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Harvey's Hot Rod Anschütz BR-50

Optimizing the Anschütz BR-50 2013-- Beyond Factory Accuracy

This article traces one shooter's individual odyssey in precision rimfire shooting. Some 10 years ago, Brian Harvey fell in love with a "stealth black" Anschütz BR-50 (2013 action) that belonged to a friend. Eventually he managed to acquire the rifle, a ground-breaking design that remains one of the most advanced factory rimfire rifles ever built. Brian's BR-50, his first truly accurate smallbore rifle, got him started on a quest for accuracy. Here he recounts his experiments with ammunition, tuners, rifle balance, and barrel indexing. Over time, Brian has "hot-rodded" his Anschütz BR-50, and it now boasts an indexed Benchmark 3-groove barrel with cone breech, March scope, and custom Fudd tuner of his own design. Brian has made amazing progress in his shooting with this rifle, but as he tells us "I still learn something new every time I go to the range."



Hot-Rodding the Anschütz BR-50

by Brian Harvey

Love at First Sight

Back in 1997 my best friend called me up and said he just bought a new 22 rimfire that I would like. Boy, was that ever an understatement! Upon laying eyes (and hands) on this rifle for the first time, I felt emotion stirring in me that I never knew existed. You know what I'm talking about, when something not only looks just right, but feels as good as it looks. I told him at that moment if he ever wanted to sell it, I wanted it.

Flash forward to 2004. My friend called and said the black BR-50 was finally for sale. At long last I would have my dream rimfire rifle. I happily paid him the \$1600.00 he had invested in the gun. It was a bargain. In my mind, I have one of the finest factory rifles available. Until now, the best shooting rimfire I had was a 22 Marlin bolt action. The Anschütz was a huge upgrade to say the least.



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The rifle is a BR-50 2013 single-shot. From the factory it came with a 19.6" barrel and a special stock upgrade option that bumped the new price up \$500 over the standard BR-50, according to my research. As delivered by Anschütz, it has an adjustable cheek and butt and has a superb two-stage trigger that is fully adjustable in both stages. It came with a barrel weight that looks more like a suppressor than anything else. Above is the rifle in original factory configuration. This was the starting point for my odyssey into rimfire accuracy. I've subsequently added many upgrades, including a new Benchmark barrel, custom metal buttplate, March scope, and an arsenal of tuners.

Initially, I wanted to see how the rifle, in stock, factory form, would perform with ammo cheap enough that I could still eat once a day. For testing the factory set-up, I settled on Lapua Midas L and Wolf ME. The Midas L was the benchmark as it averaged .297" for twenty, 5-shot groups, versus the Wolf ME at .4" average. Since Midas outshot the Wolf by a good margin, my mission was to see if I could get the Wolf to match it. Now it was time for a tuner and some tight groups. I called Scott 'Fudd' Hamilton and ordered one of his bloop style tuners based on his recommendation

Working with Tuners — Part Science, Part Voodoo

Early on, I spent quite some time working with the tuner and did not see much difference in group size, the average was around .380" now. So I spent more time researching and reading and came to the conclusion that my 11 oz. tuner wasn't heavy enough. I picked up some washers of the correct diameter that weigh .65 oz each and thought 10 should be enough. When starting to add weight, the POI was all over the map and group size was as well. I kept adding one washer at a time onto the bloop tube and it was not looking good the whole time. I was sure it wasn't going to work because the groups kept getting more erratic. When I had added all 10 washers, the rifle gave an average group of .195" for eight 5-shot shot groups, on that day. This was by far the best the rifle had ever shot. But, as I would soon learn, rimfires are very 'touchy' with regard to how accurate it is on a given day.



Now, based on Calfee's theories, the barrel was not actually tuned, but damped. I spent some more time studying and came up with a design for a tuner that I had not seen offered. It is based 100% on Calfee's theories and I called Fudd to see if he could build it. Two months later I have a new tuner that weighs 14 oz. to start testing. I started testing and quickly found that this tuner was much like my other one. It needed more weight. After adding 2 oz. to this tuner, it started showing promise. When I found the preferred area to start with, then fine tuning was just that. The rifle sounds WAY different than anything I've heard before when shooting.

