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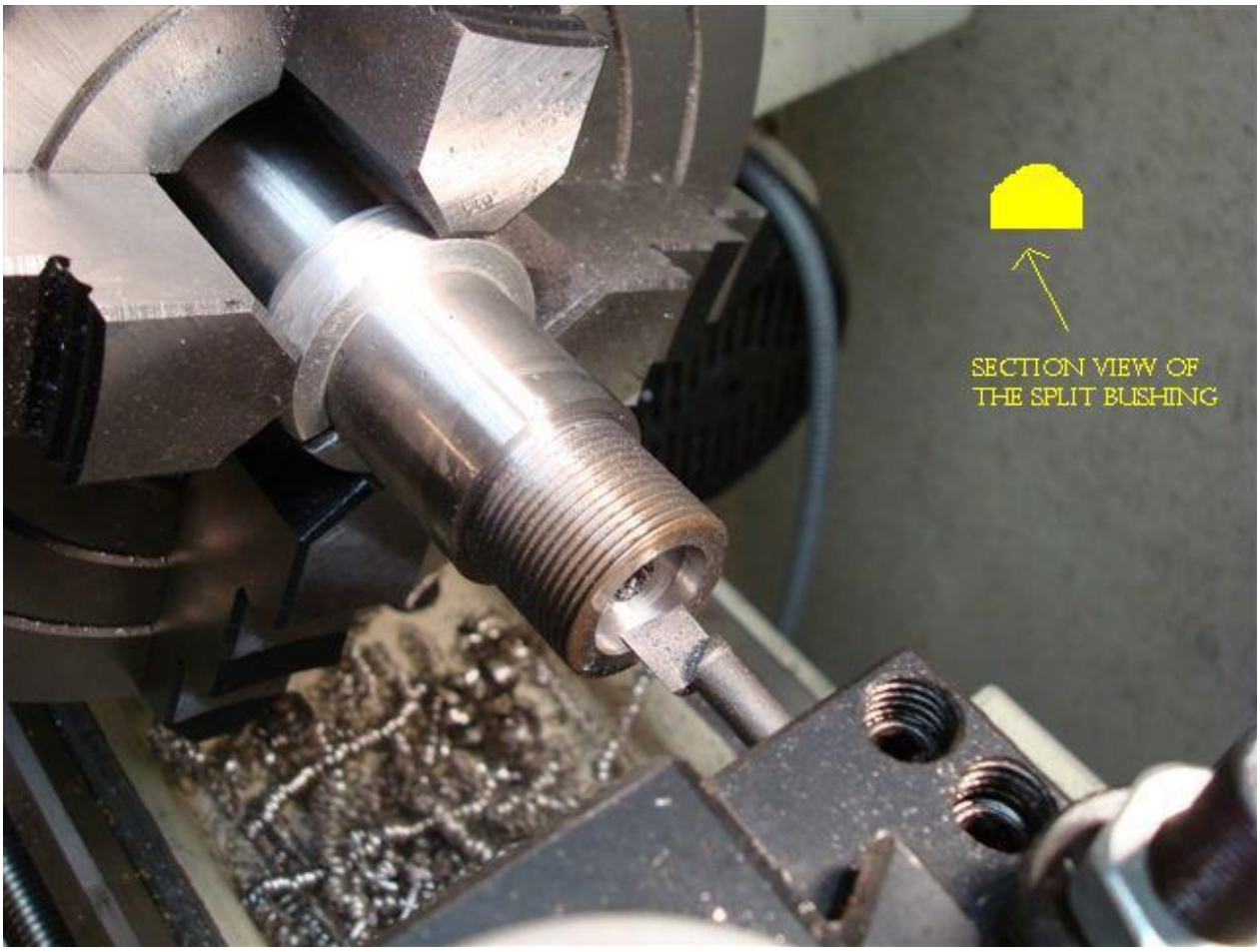

What Makes For Peak Rifle Accuracy?

By Mike Bryant

What makes one rifle accurate and another inaccurate? That is a question that many people have asked over the years. The basic principles of rifle accuracy are the same whether you are dealing with a high-grade benchrest rifle or a bolt-action hunting rifle.

Most of my experience with rifle accuracy has been in competition benchrest shooting. I shot my first match in the summer of 1982 and have been shooting in registered competition ever since. My experience with rifle building began a little before I began shooting benchrest. But in general, I have been stocking and later barreling the benchrest rifles that I shoot in competition since I started shooting competitively. There is nothing like building tight necked 6 PPC's and Waldogs to teach you what it takes to make a rifle accurate.

There are no deep dark secrets to obtain peak rifle accuracy, only top quality mechanics. For the purpose of this discussion, the rifle will consist of three major parts, the barreled action, the stock and the scope. You cannot have top accuracy without all three parts pulling their weight.

The Barreled Action

The relationship of the barrel and action can best be thought of as how every part of the barreled action relates to the centerline. The centerline is an imaginary line passing from the center of the bore through the center of the action. The centerline may be imaginary but can readily be determined with the aid of a good 0.0001" dial indicator. Of primary importance, the chamber has to be absolutely concentric and parallel to the centerline of the bore with the bolt face being an absolute 90-degree perpendicular to the centerline. The kicker here is that this is hard to accomplish because it is dependent on three different separate parts, the bolt, receiver and barrel and how they fit up to each other.

The bolt body, firing pin, barrel threads and chamber should be completely in line with the centerline of the bore. The action lug recess, bolt lugs, bolt face, receiver face and barrel shoulder need to be 90 degrees to the centerline. The bolt lugs and action lugs should make full contact on all locking surfaces. The action threads and barrel threads should make full contact on the bearing surface of the threads with no contact between the top of the barrel thread and the bottom of the action threads. The chamber should be a size to precisely fit the cartridge case.

The shape or angle of the crown makes practically no difference as long as there are no burrs or irregularities in the crown and that one side of the bullet doesn't clear the barrel before the opposite side of the bullet does. In other words, the barrel doesn't need to be longer on one side than on the other.

Why, you may ask does all this concentricity and 90 degree stuff make any difference? The sole purpose is to launch a bullet precisely centered in the bore straight down the center of the bore and out the crown with as little wobble as possible. If the bolt face is at 90 degrees to the chamber and the barrel bore, some of the relationships in the receiver don't have to be perfect and still you will obtain peak accuracy. The thing is that it is far easier to obtain a bolt face perfectly at 90 degrees to the chambered barrel if every other part is in its proper relationship within the receiver.

An oversize chamber can ruin all your best efforts at building a tack-driving rifle. The oversize chamber will allow the cartridge to lie in the bottom of the chamber and throw the bullet out of alignment with the bore. Why then do benchrest shooters get such good groups when they are fire-forming brass? The necks of their cases are turned to such close tolerances that the bullet is still in alignment with the bore as well as the case head is still supported by the chamber.

I haven't mentioned anything about barrel quality. I have used barrels from most of the top makers of benchrest barrels and have had high quality barrels from all of the makers that I have used. If you are going to economize on building a custom rifle, the barrel is not the place to do it. Stick with a top maker and it's hard to go wrong.

Good triggers are critical for the accurate rifle. Not that it is necessary for peak accuracy, but that it makes peak accuracy easier to obtain. Two-ounce trigger have their place in the accurate rifle. That place is on target rifles. With practice a two-ounce trigger can be squeezed and released if wind conditions change, but only if they are being shot from the bench. Two-ounce triggers and field conditions don't mix. I once had a two-ounce trigger mounted on my .280 deer rifle. I was watching a coyote come into a windmill at 300 yards. I placed my crosshairs on him and had a dead coyote. Only thing was, I wasn't ready to shoot yet or at least, so I thought. I replaced that trigger that day with a two-pound trigger and haven't used a two-ounce trigger on a hunting rifle again.

The Stock

The stock and its relationship to the barreled action play a significant role in the accuracy of the rifle. There are three major methods of stock bedding to barreled action. In the majority of benchrest rifles, the predominant method is the glue-in in which the action is glued into the stock with epoxy glue. Another method that is being used is pillar bedding. Conventional glass bedding is also used, but by very few in the benchrest community.

The glue-in is the easiest to use and the easiest method to obtaining an accurate rifle. It does, however, have its drawbacks. For one, it is harder to take the action from the stock in case of mechanical problems. Triggers have to be able to be removed from the bottom of the stock, which is no problem with the actions commonly used in benchrest. These actions usually have trigger brackets that are removable from beneath the action. The Remington actions that are being used in competition have holes through the stock that allow the trigger pins to be driven out and the trigger removed. This is not too practical if the glue-in happens to be on a hunting rifle like a Remington 700. The thumb safety would make it extremely difficult to remove the trigger from the bottom. Secondly, just because an action is glued-in doesn't mean that it is glued-in without stresses on the action. If the action is stressed when it is glued-in, you then have a bedding problem. But, its a bedding problem that you can't detect. Lastly, the glue-in is intended to be bedded permanently. But in time a glue-in can become completely or partially unglued by cleaning solvent seeping under the action or any other number of reasons. Murphy's law applies to this really well. When you can least afford the gun coming apart is probably the time it will. A friend of mine had just shot a 0.140" group at 100 yards in the previous match, when his action came unglued before he could shoot the next group. The 0.140" did win him small group for the 100-yard segment, but he was unable to finish the match. That won't happen with a pillar bedded rifle and is also unlikely to happen with a properly glued-in action.

Pillar bedding with aluminum or glass pillars is a method that has started showing up in a large number of benchrest rifles, as well as in high accuracy hunting rifles. As you can guess from my opinion of glue-ins, the rifles that I shoot in competition are pillar bedded. (I now use both methods in competition, pillar beds and glue-ins. I did shoot strictly pillar beds in '96 when this article was published. A properly done glue-in will not cause any problem.) The glue-in is still the most popular bedding method in benchrest competition. But, the number of top competitors, such as L. E. "Red" Cornelison, Harold Broughton, Speedy Gonzales, Frank Wilson and others, that have shot pillar bedded rifles in competition shows that they believe that they are not losing any accuracy because their rifles are not glued-in. Believe me, if a competitor thought that he was at any disadvantage by shooting a pillar bedded rifle, there is no way that he would be shooting it in competition.

