

How to Zero Your Rifle

I'm going to begin with the assumption that you've already purchased your telescopic sighting device – 'scope' – and skip all the stuff about selecting rings and mounts. If you were smart, you bought the scope and all other parts at the same time, and had it mounted by a gunsmith. You can also have a gunsmith bore-sight the gun for you, but you'll need to make certain you have the correct eye relief and focus the crosshairs before he can do this.

If it's a new gun, see the article "Breaking In a New Rifle."

Focus the Reticle

If you've only had your scope mounted, or even if you are just pulling it out of the closet where it has rested since last season, then before you head off to the range you need to focus your scope. Clear the chamber and magazine, and point the rifle at a blank wall – no pictures, no wallpaper, no wood paneling – just blank, light-colored wall.

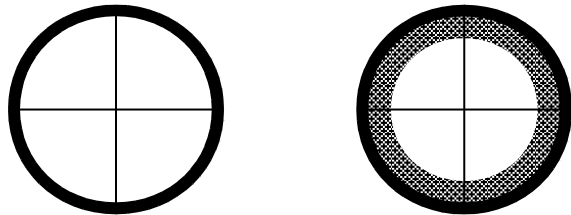
Look through the scope and adjust until you have the correct eye relief, then close your eyes and count slowly to ten. Open your eye for 2 or 3 seconds, and see if the reticle (crosshairs) are sharp. Close your eyes again and count to five, then check again. If you stare at the reticle too long, your eye will try to focus the reticle, and you won't be able to tell if it's really focused or your eye is fooling you.

If the scope is not positioned so you are in a comfortable position when the eye relief is correct, then you need to move the scope forward or back in the rings until you have a comfortable cheek weld and correct eye relief. Loosen the rings just enough to move the scope, then retighten. Be careful to tighten each screw equally. Also be certain the scope is level when the gun is level. If it is rotated clockwise or counterclockwise in the mounts, you'll have one heck of a time getting it zeroed in.

What's 'eye relief'?

The distance between the rear lens of the scope and your eye is 'eye relief.' It's not a specific distance, but rather a range: 2 to 2½", for example.

If your eye relief is correct, you will see an image as on the left. If you are too close or too far from the lens, you will see an extra gray fringe between the crosshair image and the body of the scope, as on the right.



If you are new to this game, I suggest you enlist the aid of someone with experience, whether amateur or professional, to make sure everything is right 'on the bench' before you go any farther. A gunsmith can adjust the eye relief, level the scope, and bore-sight the gun for you. You'll save enough money in wasted ammo to pay for his services.

If the reticle is not sharply in focus, loosen the locking ring and give the ocular (look-through) lens two full turns to the left or right. Now follow the same procedure again, looking for only 2 or 3 seconds at a time. See if it's more or less in focus than before. If it's less, give the lens *four* full turns in the other direction.

Keep going, one way or the other, another turn left, a turn back to the right, whatever it takes until the crosshairs are really sharp. Then tighten the locking ring again and don't adjust it any more. If you play with the focus after sighting in, you will have lost your zero.

At the Range

You will need a batch of the same ammo you intend to use in your gun on the big day, plus a dime, maybe an allen wrench, a small notebook and pencil, a spotting scope or good binoculars, targets and some nail polish in a bright color (maybe two or three colors).

If you have a bolt-action rifle, you can bore-sight the rifle when you get to the range. Take out the bolt, and set it up on sandbags or other rest that won't allow the gun to move or tip without force. From a position near the butt, sight through the barrel and line up the gun on a 100-yard target. (You can also bore-sight at 25 or 50 yards, and then move to 100 yards for live fire.)

Look through the scope without moving the rifle. The eye relief should be the same as when you will be shooting. If you move the gun, you'll have to start over. Use the elevation and windage turrets to adjust the crosshairs so they are on the target. Remember that the turrets work backwards when you are bore sighting: Turn them UP to move the crosshairs DOWN, and RIGHT to move them LEFT.

Occasionally sight through the bore to be sure you haven't moved the rifle – it's easy to do. When you have it as close as you can manage, you're ready to send some rounds downrange.

If you have a laser bore sight, use that instead. A laser is ideal for lever guns or semi-autos that won't allow bore sighting. A collimator can also be used, but is less accurate than bore sighting or a laser. It does allow you to record the position of the crosshairs relative to the bore, and check on it at a later date if you think the scope may have moved during transport.

You should now be able to get on paper, though the chances that you are actually zeroed in are pretty slim. If you have a variable-power (zoom) scope, it should be on the highest magnification setting. If you have parallax adjustment, set it to 100 yards. See your owner's manual.

