



## Staying Level and Centered!

Scopes, Bases, Rings & Rifles; Making It All Come Together

Article Contributed by: [Mark Trope](#)

In my recent article, *A Rifle Comes Home*, I touched briefly on using Burris Signature Rings with floating, synthetic inserts on the subject [Mil-Surp Remington 40X](#).

Many Mil-Surp owners choose to scope their rifles these days. Some rifles, like M-93 & M-98 type Mauser designs will easily accept one and two-piece top mount bases. However, they will require drilling and tapping, (*D&T*). Usually 4 holes are required to get a set of bases on a rifle. To D&T a receiver costs \$20.00 to \$30.00 per hole these days. Sure it's a lot, but, the Gunsmith's kids need dental work, his mortgage payment is due and his wife's tires have canvass showing! When your project requires the services of a professional, pay the man and be happy. Some other rifle designs will allow a prefabricated, clamp or bolt on type scope base.

Companies like B Square™ openly court the Mil-Surp shooter with no less than 29 "No Drill or Tap" scope bases that are specially made for various hard-to-scope Mil-Surp rifles. Usually these bases replace part of the rifle, or, are so designed as to follow the unique contours of the rifle. Often they attach to preexisting holes or slots in the receiver. The B Square line uses the Weaver style cross-slot rings.

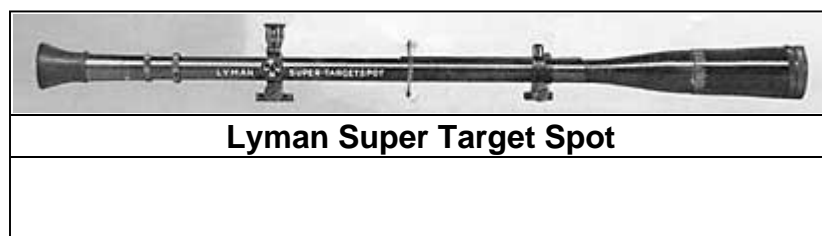
Mil-Surp rifles tend to have rather generous tolerances, especially on the outside. For an iron-sighted rifle, outer tolerances have little bearing on a soldier's ability to

achieve "Battle Sight Zero". If the soldier could keep all or most of his shots on a man sized silhouette, while standing duty on the line for long hours in a muddy foxhole, surrounded by the mists of Central and Eastern Europe, or the dust storms of North Africa, he and his rifle were considered ready.

Today, we Mil-Surp shooters have the luxury going to the covered ranges equipped with shooting benches. We engage targets that won't return fire! Under such comfortable conditions we expect more accuracy than a man-sized silhouette. Aging eyes benefit from the use of scopes, no doubt about it.

So, scopes are a good deal, however, there's a lot more to consider when mounting a scope on a Mil-Surp than just getting a base or bases and rings for your scope. Also, most of the scopes usually seen on carbine type Mil-Surp rifles are short scopes. Their range of adjustment on the "X" axis (left & right), and the "Y" axis (up & down) is limited in comparison to the larger & longer scopes seen on sporter and target type rifles.

For a moment, let's consider what is going on inside a scope. This will be a short version; a full discussion of rifle scope design could fill a fair sized book! A scope has a series of lenses that magnify and correct the view of a distant image. In years gone by the very best scopes had external adjustments. That is, the external rear scope mount/ring assembly had provisions for adjusting the X&Y axis of the entire scope body. Those adjustment turrets physically moved the rear portion of the scope body up & down and left & right. The front ring allowed the scope tube to pivot and follow the amount of adjustment dictated by the rear adjustment turrets. No lateral or side pressure was imparted to the scope tube. The Unertl scope line and the Lyman Super Target Spot series best typify the external adjustment system. Those scopes were very l-o-n-g & heavy! Since the adjustment turret system was standing up on top of the rifle; it was easily damaged. Blowing dust getting between the scope tube and adjustment stems would throw off a shot.





However, for all their faults, the externally adjusted scopes were and are great units! The shooter was always looking thru the exact center of the lens system. In any scope, exact center IS where the best optical view will be found. The further one has to move toward the edges of the lens system, (*as in a internally adjusted scope system*) the optical view will degrade proportionally.