One of the chief advantages with pillar bedding is that the rifle can be taken apart. The bedding can be checked with a dial indicator that measures in ten thousandths by checking the movement between the barrel and forend of the stock as the action screws are loosened and tightened. There should not be any more than 0.002" movement between the barrel and the forend.  If there is more than that, say 0.003", you have a bedding problem and your rifle will not shoot to its potential. The action cannot bind in the stock. With a round receiver, you should be able to take the guard screws out of the stock and have the barreled action drop out of the stock. Flat bottom receivers with square sides won't do this. But, even with them, the barreled action should come easily out of the stock. The bedding area and the receiver should be completely clean before they are screwed together. Even the smallest piece of crud between the action and the bedding surface will show up when the dial indicator test is used. All action screws should not touch any part of the stock except at the screw heads. Likewise, the bolt handle must not touch any part of the stock. When the bedding tests out right, don t' take the action out of the stock any more than absolutely necessary. Every time the action is removed is just taking a chance of nicking the action or messing up the bedding area in the stock. Really tight screws are not necessary; so don't get carried away tightening guard screws.

Conventional glass bedding has all the advantages of pillar bedding except that the bedding can easily be ruined if the guard screws are over-tightened. I personally know of only one competitor that used conventional glass bedding and he may not anymore. (To my knowledge, he doesn't compete anymore.) There may be more that I am unaware, but this is an area that is not listed on competitor equipment lists.

Stock shape makes a difference in accuracy not because it makes the rifle's potential accuracy any better, but because it makes that accuracy easier to obtain. That is why benchrest rifles have three-inch wide flat forends. But, stock shape has to be practical for the purpose that the rifle is to be used. After all, who would want a deer rifle with a three-inch flat forend?

The Scope

An accurate rifle is only as good as the scope mounted on it. Scopes that are good for one use may not be good for other uses. Most of the scopes used in benchrest competition are Leupold, Lyman conversions, Bausch & Lomb, or Weaver 36 power target scopes. They are great for obtaining the most accuracy that you can get from your rifle. But, they are highly impractical for a hunting rifle. They do have a place for use in a hunting rifle, though. A 36-power scope is a great scope for working up the load that you will use with your accurate hunting rifle and then switching to the scope that you will use for hunting. My heavy barreled .280 will shoot significantly smaller groups with a high power target scope than it will with the Kahles 8x56 that it has on it now. The 8x56 will, however, shoot 1-inch groups at 100 yards by full moon light and better under better light. In Texas, as in the rest of the United States, you have to watch your watch when you are hunting with it or you could get in trouble for deer hunting too late. It will allow you to make that shot on a cloudy day at the limit of legal hunting time that a lesser scope wouldn't be able to see.

An accurate scope has to be able to hold its point of aim. The scope is one of the variables over which we have the least control. It is commonly said that benchrest shooters "don't look for accurate rifles, they look for accurate scopes". A scope that loses a shot can be enough to make you lose a match or worse. With an unlimited rail gun set on eighteen inch centers, one thousandth of an inch movement will move you approximately " on the target at 100 yards. With a scope, the inner adjustment tube may only be 3 or 4 inches. That same movement within the scope of 0.001" could move you well over an inch at the same distance. By comparison, a sheet of paper measures approximately .004". It is a wonder that the scopes that are in production are as accurate as they are and it is a marvel to the machining ability of the optical industry.

For the past several years, there have been a number of modifications to target scopes to help limit movement on the adjustments and also, to limit movement in the parallax in either the objective or by other means. These have ranged from setscrews opposite the turrets to coil spring plungers and some other internal modifications as done by Cecil Tucker of Odessa, TX. Dick Thomas at Premier Reticles at one time fixed the objective in place and moved the parallax adjustment to a set of lenses in front of the turrets. He hasn't offered that modification for quite some time. Jim Carstensen, presently (2002), makes a modification that locks the objective front and rear on Leupold 36 BR's and also has a modification to the objective to suppress movement on the older non-locking Leupold 36's. Burris has taken Cecil's modification a step farther on their scopes with the introduction of the Burris Posi-lock that combines a coil spring plunger and locking mechanism on the plunger. This has to be a good idea, especially on a hunting rifle that is sighted in and then usually left alone.

It goes without saying that the accurate rifle cannot be accurate without high quality ammunition, but that s another story.

No matter what the shape, no matter what the weight, no matter what the caliber or purpose, the same elements that make a benchrest rifle accurate are the same elements that make a hunting rifle accurate. I hope that this discussion has left you with a little more insight into why certain rifles are accurate and why some are not.

---------- Gordy Gritters method of alignment and the home made rods to do it. ----------

Notes on the Grizzly chambering DVD

I certainly do not feel like anyone has been bashing me - it's just nice to see some discussion and other opinions on this topic. There definitely are other ways to set up and chamber barrels that work very well, but the way I'm currently doing it has produced consistently better results for me than ways I've done in the past.

I am a full-time gunsmith and have been doing this for about 21 years now. I do from 50 to 75 barrels a year and I've always continually experimented to try to find better ways of doing things. I did it between centers for awhile, and then for a long time I did it by indicating at the throat and the muzzle like a lot of guys do now and got along just fine, but when I changed my methods and started to set the bore up so the chamber perfectly aligns to the first few inches of bore AHEAD OF THE CHAMBER like I do now, my percentage of "so-so" barrels noticeably went down and the number of "hummer" barrels went up.

I first noticed this when I saw in my bore scope that the throat wasn't always as perfectly true as it should be. Then when I measured with an indicator, the chamber and the throat would be perfectly true, but even as close as 1/2" ahead of the throat I was surprised just how much runout there would be on some of these barrels (the more curvature in the barrel, the worse this is) - this really bothered me since my customers were paying good money and I felt I wasn't giving them their money's worth. Doing it the way I do now, I can measure the back of the chamber, the front of the chamber, the throat and 2" or more up the bore ahead of the throat and everything is still running straight and true - every single time - which is exactly how I want it.

You guys are right about the range rod. It doesn't turn so it doesn't matter if it's true or not. If the bore is running out, it will flex the rod along with it and this is easy to measure and use to get the bore running true. After I get it running true with the range rod, I always double-check the bore (and fine tune it if needed) with the dial indicator since it will give a more accurate reading than the range rod can (range rod bushing has clearance in the bore, it runs on top of the lands which aren't always true, and the bushing itself isn't always perfectly true).

I try to control everything as much as I possibly can, so I then started to index the "high side" of the muzzle end of the barrel so it pointed up. When setting a barrel up like this, even though the curvature in the bore isn't always "straight up" but sometimes will also curve a little right or left of center also (compound curve), the bore will still be generally be pointing up or close to it. This makes it better for long range shooting. I used to worry about the muzzle runout using this method, but after seeing the results for me, I sure don't worry about it any more. But the bigger benefit in my mind is no matter what the bore is doing at the muzzle end, I don't want the WEIGHT of the barrel at the muzzle hanging to the side at 3 o'clock or 9 o'clock - I feel this could be cause for more problems from harmonics and barrel whip.

There are so many details that are not on the DVD, but we hopefully cover the basics well enough for just about anyone who watches the DVD to do it that way if they want to and end up with extremely good results- that was one of the main purposes of this DVD! Hope this addresses some of what you guys are wondering about.

Gordy Gritters

Enjoying the discussion!

But some of you are making this seem considerably more complicated than it really is. Doing it this way like we show in the DVD (please buy the DVD from Grizzly before you criticize this method too much) perfectly aligns the receiver to the chamber and to the beginning of the bore, and the muzzle is only ever so slightly offset to achieve this. The barrel still fits the barrel channel almost exactly the same, and there is absolutely nothing "crooked" about it. It works great - every single time

without fail!

Roy B asked earlier about how much misalignment I'm seeing when I set up barrels this way, and how much is too much. Looking at my records for the past 2 years, the muzzle runout in benchrest barrels was anywhere from .003" to .031", with most barrels in the middle of this range, which isn't very much at all. I've seen hunting barrels as far out as .100" (quite rare) and once had one that was over .200", but I send them back if they go over .060" or so since I don't really like to see that much. I really have not seen any problems with accuracy with barrels anywhere in the .040"-.050" or below range, which almost all benchrest quality barrels are. I find quite a bit more problems when I slug and evaluate barrels as I get them from the manufacturers and I send them back when they show bore dimension problems - again this is rare with high quality benchrest barrels though.

If I am doing a barrel for a glue-in (which I seldom do anymore), I don't worry about trying to index the muzzle up or down (it will still shoot great without indexing it), but I definitely still align the chamber to the first few inches of bore ahead of it like I do everything now. I started to index muzzles "up" with the 1000 yard guns to get a few more (very few usually) minutes of elevation adjustment for some of the guys whose scopes were limited on elevation adjustment range. Even with the barrels that have the muzzle .030" or so out, this only makes for a very slight difference in windage or elevation, but for long range shooters I want as much elevation capability as I can get. If it's "off the paper" like someone said, that is a bad barrel, not a problem with doing it this way. I also like the idea of the weight of the barrel at the muzzle to be up or down, not at 3:00 or 9:00 if I can help it.

Somebody also mentioned about how this affects crowns. It doesn't matter which way you indicate the barrel in, the crown will be cut straight to the centerline of the lathe, just like the chamber would be - that's just basic machining. But in my opinion, no matter how much we may want it to be otherwise, if you indicate both ends of the bore to be running true at the throat and the crown, the bore WILL be curved in between those 2 points, and the bore WILL be coming down to the chamber and the crown at a slight angle, which I don't like to see. Just like at the chamber end, if you indicate the last 2 inches of bore before the crown to run straight and true, the crown will be cut just a little straighter to the bore (90 degrees as opposed to 89 3/4 degrees for example).