Now, the new tuner is far less picky about conditions, or different lots of ammo, but I have yet to duplicate what it did on the .195" day. This setup gives an average of .275" with Wolf ME. With Midas L, its 6-group average was .211".



Tuning and Bench Material

Here's a rarely discussed subject—the effect of benchtop surface composition on vibration damping and tuning performance. I learned you not only have to tune for the ammo, but you also have to tune for the bench material. I experienced this first hand recently.

Recommended Vendors

- Bruno Shooters Supply
- Midsouth Shooting Supplies
- E. Arthur Brown -- EABCO
- AccurateShooter eStore
- TacShooter eStore



I usually shoot from a very sturdy wood bench, and developed my tuner settings on wood. This weekend, at a different range, I shot from a concrete bench and it changed the tune of the rifle greatly. I was listening to the rifle when adjusting the tuner and it took another two outward revolutions to bring the rifle back in tune. The concrete transmits a lot more sound to your ear and I could hear from the first few shots that the rifle was not tuned. You can hear a big difference between wood and concrete. It has been said that "rimfire shooting is all about vibration damping." If that's true, I certainly learned that you have to consider *all* the elements at play—the action, stock, rest, and bench can all affect the gun's damping and vibration.

Shooting Styles—Bipod vs. Pedestal Rest vs. One-Piece

Initially, I did most of my shooting with this rifle using a bipod on the bench. Shooting on something other than a bipod and bag was a new challenge. The bipod has always given good groups but when changing bulls on a score target your POI is all over the place. The conventional pedestal front rest and rear bag works well but I felt I didn't have enough time with it to really master that set-up. The POI was still 'iffy' and moved somewhat.



I then made the big jump to a one-piece rest, the kind of set-up used by top ARA rimfire shooters. I placed an order for a [Roger von Ahrens](#) one-piece rest. Roger's rest is not only a work of art (see below), but it shoots better than it looks. It is unreal how good it is. Bye, bye POI problems! Once I started using the Von Ahrens rest I was shooting tiny groups right away—sub .2" with ease, with many around 0.15" and some closer to 0.1", all without the tuner! Yes the rest makes a difference, needless to say.



The slick-looking copper buttplate was custom-made for this rifle by my friend Jeff Harris, a very skilled machinist. Weighing three pounds, it is built in two pieces, so you can use just half if desired. The extra weight in the rear made all the difference in balancing the rifle on the rest. It only took Jeff an hour to make this buttplate, he's that good.

Factory vs. Custom Barrel—Upgrading to a Benchmark

Earlier this year, your Editor contacted me about doing a story on the Anschütz. He let me know Mike Ross of [Ross Precision](#) had a new 26", 3-groove, 16-twist Benchmark barrel set up with a cone breech for a 2013 action that might be available at a very nice price. This was definitely an upgrade I wanted to try. I wasn't completely happy with the factory barrel. I also thought the extra barrel length might give me more consistent ammo performance.

The factory barrel never seemed to give consistent velocities. Extreme Spread (ES), Standard Deviation (SD) and averages were all over the map. Within the same batch of ammo, some would clock sub-sonic and others supersonic. It also would foul up and take a good cleaning after every shooting to bring it back to top form. It also fouled up the tuner. After 100 rounds, the inside of the tuner would be black. The muzzle would cake up as well. The tuner would need to be removed to clean the muzzle it was caked so bad.



The Benchmark out-performed the factory tube in almost every way. Right from the start, groups with the Benchmark *without* a tuner were as good or better than the factory barrel's groups *with* a tuner. As hoped, ammo velocities were much more consistent over the chrono. The Benchmark is also more consistent from session to session.

The difference in fouling was like night and day. The Benchmark seems to go on forever before needing cleaning. Even then, it is still shooting well. The muzzle barely gets light gray and the tuner is still light gray after 3000+ rounds. The barrel hardly fouls and it looks to be just a case of pushing out the residual with a patch or two. Big thumbs up to Benchmark for making such a good product.

