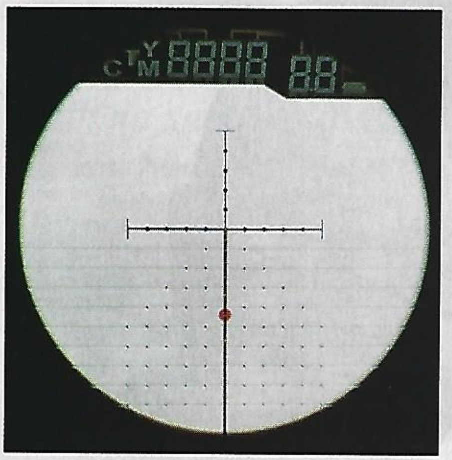


The Burris Eliminator III ranges the distance, and a lit red dot on the vertical wire (above) indicates the aim point.

High-Tech scopes for precise Trajectory Compensation

By Al Voth

I'm ancient enough to remember when if I wanted to hit a distant target with a rifle, I just aimed higher to compensate for the bullet drop. Yes, it was simple, and I managed to take plenty of game and predators at reasonably extended ranges. But it certainly wasn't precise, and only hunters who spent years shooting at distant targets were really good at it.

Technology now helps the rest of us compensate for lacking such remarkable skill, and with that help I can hit ground squirrels at 300 yards and coyotes at 500. I am fascinated with this new technology and have tried most of the sighting equipment designed to compensate for gravity's effect on a distant bullet.

The spark for the revolution in trajectory compensation wasn't the optics but rather the ready availability of affordable laser rangefinders. Range estimation used to be little more than a guessing game. But these now-commonplace devices provide precise measurement, typically within a yard or two at any reasonable shooting range. That set the stage for the development of modern trajectory compensation systems, which I break down into three basic categories.

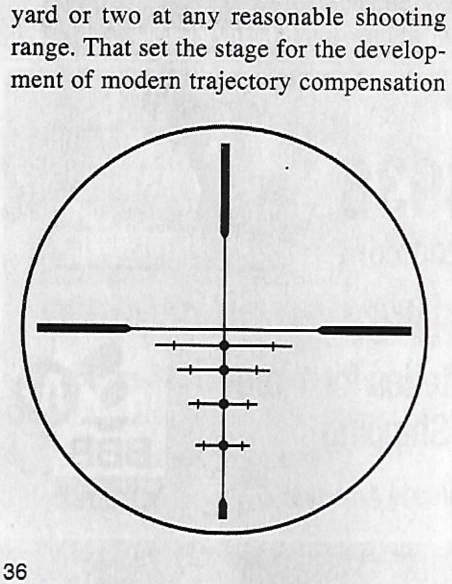
Reticle systems are the simplest, and the simplest of all is the dual-X crosshair. By using the top of the bottom post as a second reference, we get a second aiming point that is more suitable at extended range. If you know the range and also the difference in drop between the sighted-in crosshair and the top of the post, this second reference can be very helpful.

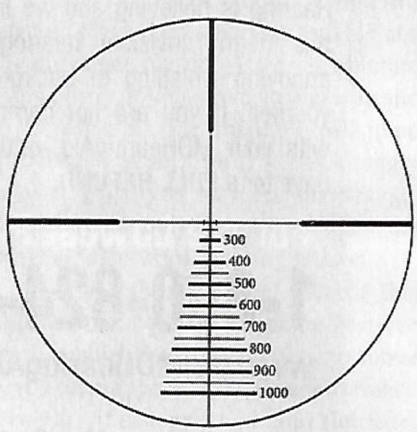
The next step up is the addition of multiple hash marks below the crosshair. Sight in the crosshair at the prescribed distance, and you can use those lower hash marks to line up shots at a variety of greater distances. Typically, manufacturers try to correspond them to the trajectory of popular hunting cartridges.