There is no question that guns will shoot extremely well done either way as we all know, but in my opinion I just feel it gives a slight edge doing it the way I do it now, and anything I can do to gain any edge at all I am going to do! Like I said earlier, since changing to this method my percentage of "so-so" barrels has noticeably gone down and the number of "hummers" has gone up.

Someone also asked if I'm selling these DVD's since they live in Canada. I'm sorry, but I'm not selling them at all - that is all done through Grizzly at this point. Not sure how to get them to Canada - maybe if you know someone coming to the SHOT shot, they could pick one up for you there.

Gordy Gritters

Butch,

It actually does work exactly like I show in the drawing, although I greatly exaggerated what was going on in the drawings so people with all levels of expertise could hopefully understand what I was trying to show them - I know I'm not much of an artist, but I tried to make the drawings as simple as I could. What I maybe should have done was shown the reamer/chamber in the barrel instead of outside it like it would be before starting the chamber- maybe that would have made more sense to you.

The reamer is not really crooked like my exaggerated drawing makes it look like- everything

(chamber, threads, receiver) is just being aligned to the centerline of the bore at that end, and the bore right ahead of the finished chamber will be lined up perfectly to the chamber also, which is the most important part.

If you have a bore with some curvature to it, which all barrels do, and you indicate it to run true at both ends of the bore - at the throat and the crown - the bore will be curved in between those two points. So if you indicate it at the throat, drill and bore, then chamber to that dialed in throat, the bore coming to that throat will be curved and on a different plane than the chamber.

Next time you chamber a barrel that way, when you are done, test this by running a long reach indicator in and measure at the rear of the chamber, the front of the chamber and the throat. If you've done your part all those parts should have zero runout and be running true.

But don't stop there, now keep moving the indicator forward past the throat up the bore a ways ahead of the chamber. Depending on how much curvature that particular barrel has, you will IMMEDIATELY start to see some bore runout. Sometimes this shows up quite well in as little as 1/4" to 1/2" into the bore ahead of the throat. Long bullets aren't even clear out of the case yet and they are having to turn ever so slightly to get lined up to the bore when they are starting into it.

You can clearly see on the DVD when I am done with the chamber I do exactly that test. Not only is the whole chamber, front and rear, running perfectly straight and true, the bore ahead of the chamber a ways is also running perfectly straight and true with absolutely no runout. I have never been able to achieve that until I started to dial bores in like I do now.

Hope this explains it!

Gordy Gritters
I had a lot of questions on range rods, and I see some of the same questions here after I got back so I thought I'd clarify how I do it. I made three sizes of rods for the main chambers I do: #1 for 22 and 6mm: make from 13/64" drill rod, turn the end down to about .189" and then grind it or spin it down to where the reamer bushings will just barely go on and turn freely. #2 for 25, 6.5, 270 and 7mm: use 15/64" drill rod and turn end down to about .220" and fit bushing same way. #3 rod for 30 cal, 338 and larger: use 17/64" rod and turn end to about .252" and fit bushings. The ends will drill and tap easily. Dave Kiff at Pacific Precision is making them now so those of you who don't want to make them can buy them and the bushings all from Dave.

I hold the range rod in the tailstock chuck as little as possible - only about 1/16" or so to allow the range rod to freely pivot back and forth as the bore moves. I've had better luck doing it this way than holding the rod more firmly in the chuck.

I did have an extra large bore and consequently a very loose fitting bushing one time and no tighter bushing, so for that particular job I bent the range rod slightly and held it firmly in the chuck so it would hold tighter against one side of the bore and I could get a pretty good reading on it, but it works way better to get a good fitting bushing and let it freely move.

One other thing to keep in mind is what Alinwa posted earlier - it's having more of the shaft outside the barrel to give more accurate readings (the pivot point is farther away from the indicator), so the longer the rod the closer your indicator readings will be to the actual bore movement you are measuring. I think 12" is minimum size and works really well, but it sure wouldn't hurt to go even longer yet.

After seeing how many questions guys had, even after seeing the Grizzly DVD, it really seemed to help quite a few guys understand so much better what was going on when they could see it in person and ask a lot of questions as the process went on. The DVD shows all the basics, but there are so

many details that aren't on the DVD that I explained to people at the show in person, and it really seemed to help.

I do several classes a year now on long range shooting and after seeing the interest at the SHOT show, I think I will start offering classes in chambering, crowning and bore slugging/evaluation to interested people at my shop. I can do this about any time since I chamber barrels year-round. I have rifle ranges from 100 to 1000 yards right outside the door at my shop that you can also shoot on if you want, and my wife has started a bed & breakfast at our home for hunters and shooters if you need a place to stay (my shop is attached to my home and she's a great cook). Just let me know if anyone is interested.

Thanks!
Gordy Gritters

Gordy Gritters
Registered User

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Contact info

Rolandr, My contact info is as follows:

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Home made Girzzley rods:

Joe
I'm not Gordy but I would guess that he is on his way to the shot show.
Since I got this information from Gordy I'll pass it along.

Gordy makes his own rods using 12" long drill rod.

Quote:

> I use three different size drill rod for the three main ID of reamer bushings -13/64", 15/64" and 17/64" if I remember right.

I had some brass rod on hand so that is what I used to make mine and they turned out very well. I drilled and tapped the end of the rod to use a 6x32 screw to hold the bushing on the rod.
I fitted the bushing by turning a little at a time and trial fitting the bushing on the rod until it just slipped on and rotated freely when well lubed.
If you don't want to make your own you might try contacting Dave Kiff at Pacific Tool and Gauge. I know Gordy discussed having him make some.
James

Using a caliper with resolution to .0002 most readings I get are .0002 smaller than those in the picture. You don't want any slop between the rod and the bushing or more correctly no more clearance than is required for the bushing to rotate on the rod.

You'll notice that there is a step in the smaller rod I will probably turn it down to .200 the rest of the way down the rod until there is only about 1" left unturned so the rod isn't trying to flex in to places. James

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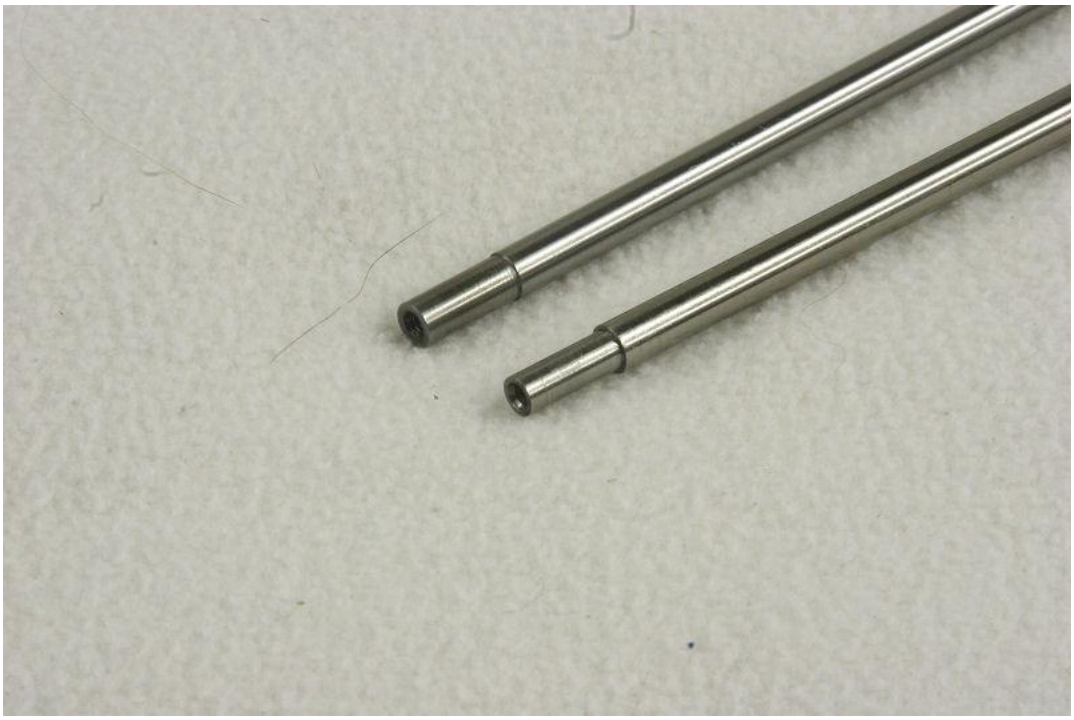
Shop made long, flexible range rods. Used to indicate in the barrel bore prior to machining tenon, thread, and chamber. Based on the Gordy Gritters design, they are held in the tailstock chuck, and a dial indicator is set just outboard of the barrel tenon. As the barrel is rotated, any runout is translated into rod flex, and is shown on the indicator as a lateral movement. The rods are moved in and out of the bore as the chuck and the spider are adjusted, until the indicator no longer shows movement.



Another view of the rods, showing the 6mm and 6.5mm bushing surfaces. These are machined to a perfect slip fit, with less than 0.0001 clearance. The 6mm rod is made of 303 stainless turned down to 0.232, and the 6.5mm rod is made with 0.250 W1 drill rod.

Another view of the 6mm rod, showing the 6mm bushing installed. The 4-40 screw holds the bushing in place.