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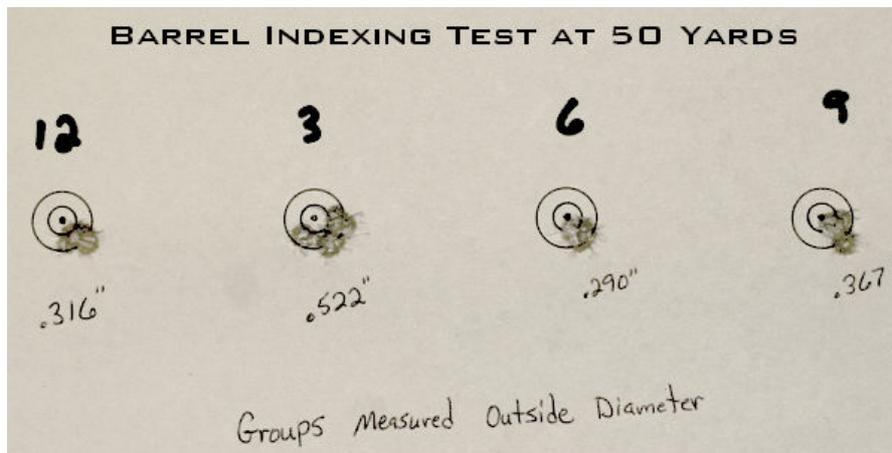
Barrel Indexing—Worth Trying with an Anschütz 2013

The concept of barrel indexing, discussed in greater detail by Mike Ross at the end of this article, is pretty simple. You test the barrel in different rotational orientations to see if one particular "clock setting" produces the best groups. Mike has done a lot of research on this and he has found that most rimfire barrels have a definite rotational "sweet spot" for best accuracy. This usually corresponds to a barrel orientation that produces the lowest Point of Impact (POI). Since the barrel in an Anschütz 2013 is clamped rather than threaded, it is much easier to experiment with barrel rotation. If you have a cone breech on your 2013's barrel, indexing is a simple matter of loosening the action and rotating the barrel to the desired position. Typically you start in 90° increments.



My factory barrel has conventional extractor cuts and so it was not a good candidate for indexing. But the new Benchmark barrel, with its cone breech, was ideal. All I needed to do was unclamp the action and rotate the barrel. (I did have to remove the extractor claws to get the headspace right.) Mike had tested the barrel in his test fixture before shipping it to me and it came with a recommended index point. I was curious to see if I could confirm Mike's test results when the barrel was installed in my Anschütz.

I came up with the plan of having a friend index the barrel, and label each position as 1,2,3 and 4 and to have targets labeled as well. He would later reveal where the barrel was indexed for each test number. Shown below is one target shot in very good conditions. It's representative of what the other targets look like after zeroing each index point. From left to right the target shows 12, 3, 6 and 9 o'clock index points. Time will tell if other index points are better, but my rifle shows a preference for a couple of points. The average group is smaller at a couple of index points and it showed this on ALL 5 targets. The difference is not dramatic, but it is there. (Note: For the target shown below, I rezeroed for each index point first. This is necessary because of the POI shift described in the next paragraph).



Also significant was that when changing 90° index points, the POI shifted with each new rotation—just as Mike predicted. In fact, the POI shift was a bit of a give-away as to which index point I was shooting. Changes in POI occur, Mike believes, because the bore has an internal curve. As you rotate the barrel, that curve is re-oriented to “favor” left, right, up or down, so the bullets end up at a different spot on the target. NOTE: Only the barrel was rotated in my tests, not the action. The action stayed put in the stock, so that the firing pin position remained unchanged. The POI shift was caused only by barrel rotation.



The Quest for Perfection—Thoughts on Rimfire Accuracy

After as much studying about rimfire as I have done the past couple of years, it seems each month a new tidbit of info comes out that makes you rethink what can be done. There are countless factors to consider: ammo lots, tuners, bullet lube, ignition, barrel taper (and reverse taper), barrel length, choked bores, freebore lengths, chamber specs, and barrel indexing. I don't know about you, but I can't afford 10-15 barrels with all different chambers and various specifications. The things I CAN play with are ammo lots, tuners, lubes of various types and since I have a 2013, barrel indexing.