The externally adjusted scopes have been basically out of production for almost a ¼ century. Yet, when in fine condition, they command extremely high prices. One only has to watch these scopes on ebay to be convinced of that. There is one company that makes 8-10 new external adjustment scopes per year, and a few others that do a brisk business refurbishing old external adjustment scopes.

Now, let's discuss how a rigidly mounted, internally adjustable scope works to make the scope reticle coincide with bullet Point of Impact (*POI*). An internally adjustable scope's outer tube, (*one inch or 30mm diameter*) is rigidly mounted to the receiver by bases and rings. Since the outer tube can't follow the bullet *POI*, (*as in the externally adjusted scopes*) it becomes necessary to have a system of adjustable aiming. Inside the scope's outer tube is a smaller tube. This smaller tube is called the erector tube. When adjustments are made at the scope turrets, the erector tube is what actually moves. It allows the shooter's line of vision to look where the bullet *POI* is.



**Anatomy Of A Scope! Top From Left: Adjustment Stems, Tension Spring, Caps, Center From Left: Erector Lens, Erector Tube, and Erector Lens Bottom from left: Eye Piece Lens, Main Scope Tube Objective Lens (Note Ring Marks On Main Scope Tube To The Right Of Power Ring)**

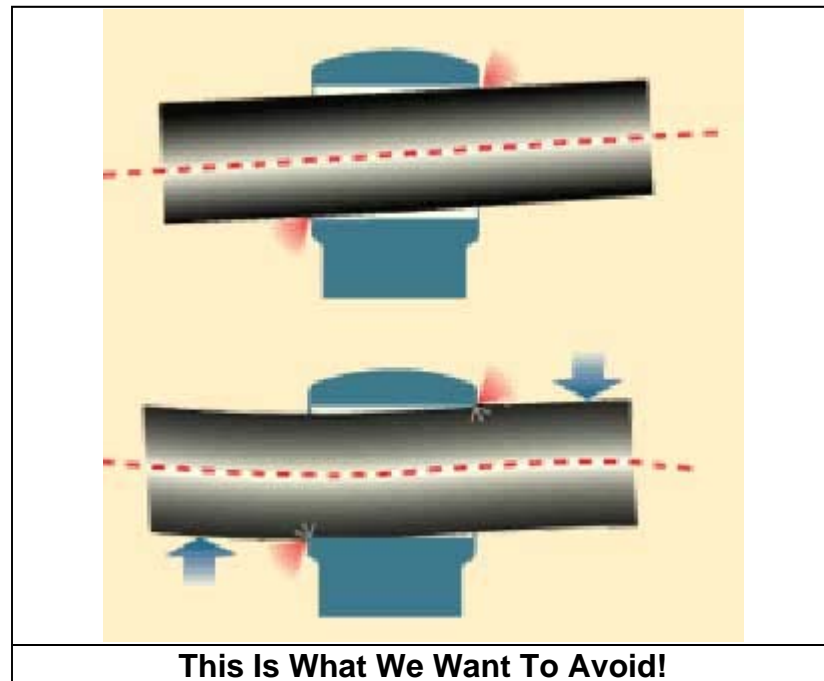
Ideally, in a perfect world, all action tolerances would be exactly +/- 0. All D&T'ed holes in a receiver would line up exactly with a perfectly installed barrel. Base contours & heights would match receivers and sit dead flush. Rings would fit without the slightest variance. In other words, there would be two perfectly straight datum lines. One running through the receiver & barrel, the parallel line running through the scope rings. However, it's not a perfect world, there is still an acceptable tolerance level in any production arm, base, ring etc. The chances of everything just "lining up perfect" are about non-existent. So, the turrets push the erector tube so the shooter can place the reticle over the bullet POI.

IF things line up fairly close, then only a small amount of adjustment will be required at the scope turrets (*as in most, BUT NOT ALL sporting arms, bases & rings produced today by quality vendors*). A small amount of adjustment is OK, and it's the only way to deal with wind drift. Recall we said that the best optics in any scope is in the exact center of the lens system? Every click on a scope adjustment turret moves the erector tube, and the shooter's line of vision further from center, and the optical view degrades. A small amount of adjustment has little effect. But what about when large amounts of correction are required?