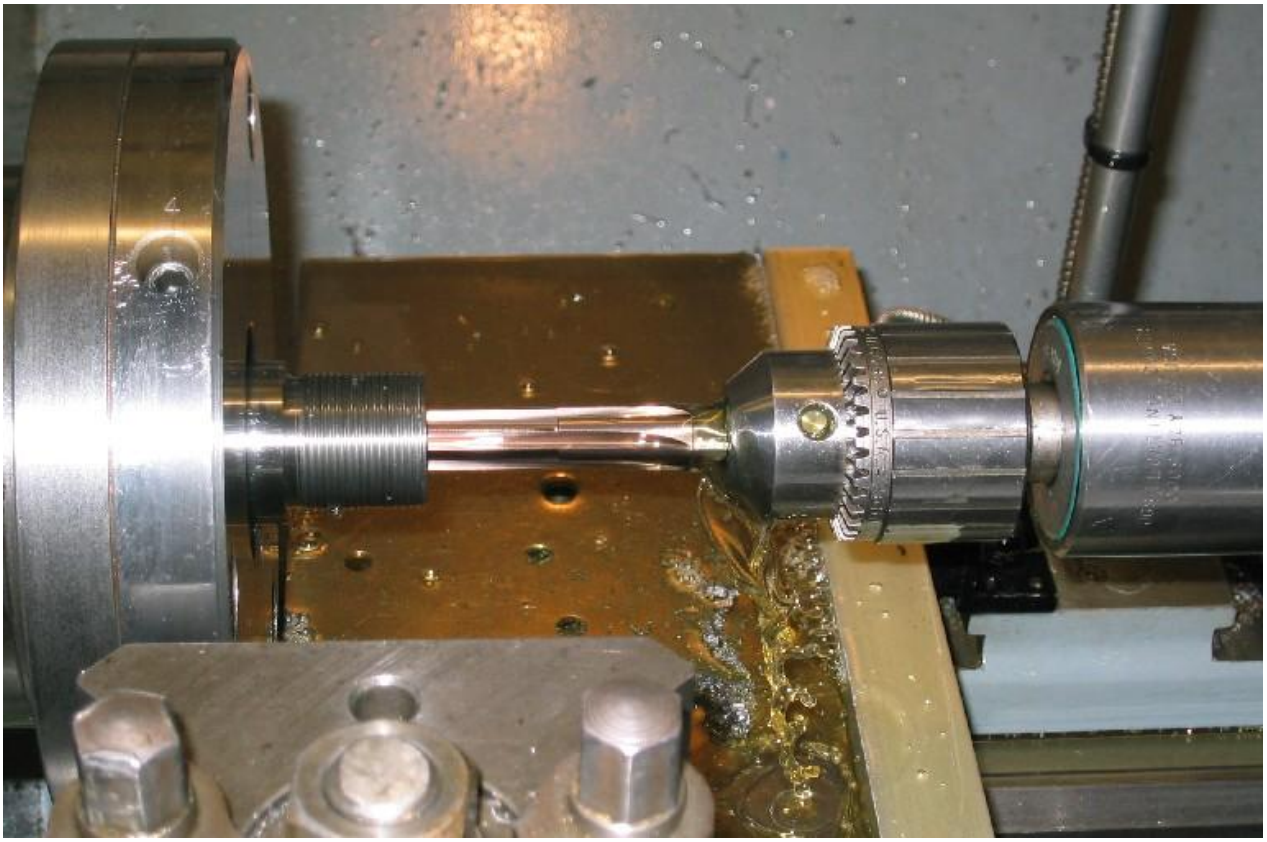
Workshop

The large rifle manufacturers just can't work to the tolerances required to achieve *ultimate accuracy* from a rifle.

Misalignment can occur at almost every stage of the manufacturing process and although these minor errors can only be measured in thousandths of an inch they can accumulate to the extent where they will have a detrimental effect on accuracy. The easiest place to see these misalignments is on your fired cartridge case. Is the firing-pin strike exactly in the centre of the primer?

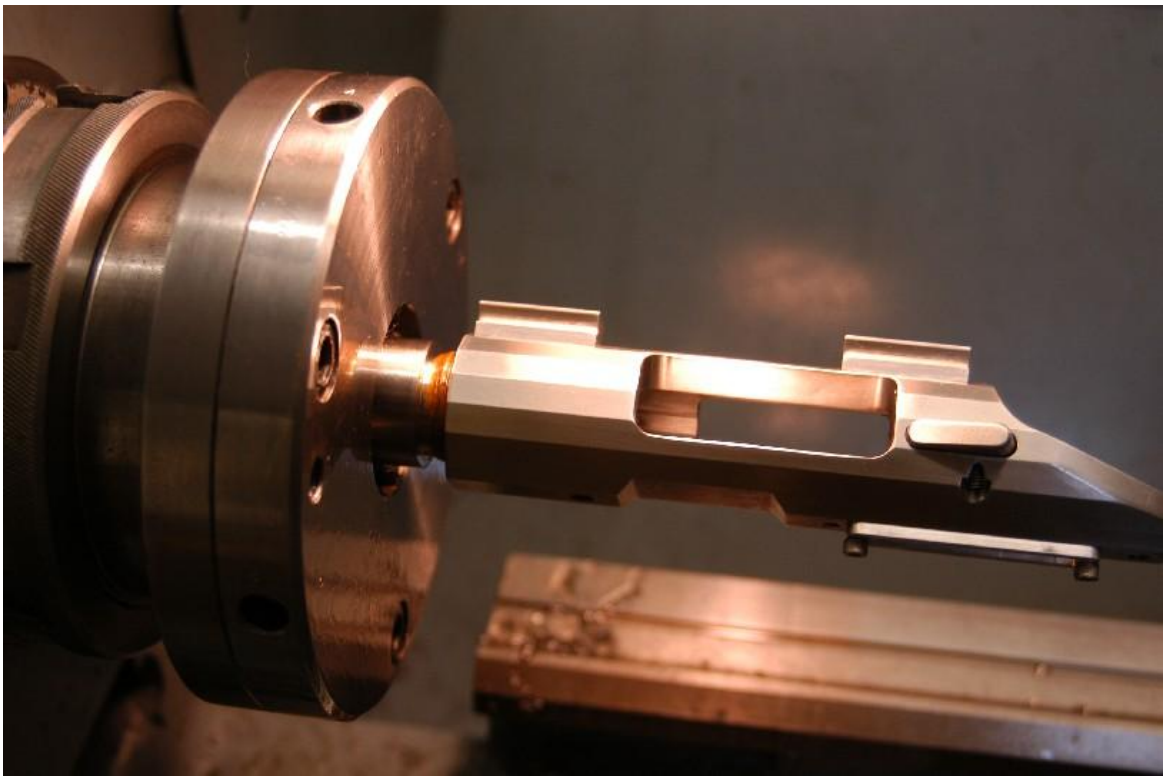
The custom gunsmith will set out to eliminate these errors. The result is a rifle where all critical components are perfectly fitted, aligned and centred. Of course, this kind of work takes time and skill and these cost money but it is money well spent if *ultimate accuracy* is your objective.

There are plenty of gunsmiths in the UK who can thread, chamber and assemble the components of a rifle but there are few who will do it to the standard required for *ultimate accuracy*. Choose your gunsmith carefully.



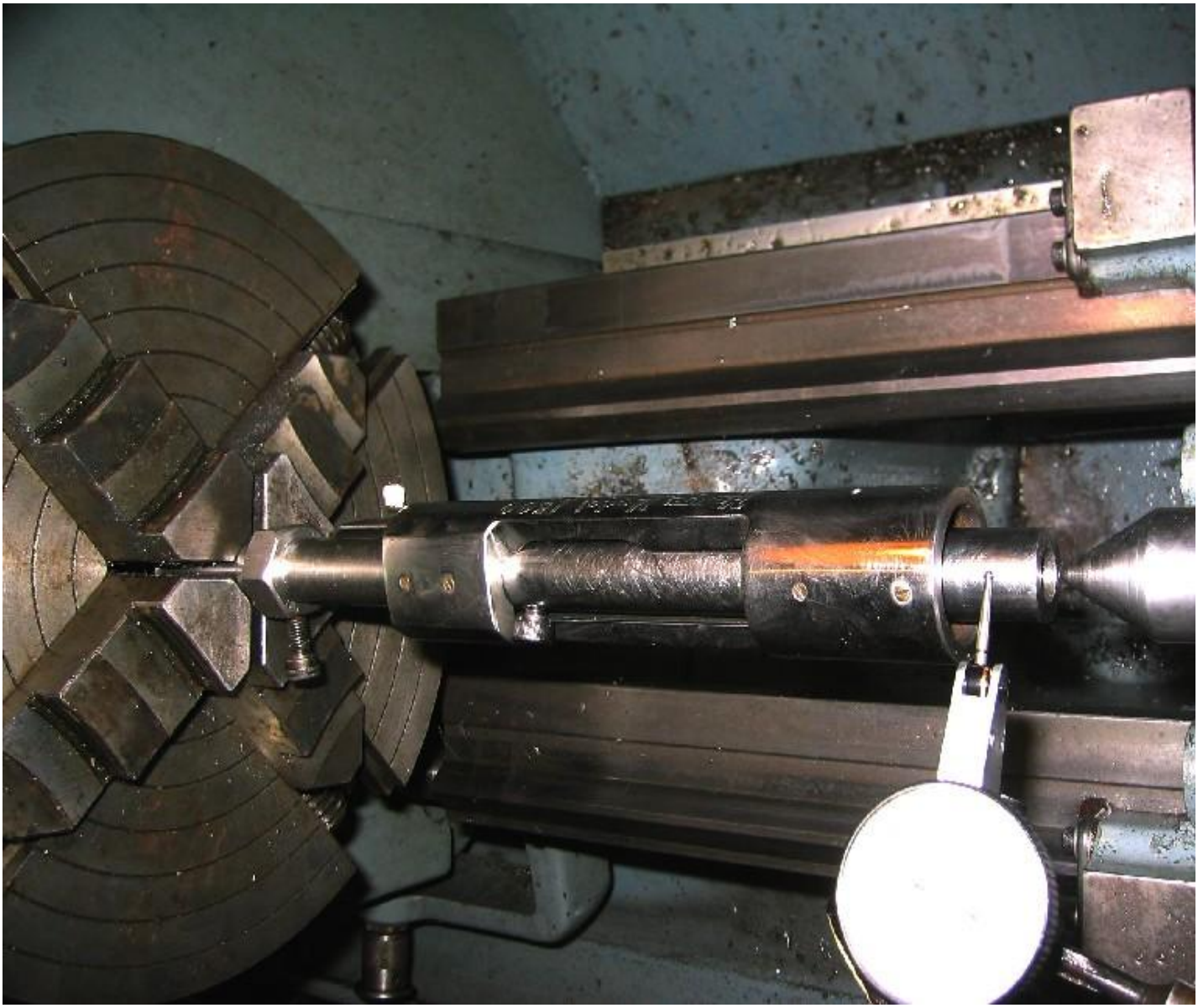
Running in the reamer. Cutting the chamber is critical. Not only must alignment and concentricity with the bore be spot-on but the resultant internal finish must be free of machining marks and scoring, otherwise extraction problems could occur. The reamer in the picture is held in a JGS floting reamer-holder thus eliminating any mis-alignment of the lathe tailstock. The flushing system seen here helps to flush away swarf from the reamer-flutes which could easily score the chamber. Thin cutting fluid is pumped down the barrel from the muzzle-end under high-pressure.