Work on sandbags or other 'soft' support, and don't let the barrel touch anything. You need a rock-steady support. Find a natural, comfortable body position. Make sure you have a proper cheek weld between the stock and your face. Look through the scope the same way for each shot. The gun must not be canted – It must not lean to the left or right. Look at the scope reticle, not the target.

Fire only one round, and see how far from the center of the target it hits; a target with 1 inch squares or similar measurements clearly marked will be a big help. Convert the distance you missed the center of the target into minutes of angle.

What's a 'Minute Of Angle'?

A circle has 360 degrees. Just as each hour on a clock face is divided into 60 minutes, so each of the 360 degrees in a circle is divided into 60 minutes of angle – or MOA.

At 100 yards, one minute of angle is equal to 1.047", so for practical purposes we can round that off to 1" and be pretty close.

At 200 yards, 1 MOA would be 2.09", and at 325 yards it would be 3.4". At 1,000 yards it's about 10" (actually 10.47").

If you are 8" low and 12" left, you need to adjust the scope 8" up and 12" right. If, like many scopes, yours provides ¼ minute of angle for each click, that will be $4 \times 8" = 32$ clicks up, and $4 \times 12" = 48$ clicks right. The top turret is elevation (UP/DOWN) and the side turret is windage (LEFT/RIGHT). A few scopes offer 1/3 MOA adjustments, and precision scopes may have 1/8 MOA adjustments.

An alternative method is to fire one round, and then sandbag your rifle as for bore sighting, putting the crosshairs on the same point you originally aimed at. Then move the elevation and windage turrets until the crosshairs line up on the spot where the bullet actually hit the target. If you move the gun, you'll have to fire another round and start again.

Fire one more round, and you should be much nearer the center. If you are off by more than 6", make another bold correction and fire one more round. Repeat with another bold correction if you have to.

When your single shot is reasonably close to the point of aim, fire a five-shot group. Traditionally, a 3-shot group is recommended, but I think a 5-shot group more accurately reflects how well you, the rifle

and the ammunition work together. If you can't see where your group is, that's great – Don't cheat and use the spotting scope or binoculars until you've fired all 5 shots, or you may be tempted to compensate as you aim. Take your time and make each shot count.

After each shot, close your eyes for a moment and visualize where the crosshairs were when the gun fired, then 'call the shot': Imagine a clock face, and call it as "2 o'clock" or "6 o'clock" or whatever.

Now look at the cluster of shots and determine the center of the cluster. Disregard any 'fliers' you called; a flier is a shot that you *know* was significantly off-target. Measure the distance from the center of this group to the center of the target, and use the turrets to make MOA adjustments.

Fire another group of five and make further adjustments, as needed. You may need to change targets at some point, so you can see where the latest group is hitting.

When you think you've got it right on the center of the target, fire another group to be sure.

If you've got a fancy scope that allows you to move the elevation and windage rings on the turrets without changing the settings, use your allen wrench to loosen them up and reset the dial to '1' for 100 yards. Let the owner's manual be your guide.

If you're like the rest of us, and just have a dial with a series of lines indicating individual clicks of elevation or windage, there should be a dot or line on the surrounding housing that you can use as an index point. Use the nail polish to put a *small* dot on the point of the inner (movable) ring that corresponds to the line or dot on the housing. Now you have a quick reference point for your 100-yard zero if you need to return to it.

If a 100-yard zero is all you need, you're done. With a 100-yard zero, the difference in the impact point at 25 yards to 150 yards will be pretty small, probably less than 1". For basic deer hunting, the chances of being able to take a shot beyond this distance are pretty slim, especially in wooded areas.

But if you know you will be hunting in more open country, you can now move to 200 yards and zero again. Exactly how much elevation you need to add will depend on your caliber and ammunition, and the bullet drop chart provided by the manufacturer (on the box of ammo) may help. 3 to 6 MOA would be a good starting point. If you have parallax adjustment, set it to 200 yards.

If the first shot is within 2 MOA (2" at 200 yards), then fire a group of five. If the first shot is off by more than 2", make another adjustment and fire one more, following the same procedure as for the 100-yard zero. You shouldn't have to move the windage knob, but you may.

When you've got it, mark the 200 yard point on the elevation turret with a *second* color of nail polish, one that you can easily differentiate from the first. Also record in your notebook how much you had to go up; example – 200 yards = up 16 clicks / 4 MOA.

Repeat at 300 yards if you wish, again starting with 3 to 6 clicks up. Record the data, but based on the 100 yard zero, so it would be something like 300 yards = up 26 clicks / 6.5 MOA. Add a third colored dot, and note which color marks the 300-yard setting. Don't just write down the color name – put a dot of nail polish on the paper next to our notes.