The tuner advantage is well documented and is worth the time and effort to get tuned on a rifle. Different ammo lots make a huge difference in tuning a rifle for a given day. Eley probably has the best system of being able to track what your rifle likes.

Lubing your ammo does indeed help cheap ammo shoot better. It helps the Wolf ME alot. There are many lube recipes online that you can try. I have found that Dillon case lube works best for my rifle, with Wolf ME and the factory barrel. It's also the easiest to apply. Editor's NOTE: At most sanctioned rimfire matches it is illegal to modify your ammo in any way. That includes adding or removing lube. But if you're just shooting for your own enjoyment (or bragging rights), there's no reason not to experiment with lube. Just be sure to keep chamber and boltface clean of excess lube.



The biggest thing I have learned about rimfire is that it is all about the ammo. It seems very similar to what I have always heard about tuning a 6PPC, get the tune right for the day, and the rifle will perform to its highest level. The rimfire is the same way. I have not learned so much about rimfire as I have in the last couple of months. The curve is steep and, like other forms of competitive shooting, requires dedication, good notes and lots of practice.

Key Things I Have Learned About Rimfire:

1. Find ammo that shoots, record all data for that day and buy as much of this lot as possible.
2. Once you have a good lot, start testing more lots and then repeat step one.
3. When conditions change, repeat step one.
4. Have several lots on hand on each range trip to ensure you have good ammo for the conditions.
5. You will need a tuner. They do work beautifully and can reduce group size by at least one bullet hole, and sometimes more.
6. Windflags are a must. A 1 mph wind full value will blow the bullet 0.1" at 50 yards.



Acknowledgements

Thanks to Mike Ross of [Ross Precision](#) for the Benchmark barrel that brought a new level to my shooting. Big thanks to Jeff Harris for his help balancing the rifle. Credit goes to [Roger von Ahrens](#) for making such an unbelievable one-piece rest that immediately produced smaller groups. Thanks also go to Bob Collins, Ron Garret and my friends for putting up with my endless talk about this rifle.

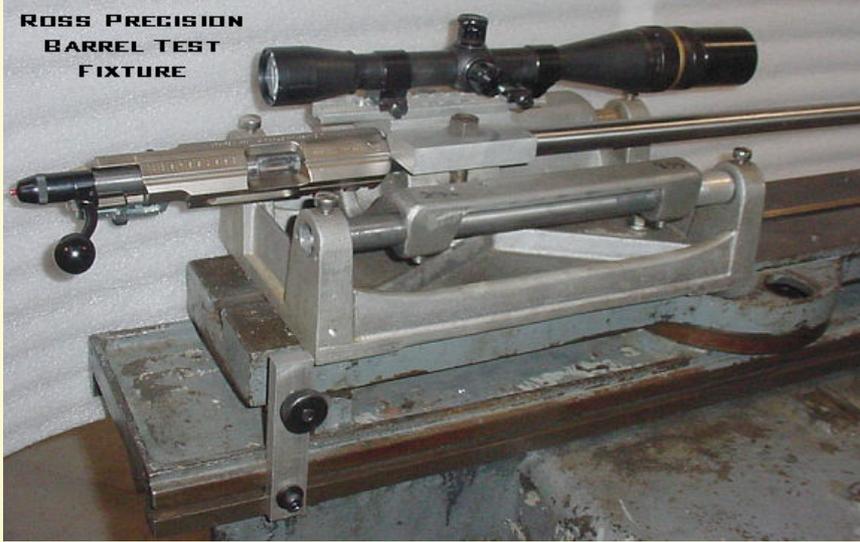
– Brian Harvey –

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Barrel Indexing–Procedures, Benefits, and Challenges