A factory chamber will be reamed in seconds. It will take me all of an hour to cut a chamber.



After setting-up the barrel-blank to run to within one tenth of a thousandth of an inch - clocking in the bore, not the outside of the barrel - we cut the barrel-tenon and thread it. Action threads will vary slightly from action to action even though they are listed as the same. Final fit is therefore determined by repeatedly trying the action on the thread until the required fit is obtained. We want a smooth well fitting thread with just the slightest 'waggle' so that the barrel-shoulder will 'snug-up' against the action-face ensuring perfect alignment. Action in the picture is the twin-port 'baby' BAT for my 6PPC benchgun.

Many custom actions have a 'cone' bolt. Once the barrel is threaded we need to cut a matching cone in the end of the tenon. Again the final fit will be determined by screwing on the action until the bolt just closes against the cone. We must then decide on an operating clearance between the two faces. What is the correct clearance? As little gap as possible is desirable thus offering as much support as possible to the cartridge case. But, if we don't allow enough, the clearance could dissappear when the barrel is torqued-up and the bolt could foul the barrel cone. A few years ago, I remember my rifle locking-up at the World Championships because a bristle from a bronze bore-cleaning brush had deposited itself on the cone-face. A bristle is about five thou. in diameter - so guess how much clearance I leave!



In this shot we are attempting to improve on a factory action - in this case the Japanese Howa. A custom mandrel must first be ground-up to closely fit the bore of the action. The action is prevented from rotating on the mandrel with the small scocket-head screw in the port. Another ring-clamp prevents it moving towards the chuck. The mandrel is 'clocked'

to within a tenth of a thou. at both ends and supported on a centre. We can now take a skim off the action-face where the barrel shoulder will register. We can also have a look at the action threads - but not re-cut them with this set-up. The threads were pretty good and I settled for a four thou. skim of the face. This is why accurising a factory action can be expensive - making the mandrel, setting-up and squaring-off the action-face took me a whole day.

Precision rifle-work is slow and requires great patience. There are lots of opportunities to mess-up an expensive barrel or action. If your gunsmith messes-up, he foots the bill and you won't even know about it! When you find a good gunsmith who builds you accurate rifles, be nice to him, don't rush him, don't hassle him, treat him with respect and never complain about his charges. He has a unique skill and thousands of pounds worth of expensive equipment - which doesn't last forever.

Cutting tools are expensive - especially reamers and they don't cut too many chambers before they lose their edge. If you want your gunsmith to use fresh sharp tools on your rifles, expect to pay for the privilege.

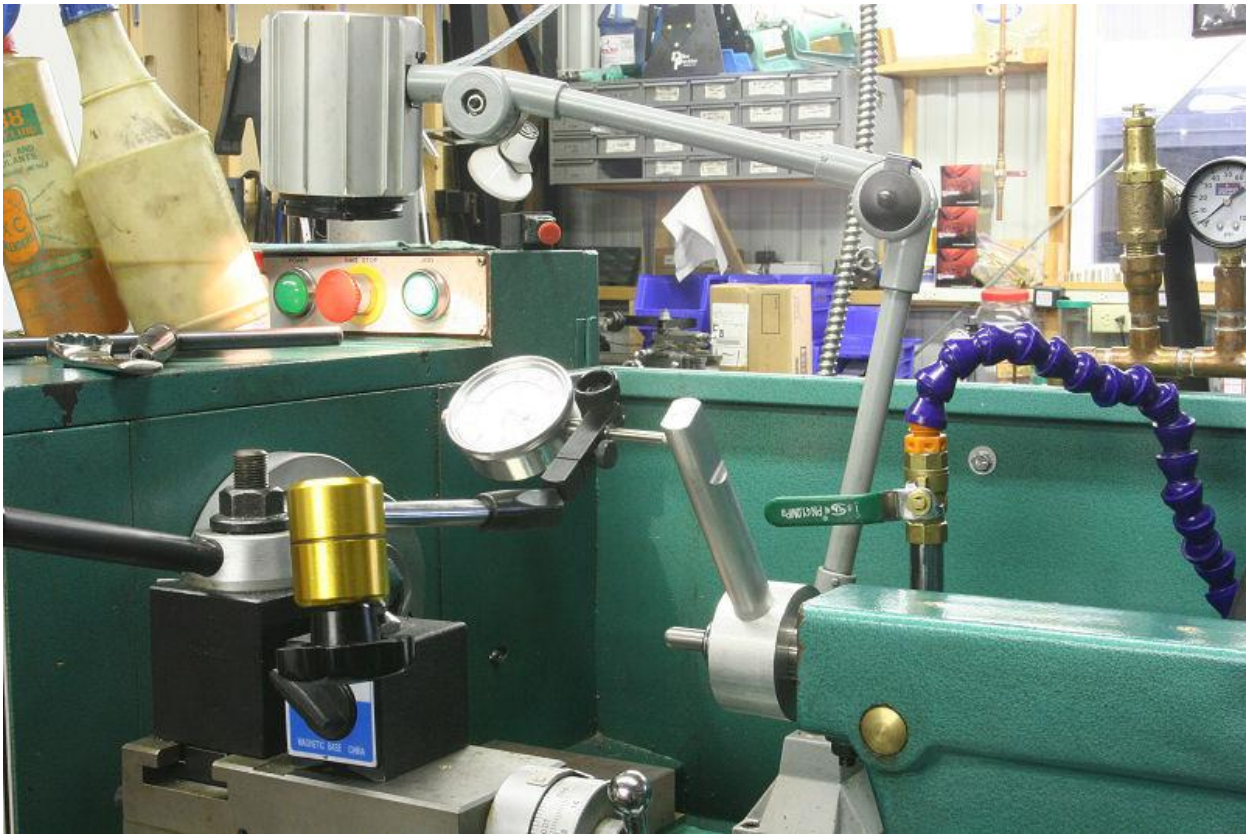
Where would we be without our quality gunsmiths?

A precision gage made from mild steel, exactly 1.2500 in. long, and a slip fit over a standard Remington 1.060 thread tenon. Used to assist in measuring the protrusion of the go-gage during chambering and headspacing. Avoids having the depth micrometer rock on the back of the go gage.

Another view of the headspace measuring collar, showing it in place over a chamber and tenon section in 6 Dasher left over from a barrel set-back. A 6 Dasher case is used to illustrate the process.


A gage made from a short section of barrel stub left over from crowning. The chamber reamer is run in about 0.250, with the throat area revealed using an end mill. Used to measure the amount of shoulder bump-back when body or full length sizing, as well as to check the seating depth to the lands for different bullets.

Another view of the headspace measuring gage, showing a 6 Dasher case in place.



This setup is used when chambering, and allows for a repeatable and precise indication of how far the reamer has advanced. The dial indicator is fixed via a magnetic base to the locked cross slide, and bears on a shop made arm attached to the tailstock spindle.

In this view, you can see how the indicator will stay in position even after the tailstock is removed and returned to place. This allows for easy and fast measuring of the headspace dimension, and allows a precise indication of how much the reamer advances during cutting. Achieving less than 0.001 inch precision in final chamber headspace is routine and very easy with this setup.

This is a shop made 5C handwheel type collet closer. A factory unit was not available from Grizzly for the G9036 lathe, so I made one using some stainless, aluminum, and 4140 tube stock. The only part that was not shop made was the precision ground 5C collet adapter that fit in the headstock spindle

nose 5 Morse taper. This was a replacement part from Grizzly for another lever type closer, and fits the lathe spindle perfectly.

This view shows the unit assembled. The outboard end rides on a collar that floats over the spindle OD, and the axial thrust is taken up with a Torrington bearing built into the collar.

Set up is fast and easy. The 5C collet to 5 Morse adapter is placed in the spindle nose by hand, the closer tube inserted into the spindle bore, and the collet of choice threaded into the brazed in internally threaded steel insert in the end of the 4140 tube. A twist of the handle, and you are ready to turn your part.

I would like to know the preferred method used by the people that frequent this board on chambering. Do you chamber in the head or on a steady? Why?
Jim

This has been covered a million times on as many sites. The bottom line is that any system that results in the barrel running as straught and true as possible gives good results providing it is at the same time perfectly aligned with the tailstock. There are times when it is advisable to chamber in the headstock such as with a very light barrel. The skinny barrel lacks torsional rigidity which can promote chatter so it may work better to chamber this in theheadstock.
Mostly I prefer to chamber in the steady and I prefer to cut my threads between centers. Any time I have seen oversized chambers cut it was when the smith was chambering in the headstock. Now, if he had been more thorough in his setup it wouldn't have happened but if he had trued the shank and run it in the steady it wouldn't either and it would have been faster.
Believe it or not I have watched a well regarded gunsmith simply chuck the barrel in a 3 jaw chuck with about 1 1/2 inches protruding and thread and chamber it this way. This was his standard procedure! That some chambers were oversize or misaligned he blamed on the reamer.
Also I have yet to see a floating reamer holder that would truly float axially when under load so there are limits to what can be expected there as well. One fellow told me of a German holder that floated perfectly in all directions and cost on the order of 1200.00. I figured for 1200.00 I should just have to show it the barrel and it would do the rest!
Do what you are comfortable with and if you do it properly your chambers will be on size and in perfect alignment. Use any technique incorrectly and a good job will be a matter of chance. Regards, Bill.