I suggest nail polish for this purpose because it comes in many colors, has a brush in the cap for easy application, and can be removed more easily than enamel paint yet holds up nicely to normal use. If you want to remove it, chances are your bore cleaner on a Q-Tip will take it right off. Acetone is the primary ingredient in nail polish remover, but lacquer thinner or paint remover will also work.

If you have a wife, daughter or girlfriend, there's a good chance she will have several old nail polish colors that she no longer uses but she hasn't had the heart to throw away. If she asks what you want it for, tell her you want to do your toenails. Shake the bottle well before use.

If you need to shoot at a distance between 100 and 200, or 200 and 300, just dial in between the dots. As a general rule of thumb, a scope zeroed at 200 yards will shoot about 2" high at 100 yards and 8" low

at 300 yards. A police sniper will shoot at 50 or 75, 100, 150, 200, 250, 300 and 350 yards, and record bullet drop in their notebook for future reference. You probably don't need to do that.

Remember that you now have the scope set up to give you good accuracy with this particular load of this particular brand of ammunition, and from this particular batch. The same load from a different batch may or may not shoot to the same point of aim. An identical load from a different manufacturer, or a different load from the same manufacturer, will give different results. It does no good at all to zero with cheaper practice ammunition and then go hunting with the expensive ammo. You've saved a few dollars, but you'll miss that buck.

Other factors that can change the point of impact include altitude, temperature, wind, rain and other climatic conditions. At a higher altitude there is less air. Less air = less air resistance = higher impact. A lower altitude will mean more air resistance and the bullet will slow down sooner and hit lower. If you're traveling to Montana, check your zero when you get there.

A warm or hot barrel will also shoot to a different point of aim than a cold barrel, and when hunting, you will probably have a cold barrel. If your barrel got even moderately warm during your sight-in, it would be a good idea to let it cool and shoot another round or two to see how much this affects your point of aim. If there's a big difference, you can make further corrections, allowing the barrel to cool between shots. If you have the opportunity, you should let the barrel cool overnight and shoot again another day.

If you were unable to get the scope sighted in because you couldn't move the crosshairs far enough up/down/left/right, the fault probably lies in the mounting. You may need to loosen the scope mounting rings and add thin shims of brass or plastic to raise the front or rear of the scope physically. I've found brass 'shim stock' at old-fashioned hardware stores, which can be cut with scissors. Thin aluminum, which can be cut with scissors from a soda can, would also work. Don't use paper or cardboard, as they may be compressed over time, or swell up due to moisture.

Be sure the rings are mounted squarely on the gun. A slight misalignment with the barrel can mean a big difference at 100 yards. Also be sure the rings are not bending or crushing the scope, which can prevent internal parts from moving or throw them into misalignment.

If you can't get a decent group, and you don't believe your lack of marksmanship skills or the accuracy of the rifle are to blame, then check to see if the mounting rings are securely fastened to the gun. It's possible they have loosened from repeated firing. Using a thread locker (blue Loctite®) may help.

If you have a friend who is a good rifle shooter, ask him to fire a 5-shot group. The point of impact may not be the same as it was when you were shooting, but if the group is tight then (sorry, Charlie) the problem *is* your marksmanship skills.

Testing Your Scope for Repeatability

Go back to the 100-yard line. Move the settings back to your 100-yard marks and fire another shot to see if your settings are still accurate. If not, you've got a problem. Repeatability is an important quality for any scope, and yours has failed the test. There's not much you can do to make a bad scope better.

But let's assume for a moment that you did hit the spot you were aiming at. Congratulations!

If you have a variable scope, zoom out to the *lowest* magnification setting and fire another shot. Depending on your marksmanship skills, you should have one ragged hole, or at least a very tight group. If you have a good scope, the point of impact will not change; if you have a bad scope, you will have a different point of impact.

You can zoom out one magnification setting at a time and fire one shot at each setting, then record the difference between the various settings in your notebook, so you can 'hold over' when shooting at these settings.

Or you can do all your shooting on the highest setting.

Or zero at the setting you think you're most likely to use (probably 4 to 6 power for deer).

Or you can buy a better scope.

You can also perform the Box Test:

1. Fire one round at the center of the target with the dials set to your 100-yard zero.
2. Go up 5 clicks and fire one round, still aiming at the center of the target
3. Go left 5 clicks and fire one round, aiming at the center of the target
4. Go down 10 clicks and fire one round, aiming at the center of the target
5. Go right 5 clicks and fire one round, still aiming at the center of the target
6. Go up 5 clicks and fire the final round, aiming at the center of the target (you are back to your original settings)

If you draw a line connecting all your shots in the order they were fired, they should form a box shape.