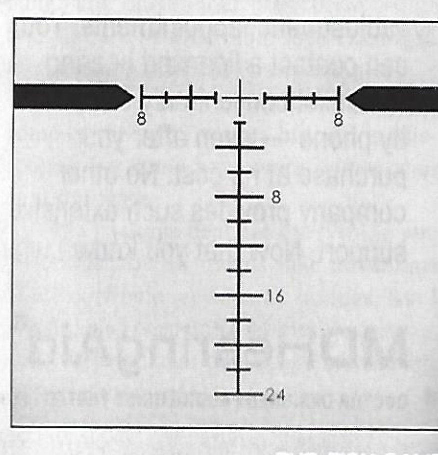
Some mark the lines with numbers indicating the distance at which each hash mark should correspond with the point of bullet impact. Almost all scope manufacturers offer a version of this, some with refinements that allow more fine-tuning.

Bushnell calls their system the DOA 600; Nikon calls theirs BDC; Leupold calls it a Boone & Crockett reticle; and Vortex calls it a Dead-Hold. If you use the suggested loads, these systems work well.

But one limitation is the fact your load's trajectory probably won't exactly







Bushnell DOA (left) aiming points approximately match popular calibers at various ranges. Quigley-Ford scope (above) holdovers marked in yards. Lower reticle wire in the Vortex LRH (right) is marked in minutes of angle.

follow the same path as that predicted on the reticle. Slight differences in bullet ballistic coefficient, muzzle velocity and field conditions all effect how a bullet flies, and these differences only increase as distances grow longer. But out to 500 yards, maybe 600 with big game, it works fine as long as you know and closely emulate the load the company used.

The key is to test-shoot your actual cartridge from a steady bench at the various hash-mark distances. Then you can see for yourself how well the points of impact coincide. Shoot five-shot groups, throw out any obvious "flyers," and then use the center of the group to further iron out any shooter error.

If it isn't close enough to assure a hit in the vitals of the animal you will be hunting, shoot some more at longer or shorter ranges depending on if the group hit high or low. When the group and the hash mark line up, note the actual distance, write that with indelible ink on a bit of white tape and stick that somewhere on the scope or rifle where you can quickly check it.

In the field, take a distance reading with the laser and then look at this reference to see which hash mark most closely matches. You may still have to apply a little "Kentucky windage," but you should be okay for big game.

A second more technical limitation is the fact that the reticles of hunting scopes are typically mounted in the second focal plane, which means the bullet drop distance which each of those hash marks represents will change as a variable scope's magnification is changed. Recognizing this, manufacturers make the reticle hash marks "correct" for the scope's highest magnification. So, if you prowl the brush with a 3-9x scope set at 3x, and a 400-yard shot suddenly presents itself, you'll have to remember to turn the scope up to 9x if you want to use the 400-yard hash mark as an aiming point.

It's not a big deal until you forget to spin the magnification ring. Please don't ask me how I know that.

Perhaps the ultimate in this system is found in products like the Quigley-Ford scope. You send your own precisely confirmed bullet and ballistic data to the company, and then they custom etch a reticle to match that load's trajectory.

This works very well. I've taken coyotes at 500 yards using this system.

You still have to remember to turn the magnification to maximum, and you still have unpredictable field-condition variables. But if you shoot that one load, always hunt at about the same elevation, and the weather doesn't take any wild swings, this system can be superbly accurate.

However, these things do change, and then you may be back to "guesstimating" the trajectory and hold-over aim point. Which takes us to the next level, a variation of this system which is not based on a specific cartridge's predicted path. Instead, the lower reticle marks are etched to units of angular measure, either minutes-of-angle (MOA) or milliradians (Mils).

Using this system requires calculation of the cartridge's trajectory with a computer-based ballistic program.

If you don't mind working on a smartphone, that is the most convenient way to go in the field. There are many apps for this, and my favorite free one is offered by JBM ballistics. I suggest trying various free apps to see which you prefer.