For years I had a lathe with a small hole through the spindle so I did all my barrel work between centers. And I turned out some very accurate barrel jobs if I do say so myself.

Then I acquired a 5900 Clausing with a large hole through the spindle and began threading and chambering barrels through the spindle. I have a 4 screw spider on the back side and indicate both ends to .0001". Due to more rigidity I get a much smoother finish in the chamber and on the shank and threads. I now use this method when possible.

I can think of some problems to avoid using either method. If chambering between centers I strongly recommend you buy a set of piloted center drills to get a very accurate 60 degree center cut. If doing barrel work through the spindle you must very careful not to introduce axial stress on the barrel with the 4 jaw chuck. This normally happens when you adjust the 4 jaw chuck first with the jaws very tight then adjust the muzzle end at the rear of the spindle next and you actually put a bow in the barrel.

I know there are some very good accuracy gunsmiths who build winning competition rifles using both methods. I think either method is good, it is simply a matter of which one you get the best results and are most confident with. There are a lot of good machinist who turn out flawless work with different approaches. They both have one thing in common, they pursue excellence at any cost.

There is one thing about using a steady rest that really irritates me. You will read an article about someone building a varmint rifle or target rifle and there will be a picture of the barrel in the steady rest and being driven by a 3 JAW CHUCK! It should be done between centers or if you must drive the barrel with a chuck it should be a 4 jaw chuck and then only after turning the outside of the barrel concentric with the bore. Craftsman

Guys,

Can I ask what the preferred method of holding the reamer is? I'm aware of several methods but have heard the floating holder mentioned most often. If this is the preferred method then which brand of holder is recommended?

Can you tell I'm getting ready to try to cut my first chamber?

Thanks,

Mike

Mention a method around a bunch of gun plumbers and you get different answers from each gent. The answers depend on a lot of things: Who taught each plumber, what he has seen or read by others, what equipment he is using, equipment limitations, and, one that I really like, just how much formal or "real hands on" true machining experience the gent actually has. And we are all biased depending on our "perfect" method. One of the ways a good machinist (note I said machinist, not gunsmith) is judged on is how well he can handle setup conditions in a variety of machines when faced with unusual or difficult to handle items.

I chamber through the headstock and also with a steady, depends on the situation at hand. My chambering lathe (I have three lathes) has a 1-1/2" spindle bore and can't take less than a 26 inch barrel through the headstock. So, the shorter barrels get the steady.

My steady is much different than the conventional three finger steady, it has a hollow rotating spindle that works just like a 4 jaw chuck, so I do not have to turn a true area on the barrel for steady fingers to rub on. And it will take octagon barrels or let me crown or thread a muzzle that has a sight ramp. Try that with a three finger steady, you get into the time consuming and error producing world of catheads in a steady.

The key in accurate chambering, makes no difference if you go through the spindle or use a steady, is accurately setting up the barrel true to the bore centerline. And, as Jack mentions, ain't no straight barrels out there, does not make any difference how much you pay for them!!! Another interesting thing: I have pilots in 0.0002" increments in all bore sizes for my reamers, I select a snug pilot to fit the bore (bore sizes vary a lot too!). I have long rods made up so I can attach a pilot to the end of a rod and push the pilot bushing completely through a clean and lightly lubricated bore. You will get some real surprises on snug and loose areas in a barrel along the bore, even those expensive ones! I have a standard chambering checklist with drawings that I use when chambering a barrel, it also has spaces for me to enter the total dial indicator run out (TIR to you machinists) of the outside diameter of the muzzle and breech with respect to the bore centerline. You will see some surprises here also, even in expensive barrels, especially the TIR difference at the muzzle end of say a 28 inch blank and at the finished muzzle length.

How to hold the reamer, muzzle flush pumped coolant systems, lathe speed, reamer feed rate, chip removal, how far to run in the reamer before pulling out for chip removal, etc., are all very important and will take several pages of text and photos to describe properly. If a gent is getting into chambering, the best advice is to seek out an experienced hand and observe, then read of other methods, practice with your own equipment, and formulate your own methods. Never stop asking questions and learning, I learn new techniques every week. One method I stumbled on a few weeks ago made a significant change in my method of chambering, it was one of those moments when one says "Duh, why did I not think of this years ago!!"

One last comment: I chamber upwards to 5 or 6 barrels a week. I built a muzzle flush pumped coolant system about 5 years ago. If you are not using this type of system, you are wasting your time. Not only can you chamber much faster, but the finished chamber is much smoother, chips are continually flushed out, and the reamers run cool and do not suffer from heat build up. I chambered a 6.5x284 barrel today, running the spindle at 300 rpm, took less than 10 minutes from the time I put the reamer in the holder until I was at the final headspace, including several stops along the way to clean out the chamber and put the gauge in to check. A pumped system changes your whole philosophy about chambering!!! John Ricks

Note Craftsman's comment about three jaw chucks, take it and file it in a good place in your memory if you are beginning in the world of threading and chambering barrels!!!

I had a rifle in the shop recently that was assembled by a well known and well advertised gun builder (and expensive!!!). The rifle is a hunting rifle in a big 30 caliber. This rifle had a lot of expensive truing and re-machining accomplished by said gun builder. It was shooting 1-1/2 to 2 inch groups at 100 yards. After I took the

recently installed new barrel off and took measurements, I found the chamber was 0.004" out of being concentric with the bore, the chamber was 0.006" larger at the chamber mouth than SAAMI standard and the receiver "truing" was accomplished incorrectly. I installed another new barrel, chambered it correctly and corrected the receiver machining errors. I shot a three shot group with this rifle that was less than 1/4 inch at 100 yards after I corrected all the problems. It looks like the previous gun builder used three jaw chucks extensively and his tolerances stacked up. Maybe even used a drill chuck to hold the reamer, who knows. Like Jack says on another forum, quality is not determined by how much money one spends. John Ricks

I have to agree with Bill. I do all my work between center's with a steady rest. I use Shilen select match stainless barrel's unless someone want's something different. I use all removeable pilot,reamer's,center drill's and crowning tool's. I have pilot's in .0001 increment's. I have found the Shilen barrel's to be very uniform.
Since 98% of my business is target rifle's, if they don't shoot you don't get any return business.Your name came go up or down very fast at a match even if it's one of those people who blame's every one but himself for his failure's. I had a guy tell me his rifle wouldnt shoot. I had the guy who won the IBS score shooter of the year for 2000 & 2001 the 2000 national's and part of the 2001 national's shooting one of my rifle's shoot the rifle. He shoot 23 straight x's. The guy then said the rifle would only shoot for Jim and he thought the bolt was bent.
I once bought 7 A&B barrel's for some sporter project's on a friend's recomendation. Two of them were nice and uniform. The rest a bushing would start in nice them fall out the other end or start in nice go loose then fetch up. I know some people like them and seem to have good luck but they are not my cup of tea. I think you get what you pay for.....
I agree with John Rick's about the muzzle flush. I have been using one for 6 year's and would never go back. The chamber's come out so polished I go back and rough them up a little with 400 to keep the bolt thrust down.
Something every one who posted I am sure know's but those who don't do much machining may not is tailstock alignment.It must be right and checked often. Ron Morse

I just went through some of these threads and I just admit I did not completely read all of them. I chamber using the steady rest method. Someone early on said "all of them (barrels) are bent". To a degree, he is correct. If one sets a barrel up correctly, It should run concentric and axially correct with the axis of the lathe. By indicating in the chamber end and the muzzle end, are you accomplishing anything? What about the middle of the barrel. In other words, what I am saying is the reamer should enter the bore of the barrel concentrically and axially true within a tenth or two of the bore. How would one do this. I use a gauge pin in the bore and indicate it in when it sticks out of the bore the same length as the chamber. The outside, the threads, is now running concentric and true with the bore and the chamber can be cut accordingly. I further set it up to run in the steady by single pointing a 60 deg center in the chamber end and cut the outside area for the steady thus. Confusing? That is why there are so many different methods. I know an accuracy gunsmith who sets his Jacobs chuck in his Aloris tool holder and cuts his chambers that way. I often wondered how he got everything lined up correctly.

Regards, JIM

Again, "Different Strokes for Different Folks".

RE the crooked barrels, you just got to understand what is going on and master your technique to make the most of a barrel chambering job. Let the reamer follow the bore axis, you want the chamber axis to be right on with the bore axis. Threads also, they should be concentric with the bore axis. There is a way to do both, this is a topic for future discussion.

The key is to master your technique and equipment to produce quality results. Some of the techniques we use, especially for precision target rifles, are closely guarded secrets. And there is a whole world of information and techniques about chamber reamers for precision rifles, the reamers are different than a SAAMI or CIP reamer. Things like throat lead, throat angle, tight necks, tight bases, that are required in a match rifle chamber but will not work in a hunting rifle.

I am entering into a project to inventory all my machinery and equipment for insurance purposes. Along the same path, as I am a one man shop with no apprentice or dependents to "carry on", is a project to document what the

special tooling is for and the methods of use. Reason for this is some poor fool, when I check out of this game, at hopefully many years off, will have to sort out all the stuff I have accumulated over the past 35 years and figure out what to do with it. Would be nice to have the whole package go to an individual starting out in gun work instead of letting the auction vultures split it up. In addition, I am hoping to publish the information in book form in order to help out many others.