Suppose an erector tube has to be adjusted so the shooter is actually looking at the lower left side of the lens system to acquire bullet POI. Now the situation is different. Optical quality has really degraded. In a very high-end scope, with best quality lens, the effect will be less noticeable. Low-end scopes will suffer greatly from this situation. Now it's time to consider the other side of this equation.

Scopes are made to take a lot of linear or "back and forth" stress. They are NOT made to take lateral or side pressure. Recall we said earlier that the chances of everything just "lining up" are about non-existent? When both rings aren't exactly aligned on both X&Y axis then stress is induced in a rifle scope. This is bad business! Consider; often receiver heights are out of tolerance, so,

even by putting perfect bases & rings on the rifle one ring may be higher than the other. Or, the receiver heights may be perfect, but the holes in the receiver may not line up exactly, then one ring will be to the left and the other will be to the right. Ditto for bases & rings. A perfect rifle that has bases or rings, which aren't perfect, still has problems! Have you ever been to a gun show and seen all those used scopes lying on a table with ring marks on the scope bodies? That is induced stress from lack of alignment. The rings actually "bit" into the tube! Once side stress is induced in a scope then the values of the turret adjustments will wander.... along with zero!



Alright, now we know that Mil-Surp rifle outer tolerances tend to be generous, specialized clamp or bolt on scope base/mounts have to fit many similar model rifles that have been made in various arsenals, rings may not be in alignment, and even if they are, they may not be pointing the same place the barrel is, and that lateral stress in a scope is bad. OK, so, how we deal with all these variables? Let's look at solutions to the various problems.

**Receiver Out of Tolerance:** Often there are discrepancies between the size of the front and rear receiver rings. A .001 divergence equals approximately one inch deviation from POI at 100 yards! A competent gunsmith can "blueprint" an action, thereby bringing it back to specifications. This is expensive and time-consuming work.

**Barrel and Receiver Do Not Line Up:** Yep, it happens. Even if the scope is mounted straight on the receiver, it does little good if the barrel is pointing toward the county east of you! A competent gunsmith can re-cut the threads on both barrel and receiver. If metallic sights have been retained on the barrel, they may need realignment. Once again, this is an expensive and time-consuming procedure.

**Ring Holes Very Slightly Out Of Alignment, Stressing Scope Tube And Leaves Ring Marks On Scope:** Rings can be lapped, and lapping works! Lapping involves mechanically removing material from both rings until they are in perfect alignment. Lapping kits can be acquired from most mail order/web based suppliers for about \$20.00 with shipping, or you can make your own with a piece of 1 inch thick round metal stock, a piece of 400 grit wet/dry paper and WD40 as a cutting agent. However, there are some pitfalls with lapping. Lapping only works if the rings are very close in their X & Y axis alignment to begin with. Gross misalignment will not be corrected by lapping. Secondly, lapped rings are only in alignment only as long as they are not removed from their bases. Even removing the rings and replacing them back on the same rifle will cause them to need additional lapping before they are in perfect alignment again. If the barrel isn't perfectly lined up with the action, lapped rings will not correct this problem.



Lapping Materials For Cheap Guys: Wetordry Paper, 1 inch Thick Metal Bar, WD40; Total Cost; About \$8.00

**Lap Scope Bases:** If gross problems arise from rifle actions being out of height specifications, then it's possible to lap the higher base's bottom until it's height matches the lower base. While the work is relatively easy, the set up requires a dial indicator set up, level and either a lathe bed w/ carriage, or machinists adjustable vice. Minor ring lapping will most likely be required.

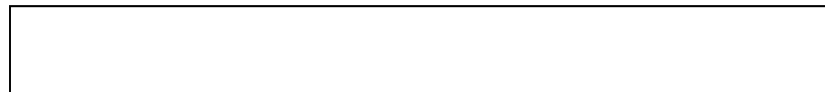
**Shim Scope Bases:** If gross problems arise from rifle actions being out of height specifications, then it's possible to place metal shims under the lower base until it's height matches the higher base. Shims can be acquired from [Brownells](#) or they can be fabricated from sheet brass available from any hobby store. While shimming is easy, the set up to determine the exact thickness needed requires a dial indicator set up, level and either a lathe bed w/ carriage, or machinists adjustable vice. Minor ring lapping will most likely be required.