Barrel indexing, in concept, is a relatively simple mode of accurizing. The idea is to test the barrel in different rotational orientations to determine at which "clock-face" setting the gun delivers the smallest groups. The simplest way to find the best index point is to use a barrel-clamping test fixture (photo below), and simply rotate the entire barreled action in 90° increments, while shooting test groups. Then you may "fine-tune" the indexing, by rotating the barrel 1/8th turn or less. Once the best barrel rotational position is found, mark the barrel and return the action to its normal orientation (trigger at 6 O'clock). Then you rotate the barrel within the action to repeat its optimal rotational setting, but now with the action squared up. This is done relatively easily with an Anschutz 2013 action, as the barrel is secured via a barrel-block-style clamp, rather than a threaded tenon. Simply unclamp the barrel and rotate it to the desired position. (With a conventional action with threaded tenon, indexing will require moving the shoulder and re-setting headspace.) If the barrel is fitted with a cone breech, then you don't have to worry about re-cutting extractor slots or changing head-space. The cone allows clearance for the extractor claw(s) at any point on the clock.

**ROSS PRECISION
BARREL TEST
FIXTURE**

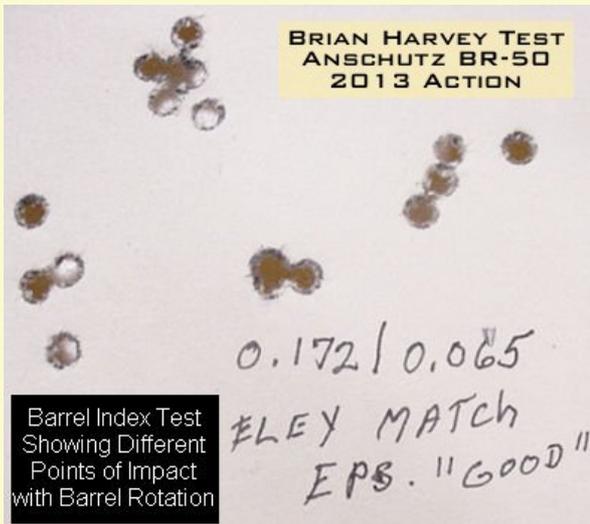


We don't know, with scientific certainty, why indexing produces the effect that it does. Mike Ross, a proponent of barrel indexing, theorizes that since barrels have an internal curve in the bore, you want to make sure that curve doesn't bend to the left or to the right. By aligning the curve straight up and down, this appears to produce the best accuracy.

Does barrel rotational orientation make a difference? To that question, we think the answer is a definite yes. Time and time again, rimfire tests have shown that bullet point of impact (POI) migrates very distinctly as a barrel is rotated. In fact, the POI can shift by 2" or more at 50 yards! This POI shift will be observed both when the barrel is rotated by itself AND when the entire barreled action is rotated in a clamping fixture. That disproves the notion that the POI shift is caused primarily by a change in firing pin location relative to the breech.

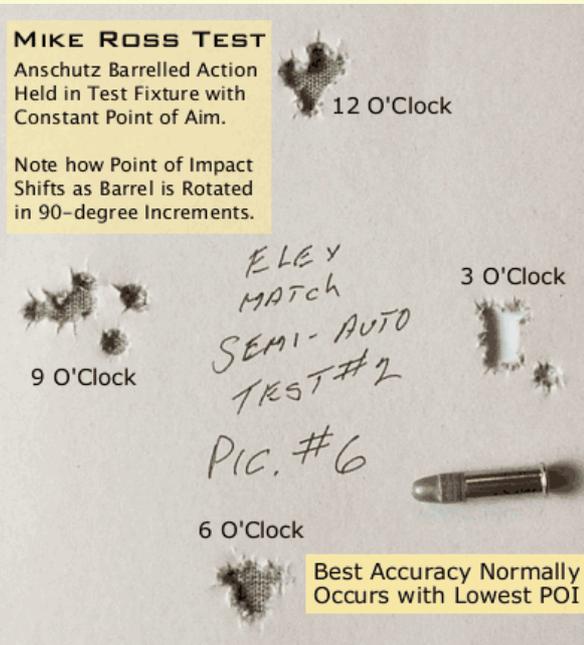
Does indexing improve accuracy? That is a trickier question. Without a doubt, something significant happens to bullet flight-path as the barrel is rotated. Shot impact will move up, down, left or right. After much experimentation, Mike Ross has observed, empirically, that not only does group POI change as the barrel is rotated, but that group sizes tend to open or shrink demonstrably as the barrel is rotated. Mike observed that 90+% of the time, best accuracy was achieved when the barrel orientation produced the lowest point of impact. In the few other cases, the barrel position delivering the highest point of impact yielded best accuracy. Mike theorizes that this shows that a rifle barrel shoots best when the curve in the bore runs straight up or down as opposed to bending to the left or right. This makes some sense, as the bullet's flight aligns with the natural drop induced by gravity. It is important to note that the point of impact is regulated exclusively by the barrel orientation and is completely independent of the action orientation.