Although my favorite rifles are classic big bores, I dabble in long range bench rest, tactical, and 1000 yard rifles. You need to be very careful in the setup and machining of a rifle of this nature, and check & recheck the setup often. I work to 0.0002" or less TIR when building a precision rifle, it pays off in the end. A few rifles on the back log include three for 1000 yard work: A 338 Improved Lapua, and two 408 Cheyenne's. The Lapua goes on a Nesika action single shot action, the Cheyenne's go on Prairie Gun Works custom single shot actions.

Isn't this game fun, there is always something new to learn, at 55 years of age I see new stuff every day! John Ricks

The problem with the three jaw is not whether or not anything will run true. If you chuck up a barrel in the three jaw and then work on the other end, you can't be certain that the outside of the barrel is running true with the bore. They most certainly do not and you end up with an alignment problem. The same can be true with turning and threading between centers. Even if your centers are concentric with the bore, the middle of the barrel won't necessarily be true. I wonder how any barrel maker can tell me whether or not the axis of a barrel is straight all the way through?

Jim

Concentricity of the barrel OD with respect to the bore axis, or centerline, is irrelevant if one uses the proper method of centering the barrel in the lathe: 4 jaw chuck and a 4 screw cathead on the outboard end of the spindle, or a 4 jaw chuck with a trued muzzle area and a 4 screw or 4 jaw steady as I described earlier. Over the past 5 years or so I have recorded TIR of the breech and the muzzle OD with respect to the bore centerline. In my spare time (Hah!) I should go back and compare this data to target groups to see if it tells me something.

The method is to try to obtain as near zero run out of the bore at the muzzle end of the barrel, and the bore at the breech end of the barrel, with respect to the centerline of the lathe. (You may never get everything perfect due to the machining inaccuracies and "lack of straightness" of the barrel.) One may accomplish this by use of precision machined bore plugs inserted in each end of the barrel for an indicator stem to ride on, or by use of a long stem indicator that is inserted into the barrel bore. The long stem indicator is a preferred method for many bench rest rifle builders, they strive to have the indicator point at the area in the bore where the throat will be after reaming the chamber. Chamber is reamed first, then another dial indicator check is made, this time with the indicator stem at different points in the chamber and throat, and a best average is taken, then the barrel is re centered and the threads are cut concentric to the reamed chamber. This method is generally only used if the action has a good snug fit of the bolt and the receiver threads have been re cut so the receiver threads and the bolt centerline are one and the same. (Meaning one of the custom single shot bench rest actions or a heavily tricked up M700 Remington)

The long stem indicator method reveals many things to a careful eye: How deep each groove is, if we have inconsistencies in land heights, width of grooves, etc.

I use both methods, depends on the rifle type being built. My long stem indicator reads to 0.0001" and a guy can spend a lot of time getting the barrel in the "perfect" chambering position, whatever that is.

Like I said earlier, the method is different for each type of rifle and barrel. No point in putting all the "bench rest quality" time into a rifle that will be used for shooting wild hogs at 20 paces.

It is easy to "nit pick" and spend too much time on minute details in the chambering process, especially when the

work is being done to improve cash flow for the shop!!!!! Like the old man said, "We ain't here to make guns, boy, we are here to make money!!" John Ricks

A couple of photos showing the "bore plug" method, using the 4 jaw chuck on the spindle and the 4 screw cathead on the outboard end of the spindle. "Bore Plugs" are about 3 inches long, machined from 7075T6, and have about 1/2 thou taper. I have a considerable collection of the things, as there is a wide variation in bore sizes among the different barrel makers and even in the barrels from a single maker. The big end of the plug is tapped (1/4-28 for 7mm and above, 10-32 for 6.5mm and below) so I can screw in a small slide hammer to withdraw the snug fitting plug out of the bore.

<photos not available>

If you look closely at the photos you can see the protective copper bushings between the setscrews and the barrel. Likewise between the chuck jaws and the barrel.

In both photos I am just starting the dialing in process, the indicators read to 0.001". I "rough in" to 0.001" or so, then switch to 0.0001" indicators. John Ricks

John- As always, you and I are in total agreement with respect to using the 4 -jaw chuck and outboard 4-screw spider method with a bore plug indicator system to obtain maximum accuracy in centering the barrel in the Lathe. I hope that the folks on this site are paying close attention as you are providing some hard won knowledge free of charge and with pictures to boot!
I use the same method (now also with a high pressure barrel flushing system for most of my work). I have also used the steady rest system for chambering with very good results. I have also seen the results of "expensive/renowned gunsmiths " who use three jaw chucks for threading and drill presses for reaming(ever wonder Why all those factory TC Contender barrels don't shoot accurately)? I've also seen those hand reamed chambers (you know those with big rings in them), Egg shaped- well that also doesn't matter does it? II's also interesting to me that people can be so arrogant in their insistence that only they know what works without obviously ever having built a rifle in their lives.
Nice job on setting folks straight!. you've got more patience than I have.-Rob

That set up sure looks familiar.
Same thing I use, copper protecting the barrel and all. Only difference is that in my spider I use brass screws so I don’t have to use the copper on that end.
I also use the chamber flushing. I have one from Greg Tannel. It works good.

Tested my 3 jaw yesterday. I trued a piece of 1" drill rod between centers, then chucked it in my 3 jaw. I was

pleasantly surprised when it only hade .002" run out. Not that I will ever chamber with it though I was just curious.
BTW, I have a Wilton Lathe.

Thanks for the picts John

Celt

I've been gone shooting for the weekend and so have just returned to the thread and have to mention a couple of things.
First off, it is unlikely that a journeyman machinist would be run out on a rail for using a steady in doing precision machine work. I never was. In some cases the use of a steady is mandatory to accomplish work that is concentric and perfectly aligned. Especially when dealing with tubing which is likely to have a bore that is both eccentric when compared with the outside and misaligned. In a case like this the turning of a steady track which is concentric with the bore and another concentric track at the driven end for dialing purposes is SOP. Properly done it is possible to bore halfway through a piece, turn it around, and bore from the other end and have the bore meet

precisely using a steady rest. It is also possible to thread inside and have those threads perfectly concentric with the bore and perfectly aligned. When you are working with pieces 12 feet long and 12" in diameter you don't do this without the use of a steady!
With rifle barrels it is a rare barrel indeed in which the bore is straight from one end to the other so that all attempts to ensure that the bore in the middle of the barrel is concentric with the outside are likely to be approximations at best. You can only be sure that the outside in the middle of the barrel is concentric with the bore at either end. If this is done, then the center portion of the barrel can be set to run true in a four or six jaw chuck but if so then only the outside will be sure of running true and only with the ends. The truth is though that this is adequate. The holding of the barrel in a three jaw chuck at the muzzle end or even in the middle while running the chamber end in the steady is also probably OK since run out of the bore is not likely to be all that bad and certainly not outside the capability of the reamer to follow the bore. This for chambering only, by the way, not for threading which should be done between centers.
I have seen highly regarded accuracy smiths set up a barrel in the four jaw chuck and dial in both ends. They are grabbing a parallel section in a four jaw chuck which may or may not have jaws which are aligned with the axis of the machine. They then dial in the muzzle end of the barrel and by doing so are actually bending the barrel so that the muzzle end will run concentrically with the axis of the machine. Those that are aware of this will hold the barrel in the chuck using narrow brass or aluminum strips which will, to a certain extent, allow the barrel to pivot. Some will use an extended gage system which will allow them to ensure that the chamber section of the barrel is running concentric and in perfect alignment with the axis of the machine and don't much care what the muzzle end does. In other words they are more concerned with the throat area of the barrel running true than any other portion. This is a necessity if one intends to bore the chamber for instance in the roughing operation.
It is certain that no system is always 100% perfect and there is a certain amount of compromise in each. It is just as certain that an intelligent and creative machinist/gunsmith is capable of getting the best out of each method. Likewise the inept can screw up using the best of set ups.
I have seen receivers which were "blueprinted" by smiths whose methodology was seriously flawed and as a consequence were probably no better than before and in some cases worse. Likewise custom actions which were supposed to be perfect were far from it whether from improper technique or improper employment of proper technique.
As I mentioned earlier, I've not seen a floating holder which reliably allowed a reamer to float axially. All, when under load, located the reamer in a center position. Now, this center position was not always coaxial with the tapered shank and therefore the tailstock barrel. So, when using one of these it is necessary to load the holder then adjust the tailstock to ensure that the reamer was held center in relation to the barrel. In one system the holder itself was used to center the barrel which was trued and then run in the steady. This ensured that the two were concentric to each other at that point at least. Concentricity throughout the range of travel of the tailstock barrel was dependent on how well the axis of the tail stock was aligned with the machine axis and is so dependent regardless of how the barrel is held. Holding the reamer in a tap wrench and supporting it on the tailstock center is a perfectly good method by the and even better if a ball center is used in the tailstock.
As I said earlier, all methods have certain potential deficiencies. Successful use of any method comes from an understanding of these deficiencies and an ability to take an intelligent approach to minimize the effects of them. The errors that may result from the use of a three jaw chuck are errors in the chuck itself or from improper mounting. Generally the church is as accurate as the scroll so that a three jaw may run perfectly when holding a 1 1/2" diameter piece and run out .002" when holding a 1 3/4" piece for instance. In addition, the jaws (as with a 4 jaw) may or may not be perfectly perpendicular to the face of the chuck. I have one four jaw wherein one pair of jaws are perfect while the other pair are decidedly misaligned so that a true test bar runs out by .010 12 inches out from the chuck but in one direction only. If a 3 jaw chuck has been mounted eccentrically on a plate then it will, of course, run eccentric unless you are lucky and the errors cancel out! Regards, Bill Leeper

Hi all or ya'll, since I'm from the south. I'm new to this board but already know many of you from other boards. I totally agree with John Ricks and all of his posts on chambering. I also put on 5-6 barrels a week. My preferred method is through the headstock, but occasionally chamber on a steady rest if circumstances require. I find it easier and quicker to setup a barrel through the headstock, but that is what I'm used to. Setup, threading, chambering, and crowning takes about one and a half hours, if the dang phone doesn't interrupt. I've never had a problem with springing a barrel, but that is something that I'm careful to avoid. John Lewis

There are floating reamer holders and there are floating reamer holders!!!! The things sold for the gun trade are sort of useless, I have tried them all. They gather dust on the wall to remind me of bad money spent.