**Receiver Scope Base Holes Slightly Out Of**

**Alignment:** Competent gunsmith can weld up holes, grind, and file & polish receiver to exact tolerance. Drill & tap new holes. Special fixture or set up required to drill holes straight, big \$\$.

**Special Mil-Surp Clamp / Bolt on Scope Mount Not in Exact Alignment With Barrel or Receiver:** Special windage adjustable rings could possibly be used to cure windage problems. They will correct gross problems with X-axis alignment. Beware, their use requires both rings to be adjusted EXACTLY the same amount, or a badly kinked scope tube is the result! Getting a correct adjustment requires a special setup, usually involving 2 dial indicators and a vise. Windage adjustable rings will not address Y-axis alignment problems.

**Best Solution to All These Misalignment Problems:** [Burris Signature Rings!](#) Burris Signature Rings have floating, synthetic inserts. No matter how out of alignment the rings are, due to out of tolerance receivers, bases out of specification or badly drilled holes, or a special Mil-Surp mount which points in a direction other than in-line with the barrel because the receiver is out of specification, the inserts float and the scope is always held straight! No side stress can be induced, as the inserts will pivot in their saddles, following the shape of the scope tube.





**Burris Signature Pos-Align® Offset Insert Kit On Left**

OK, so far, so good. Now the scope tube is held straight, but if the scope is pointing down, or off to one side, or a combination of both, then it will still be necessary to crank excessively on the scope turrets to bring the reticle into convergence with bullet POI. In such a case the shooter will not be looking through the center of the lens system, where, as we know, the best optics are.

Burris Signature Rings come with 0/0 inserts, which means the inserts are of equal thickness. However, an inexpensive Offset Insert Kit is available. It contains +/- .005, +/- .010, +/- .020, inserts. The inserts are used in pairs. However, before we discuss a practical application of the Offset Insert Kit, we need to consider the scope we are about to mount.

When a new scope is shipped from the factory it is optically centered. The turrets are set at center for both elevation and windage. A used scope needs to be centered before it is mounted. Centering a scope is easy. Turn one of the adjustment turrets completely to one side. As it approaches the end of its travel it will get begin to get harder to turn. When this happens, slow down! Don't force it; just gently bring that turret to the end of its travel. Now slowly turn the turret in the opposite direction, counting each click, until it reaches the end of its travel. Now turn it in the opposite direction again, but this time only go ½ way. Suppose you count 400 clicks for the entire range of travel. Counting back 200 clicks will optically center that one turret. Now do the exact procedure for the other turret and your scope reticle will be in the exact center of the lens system. By the way, a scope may have more travel in one direction than in the other. So, if you have 400 clicks on one turret, don't be surprised if you only have 360 clicks the other turret. Always insure a used scope is optically centered before it's mounted.



Now let's look at a practical application of the Burris Offset Insert Kit. A .22 caliber match rifle was set up with two Weaver bases and Burris Signature Rings. Burris Signature Zee Rings fit Weaver bases. The rifle was fired from a bench rest at 50 yards at the upper bull. Notice the group was almost exactly in line with the aiming point, but printed just over 5 inches low! At 100 yards the rifle would print just over 10 inches low. Since the group was in line with the bull, this tells us the bases are in line with the barrel.

The drop in elevation tells us there is a .010 discrepancy in either the bases or receiver rings. Correcting this is simple. Burris's literature says a + 0.10 insert needs to be placed in the bottom of the rear ring, and a - 0.10 insert needs to be placed in the top of the rear ring. This will point the scope so the reticle coincides with the bullets POI. After this was done it only took a few clicks on the elevation turret to get exact zero.

If you have a Mil-Surp rifle that requires excessive turret cranking to bring it to zero, consider Burris Signature Rings and their Offset Insert Kit. This is a simple, cost effective, "bolt-on" solution to a all-to-common problem.

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