Mike Ross explains: "As one initiator of the 'revived' barrel indexing concept (I can assure you this was not my invention), I can say that its application to smallbore rifles has been both interesting and mildly controversial (See Editor's Note). At the very least, it has caused smallbore shooters to come to grips with the reality that barrel bores really are not as straight as they might once have assumed. Along with that comes the novel idea that getting the bore curve to work toward improved accuracy rather than against it, is also something that has been met with some resistance.



Nevertheless, what I do hope everyone can agree on, is that going to the trouble of correctly indexing any barrel, does not carry with it any potential for harm to accuracy, only good. Nor have I ever seen any instance where the 'good position' could not be found. And that has been from a very large number of barrels. The photo below shows the result of my testing with my own Anschütz 2013 action (not Brian's), using a mechanical test fixture. You see four sets of groups, with very different points of impact. Each group set was fired at the same point of aim (the fixture holds the scope independent of the barreled action but fixed in relation to it). The only difference was that the barreled action was rotated in 90° increments. Whether you think indexing aids accuracy or not, clearly you can see that barrel rotational orientation does have an impact on the bullet's flight. The POI shift is undisputable. And I can run the test over and over again and get similar results. Four barrel orientations (on the clock-face) will produce four distinct and separate impact clusters.

With the acceptance that barrel indexing is a valid accuracy step however, comes the reality that it does not have the same level of convenience for the average shooter as does the more typical after-market devices commonly used, such as muzzle tuners and the like. This presents a real problem for the shooter as he contemplates asking for the extra step of indexing to go along with his next barrel change. Gunsmiths are simply not 'geared up' to accommodate it, and are consequently working hard to find a polite way of saying no to doing it. That may well change, but it will take time for that to happen. The article you are reading here is certainly a step in the right direction.



What else I might add here would be that there is ample evidence that vertically orienting the bore-curve of any barrel, regardless of caliber, bullet material or bullet weight, has a positive effect on the performance of that barrel. This was discovered more than a century ago, and to this day, the U.S. Military Arsenals pay very close attention to this aspect of artillery barrel fabrication. Its application to smallbore rifles, and its subsequent good effect, simply was not suspected until someone happened to give the concept a try. I rather doubt I was the first to do that, nor does that matter in the scheme of things. What is important is that now, for better or worse, you know about it, and a mere year or so ago, you didn't. What you have now, is an accuracy option you didn't know you had." — Mike Ross

Editor's Note: In a recent issue of *Precision Shooting* magazine, Bill Calfee tackles the question of barrel indexing. Calfee is a great smith, a true innovator who has built numerous match-winning and record-setting rifles. You have to admire Calfee's willingness to look into the subject. But it's obvious that he has his doubts. He doesn't say outright that indexing doesn't matter, or that barrel rotational setting has no effect on bullet travel. In fact he never deals with the "64 Dollar Question", namely "Why does barrel indexing affect Point of Impact (POI) so dramatically?"

Clearly, for simple barrel rotation to alter POI so much, something significant is at work. Calfee never disputes that fact. However, Calfee does challenge the practical utility of indexing. In a nutshell, he argues that the procedure is flawed because the results cannot be verified by testing. Is Calfee correct in saying that gunsmiths shouldn't bother to index barrels because, according to him, there is no way to verify what works?

