAD FOR ZERO AND AMAX
LabRadar	Magneto	LabRadar	Magneto	LabRadar	Magneto	LabRadar
2889						2942
2891		2855	2858	2880	2884	2904
2841	2841	2865	2872	2873	2874	2840
2853	2855	2883	2889	2860	2865	2926
2930	2932	2861	2865	2876	2880	2914
2855	2861			2883		2848
2874	2875	2892		2856		2877
2870		2859		2890		2951
2886		2893		2857		2919
2870		2879				2876
2884						
2889						

Raw data measured. For a given load and firing you can see how close the measurements were between the two units. Data points were omitted as described in previous articles.

One item I have not touched upon is the additional data available with the LabRadar. It will give you speeds at multiple distances from the rifle. The cover photo in this article shows the speeds at different distances during flight. That data and drop off in speed can allow the user to calculate more than the MagnetoSpeed ever will. I don't have any of the modern data

analysis packages like I used in the past, and fitting curves using a paper and pencil did not appeal to me when I have much better data available to me already. In addition I set up the LR to collect doppler info out to 50 yards maximum initially and I honestly believe I need data beyond what the LR can resolve to get useful calculations beyond what the manufacturers or other third parties already tell us unless you get a good statistical ensemble in a string of fire and use that average.

Final thoughts:

If I had my choice I would be doing all my testing without anyone around except my R2 unit (See I got a second Star Wars reference in there) to aim and press the buttons on my LabRadar since I can't reach the controls while behind the gun. Sadly I don't have my own R2 unit so this device loses a degree of convenience for a good portion of the shooters in the country. Since I acquired my own LabRadar it is the only chronograph I have used and I have not been tempted once to hook up my MagnetoSpeed although I do feel like I have a great backup knowing it is in my arsenal. I believe I have demonstrated that the MagnetoSpeed doesn't significantly affect my precision tests for finding a given load, and if I have to shoot around a bunch of others (like zero'ing the day before at a precision rifle match) it is OK to use it for speeds, but one would have to re-zero without it hooked up when it is all said and done.

So in summary, I think the data shows that if you have the ability to shoot alone, or have a unit that is more forgiving with regards to getting triggered by other shooters use a LabRadar, however if you have to shoot around others that will cause false readings, a MagnetoSpeed can actually get you speed and grouping(at least really close). Under no circumstances should you use the old school ShootingChrony design optical sensors unless you are a glutton for punishment or need it for target practice.