Why your scope needs professional installation?

By José L. Rodríguez (The Scopesmith)

The ultimate goal of an accurate rifle is allowing the shooter achieve his/her accuracy potential (generic "his" from now on). Many good shooters can exceed the accuracy of their rifles, but that only happens when other factors like ammunition and optics do not get on the way. A good scope, professionally installed, will take inaccuracy due to optics out of the equation.

Which are the seven steps of a correct scope installation?

1.- Equipment selection and matching

Many shooters use their entire budget buying their dream rifle and then put on it the first scope they can afford. That reminds me of the old times when as a youngster I used all my savings to get a great stereo receiver but then could only afford some crappy used speakers. I never realized the quality of my receiver until I replaced the speakers years later. Again, the goal of optics is to allow the shooter to achieve his accuracy potential. The quality of the scope should be at least as good of the quality of the rifle when compared to available alternatives. The scope should also match the priorities of the intended use of the rifle: bench accuracy? ruggedness? expected target distance/size? fast target acquisition? ability to see even in a very dim light?

Selection mistakes are even more common for rings and bases. I find that many scopes are not installed with the right rings or bases but with whatever was available on the gun store. I understand that there are many possible rifle/scope combinations but no compromise should be made in the only link between two expensive pieces of equipment. Ring and bases should be as square as possible to minimize the effort of steps 2 and 3, they should allow for the scope to mount as low as possible on the rifle and should have the right aesthetical match.

2.- Ring alignment:

It is paramount for the axis of the scope to be parallel to the axis of the barrel. This is always the case on the horizontal axis (windage) and only changed on rare cases for the elevation on some long-range rifles (with ramped bases). The gunsmith should strive for having the scope as close a possible to the middle of its windage range when the rifle is zeroed. On this range the scope works at its best and more correction potential is

available for ammunition variation and wind. In addition, some scopes have a very limited windage range. The gunsmith should also make sure that there is enough elevation available to cover all the intended range of the caliber and purpose of the rifle. A good installation will include shims as an absolute last-resource, and will do the best possible effort to correct any misalignment be replacing bases or rings or, in the case where the rifle is in fault (mostly caused by slightly misalignment on the taps for the base screws), by filing or milling instead of using shims.

3.- Ring lapping:

Have you ever replaced a scope and found a dent on the tube? It is a shocking experience after lapping a set of rings for the first time (even the high quality ones) to realize how small percentage of the ring surface was actually in contact with the scope. In many cases the gripping is just done by the one of the edges of the ring indented in the tube. This will cause damage and stress to the scope and will result in inconsistent aiming point at different temperatures, change of point of aim at different magnification and parallax. The lower half of the rings should be lapped to allow for a minimum of 60-75% contact with the tube. Is not necessary to lap the upper half of the rings as they are more flexible (in most cases), however a little lapping to smooth any irregularities or rough edges is advisable.

4.- Optimum eye relief:

It never ceases to surprise me how many people do not get this done right. For safety reasons, the scope should be as far from your eye as possible while allowing a full view at maximum magnification. This should be tested with the rifle well mounted on the shoulder. This distance or "eye-relief" is not the same for everybody. The experienced gunsmith develops a feel just looking at the customer and assessing how different he is from the generic 5"8" medium-built cardboard shooter that the rifle and scope manufactures use for their designs. When possible, the installation should be stopped at this point to check for eye relief with the customer. If not, you should assess it in advance, by measuring him and having him try a rifle with a standard eye relief.

5.- Scope leveling:

This is one everybody knows but I have seen even pros that "wing it". Nothing denigrates more the competence of a rifle owner than mounting his beautifully scoped rifle on your shoulder and seeing a crooked reticle. But it is not a matter of aesthetics. The human brain is an unbelievable computer. Every shooter eye-brain combination will find an extremely accurate parallel between the horizontal reticle line and the horizon. This means that, if the scope is not correctly leveled, the barrel and the scope are not in the same vertical line creating accuracy problems. In my experience, scopes not correctly leveled are also the main cause of shooter-to-shooter differences in point of aim for the same rifle.

Scope leveling is the hardest of the seven steps. Each rifle has more or less flat and square surfaces to help you establish level, the use of especial equipment may be needed. Don't forget that despite the fact that it is easier to check the scope-stock leveling, it is the scope-barrel leveling what is important. The gunsmith should have the right combination of leveling tools and horizontal/vertical references in his shop to do the best possible job on this stage.

6.- Adjusting of screws to manufacturer-recommended torque:

Sounds easy but it is expensive to have all the right combination of torque drivers and wrenches and the right hex or torx (or others) heads to do this right. We all tend to over-torque. This can pull the screws out of their optimum rigidity range and they could stretch, break or seize at extreme temperatures. Screws should be tightened in a disciplined and patient progressive crossed-pattern sequence; otherwise, the tightened rings may change the scope alignment or leveling. When this is done right Lock-Tite is not necessary, but does not hurt either.

7.- Bore sighting:

On this step technology has come to our rescue. With the use of laser bore-sighters and a little bit of software, the old gunsmith guarantee of "will hit paper at 100 yards" could be changed to "will hit the center ring at 100 yards". Cartridge laser bore-sighters are better than muzzle lasers but both will do a good job. The windage sighting is easy. For the elevation, a little more work is needed since the scope and the barrel are not in the same horizontal line. However, by measuring the distance between the barrel axis and the scope axis, the distance from the muzzle to the wall or surface you are aiming the laser to and doing some tweaking of a ballistic spreadsheet it is possible to bore-sight the elevation almost as well as the windage. Some gunsmiths will offer to range-sight the rifle (probably at extra charge unless the installation is part of a larger job). I find this stage unnecessary (but fun) if you do the boresighting correctly. This is also the moment to re-check that your scope zero is around the middle of its adjustment range allowing maximum accuracy and functionality under a wide distance range, ammunition variability, and wind adjustments.

Happy hunting!