Two principal points lead Calfee to the conclusion that indexing can't be verified by testing. First he says that firing pin position is all-important—that it trumps all other factors. Hence, he argues, any indexing test procedure that merely rotates a barreled action is flawed because the changed firing pin position alters accuracy. Calfee specifically asserts that the rifle will always shoot best with the firing pin in the 6 O'clock position.

If Calfee's correct, then Anschütz actions should always shoot better in the trigger-on-top, inverted position. That is easy to check, by using a test fixture and clamping the 2013 action upside-down. So, does an inverted action shoot better as Calfee predicts? Actually not.

In dozens of tests, inverting the Anschütz 2013 action did NOT correlate to better accuracy, as opposed to any other position. In fact, firing pin position (at any point on the clock face) doesn't really seem to matter much based on mechanical rest results with the Anschütz 2013 action. The tests demonstrate that firing pin position is NOT all-important—at least with the Anschütz 2013. Accordingly, it's hard to go along with Calfee's belief that firing pin re-location necessarily invalidates the results of index testing. In fact, if anything, testing with incrementally-rotated barreled actions shows that firing pin orientation may actually be relatively unimportant in the overall scheme of things. That makes sense when you realize that virtually all current rimfire accuracy records were set with 12 O'clock firing pins, the "wrong" position according to Calfee.

Secondly, Calfee says indexing tests are not repeatable because every time you open and close an Anschütz 2013 action to move the barrel you disturb the bedding and action torque settings, and that will produce unpredictable results. It's certainly possible that clamping and unclamping the barrel with the action fitted in the stock could have some effect—maybe minor, maybe major. But the answer to that is pretty simple—take the whole barreled action OUT of the stock and test the way Mike Ross does, with a barrel-clamping test bed. This eliminates the action to stock connection altogether, and

hence eliminates the possibility that a bedding change would affect test results. By employing a test fixture there is also no need to unclamp the Anschütz 2013 action to re-orient the barrel—you merely rotate the entire barreled action.

Ahah, one might say—that's fine, you don't need to unclamp/reclamp the barrel when using a test fixture, but you WILL need to do so when the barrel is re-positioned so the action can be re-installed in its normal trigger-down configuration in the rifle. Won't that alter the findings? Will the magic "best" index position be lost when the barreled action goes back in the gun?

By all indications, again based on dozens of "indexed" barrel installations in rifles, the pre-determined accuracy position repeats. This has been verified by numerous actual shooters, including All-American 6400 smallbore champion and frequent Dewar Team Member German Salazar, and, here, by Brian Harvey. There is no evidence that the mere process of replacing the barreled action in the stock somehow, mysteriously, "wipes out" *all* the positive effects of indexing. Conclusion: What is observed in the test fixture normally remains valid when the barrel is relocated in the action and the barreled action is replaced in the rifle. That's what the actual field results tell us.

So, is indexing "fatally flawed" and "un-provable" because of firing pin placement or bedding issues? The test results strongly indicate otherwise. Dozens of test sessions with actions clamped in mechanical rests and fired in every possible orientation contradict Calfee's belief that firing pin position is all-important. Likewise, variables introduced by bedding disturbance can be eliminated by use of a barrel-clamping test fixture. Bottom Line: Yes it is difficult, when "tuning" a barrel's rotational position, to isolate *all* the variables that can affect accuracy. However, when done right, index testing can often yield meaningful and repeatable findings that translate to tighter groups in the test facility and on the range.

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Topics: Anschütz, Anschütz, Rimfire, 22LR, Benchmark, Bill Myers, William Myers, Mike Ross, Ross Precision, ARA, American Rimfire Association, Worst-Edge, Best-Edge, Wolf, Wolf Ammunition, Lapua Midas, Eley, Ely Ultimate, Ely EPS, ELY flatnose, 2-groove, Two-groove, Barrel Choke, Index, Tuner, Fudd, one-piece rest, Uni-Rest, Roger von Ahrens rest, Bruce Baer, Laminated, 50-yard range, Video, free recoil, Rimfire ammo, Bison Barrels, Barrel Indexing, Cone Breech, Bedding.

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