But I'm partial to the Applied Ballistics program, so I purchased the full-featured version in order to squeeze out every last bit of functionality.

With the predicted trajectory of the bullet in hand, it's a matter of reading the distance and then determining the drop in MOA or Mils at the distance you're about to shoot. Find that aim point on the scope reticle, and you should be good to go.

But note that I still said "should." I use that qualifier because, once again, you need to check the predicted trajectory against the real trajectory of the cartridge. In other words, you have to go to the range and shoot paper targets at the extended ranges to be sure. You don't want to find out something isn't quite right by wounding and losing a game animal.

One of my scopes with this type of reticle is the Vortex Light Hunter. The bottom half of the vertical reticle is marked in MOA units. It's simple and uncluttered.

But, again, to make reticles like this work at their best, you need to run a ballistic solution on your smartphone every time you take a distant shot, or you need to record the trajectory information for the load on a card or strip of tape and attach that to the gun.

Either way this adds a step, because you need to refer to the phone or the range card between getting a laser reading of the distance and putting your eye to the scope. Yet it has the potential to improve accuracy—as long as you remember that here, too, the scope will most likely have to be set to maximum magnification.

Dial systems are different in that they rely on the scope's adjustable elevation turret, not the reticle. If you prefer scope reticles that are dead simple, this system may be best for you. As the name suggests, the trajectory compensation is done by dialing the elevation turret up or down. The steps are: range the target, dial the scope to that distance, hold dead-on and shoot. It sounds simple because it is.

The best-known version of this may be Leupold's Custom Dial System. If your Leupold scope is equipped with the CDS option, you can send them the ballistic information for the load you shoot, and they will custom engrave a turret to match.

With the turret installed and the rifle sighted in, distant shots require nothing more than dialing the range. But like reticle-based systems, the adjustment is only as accurate as the load data, and environmental conditions can still affect the results. If any of these change significantly, prediction and reality won't match.

Still, it will be just fine for the vast majority of shots. When it isn't, you may have to start counting clicks. Which brings us to what is likely the most accurate trajectory compensation system of all, but also the slowest.

With this system, you range the target and then feed all relevant data into a ballistic program on your smartphone, and that program provides what is called a "firing solution" in the number of MOA or Mils that must be added with the elevation dial to make the shot. Dial the solution into the scope by counting clicks as you go, and you should hit the mark.

Without a doubt this is the most precise system currently available for making shots at extended range. Maybe not practical for all hunting situations, but snipers and competitive long-range shooters rely on it.

If all of this is starting to make your head hurt, you can go to more advanced technology that is simpler to use.

I call this the high-tech system. It requires a laser rangefinder built into the riflescope and also an onboard computer that does the calculating. The best example of this is the Burris Eliminator III scope. Now in its third generation, using this riflescope is as simple as it gets. Just aim at the target, push the rangefinder button, and when a red dot appears on the reticle, use that as your aiming point. It's super fast, and there's no need to have the scope set at any particular magnification. I'm guessing it won't be long before such scopes also record video.

The catch here is that the scope still needs to be programmed. So, you still need to input precisely accurate data for your load, confirmed on paper targets. Also, such scopes tend to be a bit larger, heavier and more expensive. They still function as a normal scope if the batteries die.

Elevation-adjustable mounts can extend long-range sighting by canting a scope down relative to the rifle barrel. When the scope is level, the barrel actually angles up, and this raises where a bullet will hit on the scope reticle. My Recknagel ERATAC mount precisely adds up to 70 MOA of hold over to aim points, which pretty much solves the problem of running out of low aim points for truly long shots. It's a set-it, lock-it and forget-it type of device, not intended for adjustment in the field nor meant as a replacement for the scope's faster internal adjustments.

The final question in all of this is which system is right for you. And you're the only one who can answer that. I use variations of each type, and I still own riflescopes where the only option is to just aim higher. With enough experience and expertise, there are guys who can bang a gong at 1,000 yards with this most basic long-range sighting adjustment. ■