The one I use allows feel of the chambering process with the fingers of the left hand. It's a big thing, like I said above, it was made for the precision machining use, not the gun trade. Don't know what it cost, or a source, I think it is out of production. I bought it several years ago in a tooling auction at a machine shop closure.

Bad thing about using a lathe dog and resting it on the compound is you can impart a side load on the reamer and cut oversize chambers.

Like I said earlier, I have tried all common methods of chambering, and some that do not bear mentioning. I strive for straight, concentric, round chambers and I think I have gotten to the point of consistent results, but there is always another method to try that may be better than mine.

Chambering is like a gent's choice of a car or pickup: One man's Chevy is poison to a ford owner. Just pick a method you like, and try to do good work. I chambered 6 barrels this week, got another one in the lathe now, so I have to think production also, this is why I use the pumped lubrication system for reaming, and some other things that speed up the job. John Ricks

---------- **Different Thread From 2006** ----------

I'm trying to decide who to chamber my new barrel.

The methods that the smiths I have called use are:-

Concentric to the **outside** of the barrel diameter (surely not good?)

Drilling a rough chamber with a drill to reduce reamer wear... despite claims of BR accuracy and minute run out, what the hell stops the reamer from wandering off and becoming eccentric from the bore?

Use of reamer from start with pilot to guide with finishing done by hand and T piece.

Starting to get confused. It's not as if this is going to be BR but it's a high quality cut rifle barrel and I don't want it done poorly through lack of knowledge! 1894MKII

A couple people discussed it here the other day, summed up it was:
Chamber and thread concentric to the bore
Rough drill to (approx) .050 undersize/short
With a carbide boring bar, machine to .010-.005 undersize
Finish with a reamer Tailgunner

Please excuse me if this is a dumb question, I am NOT a machinist.
One of our local smiths chambers and threads from the same setup with the chamber end in the 4 Jaw chuck and the muzzle sticking out through the left side of the lathe. He said that he uses a piloted reamer and it will follow the hole in the barrel. Are there any advantages/disadvantages to his system?.....DJ

The tail stock will NEVER line up perfectly with the spindle hole. No matter how well you think you are doing with this method the base of the chamber will always be oversize compared to the reamer. I call that the "short cut method" DJC

One of the main advantages to the quick change tool posts is that you can run the reamer, mounted in a floating holder, from the carriage table/tool post rather than from the tail stock, and you can align it perfectly with the set up that DJ mentioned. Using the same, perfectly aligned set up, you can swap between 60 degree center drill bit, twist drill bit, boring bar, reamer...whatever, without disturbing that alignment. Rick 0311

I'll just put my .02 in here. I indicate both ends of the barrel, using a 4-jaw on the chamber end and a "spider" I made for the opposite end of the headstock. I rigged up a mount for a dial indicator that is bolted to the gear cover to indicate the muzzle end of the bore. Once I get both ends dialed in I ream the chamber using another dial indicator I mounted on the tailstock measuring depth. I pre-drill the chamber using a twist drill as close to the chamber size as I have. I don't think using a boring bar would add anything but time to the job.

John Farner
Eagle Machine Gunsmithing, LLC.

dj, that is the way that I chamber and as far as I am concerned it is the only way to do it. As DFC says the tailstock will more than likely be off a bit, but I wonder how he holds his reamer when chambering. He is saying use the tailstock that isn't true to turn the O.D. of the barrel, plus who is to say that the center is running true. I have always used the headstock with a buck adjust tru chuck to indicate the bore with a .0001 indicator. Indicate the muzzle end in a homemade spider with the same indicator. Turn the barrel tenion and thread. Chamber with a floating holder [only one that I have found to be worth a damn is J.G.S.]. Make sure that you get your measurement across a set of wires from a known barrel and you are set to go. It makes it a lot easier to indicate the bore if you have a full set of pilots and indicate off the proper size, a lot easier than trying to indicate off the lands or grooves. I have used my barrels in quite a few I.B.S. score matches and won probably more than my share. Bob

quote:
Originally posted by djpaintles:
Rick, I think that's how they do it. There is only about 2" or so of the barrel sticking out from the chuck. Just enough to cut the threads. I don't think the tailstock could get close enough with the tool post? in the way.....DJ

You can align the cutting tool of your choice dead on the money using that method once you have the barrel indexed off the bore.

Mark Stratton has great photos and text describing this in his book.

I'm nothing more than a self taught garage "machinist" and if I can get straight chambers using this method I would assume that just about anyone could. Rock 0311

Rick, how do you get the reamer or other tool set dead nut in both axes with it in the cross feed? I have tried this on barrel stubs and always felt better about the tail stock and a floating holder, I realize that some of them suck but the J.G.S. is a very good one. If you can cut a foot or longer piece of stock with no taper to it, the tailstock cannot be far off. I grant you it can be a bitch getting it set up originally, but I think it pays off. Bob

I use a Dave Manson floating holder mounted in an Aloris ⅝" boring bar tool post. The Aloris tool posts are adjustable up and down, and the cross feed table is obviously adjustable side to side. Coupled with the floating holder and interchangeable bushing piloted cutting tools, I don't see how you couldn't be able to get things lined up dead-nuts.

The other advantage to using the cross feed is that it seems to be faster at inserting and removing the reamer for cleaning/lubing than is the tail stock ram.

I just finished up a little experimental scope/ laser tool I've been playing with and I bored and chambered 150 pieces of one inch 60161 T6 Aluminum round stock using this method and it sure worked well for me. If anything is crooked the laser beam lets you know real quick when it shoots down the bore. Instead of getting a red dot, you get either no dot at all or a partial dot with halo's around it.

Oh, the other thing you have to figure is that when turning on centers the tail stock ram is stationary and you can draw it all the way back in so there is no “wobble”. When reaming it is extending and any play in the ram will affect the straightness of your cut unless your floating holder can compensate for it. Rick 0311

Rick, you are saying that you can line your tooling up dead nut, you sound like you are doing it by eye with no actual method of making sure that it is really on. At least with the tailstock I can attach an indicator to the chuck with a magnetic holder and indicate off of a dead center in the tailstock and get it VERY VERY close, that with cutting a piece of stock that has no taper as a check on the tailstock, I think that I will continue with what I am doing. If you had a way of verifying that the reamer was truly on [and there must be a way] I might agree with you. Along with a up and down axis the reamer must also be perfectly parallel with the bore in order to cut a true chamber. I make a cast of every one of the chambers that I cut and all seem to be right on as far as I can see. I agree with you on the Aloris tool posts I bought 3 different size sets at an auction of a shoe plant in Mass. and they are very nice. [got the 3 sets and a half doz. holders each for 75 bucks]

Bob

Bob, if I was upset I wouldn’t have stuck in a happy-face. I don’t rile all that easy, so don’t worry about saying anything that rubs me one way or the other.

My only point is that whatever system of indicating and aligning you choose to use it is much quicker and easier (for me anyway) to line up the cutting tool when it is mounted to the cross feed table and a vertically adjustable holder than when it is mounted in the tail stock that only adjusts left and right.

Once I have the work piece turning concentric to the bore using dial indicators and a range rod, I can stick a range rod in a 5C collet in my tool holder and insert it right into the bore and I then know that the tool holder is in alignment with the bore and that any cutting tool I put in the holder will also be in alignment with the bore. Is this the best or only way... I have no idea Rick 0311

quote:
Originally posted by Pat B.:
I wonder how many folks take a good .0001 Interapid and check the finished chamber for run out ??? I bet some would be disappointed.

I have on many occasions checked the run out of a chamber and the needle remains on zero. I don't now use, or, never have used, a floating reamer holder, and I guess I just don't understand the need for one if the chuck, bore and tailstock are aligned. I don't find fault with those who choose to use them, I just never seen the need.

I use a live center and tail stock to feed the reamer. I attach a lathe dog to the shaft of the reamer to keep the reamer from spinning. I actually use to hold on to the lathe dog with my left hand while advancing the reamer with my right so that I could feel how things were progressing, but that got old real fast. Now I let the leg of the lathe dog ride along the compound rest as I advance the reamer with the hand wheel. I still keep my hand on the lathe dog, but I've long ceased trying to keep it from turning. The above technique is simple but it requires that certain pieces of the machine be aligned. It doesn't take much to check and maintain tail stock alignment. The lathe is a precision machine tool and is designed to be adjusted. Using the above method, if I've done my part, the finished chamber will be centered, concentric and no larger than the reamer. Malm

The method they taught us at Trinidad: cut off each end of the barrel with the bandsaw and face to the "true" bore. Then mount between centers and take a light skim cut on each end to true that area to the bore. This is of course after the tailstock is checked for alignment using the indicator on the spindle and running it around the tailstock ram and the live center. Also the headstock center is checked and if not running true then a renewable center is cut in the three jaw. The barrel shank is turned to the proper o.d. and then threaded. The trued portion of the muzzle is then dialed in the 4 jaw and the steady rest mounted onto the cylinder. The bore is then checked for run out and adjusted if necessary in relationship to the tailstock. The bore is now pointed at the tailstock center. The chamber

is then reamed with the tailstock center supporting the reamer which is held by hand with a lathe dog. They want us to feel the reamer cutting so that we can let go in case of rolling a chip or some other calamity.

The advantage to this set up as explained to us by our instructor, is that by aligning the tailstock and the bore at the far end of the lathe rather than right up at the headstock, then any slight misalignment between the headstock and tailstock is minimized. We also are taught the headstock and Aloris tool post method and are allowed to choose the method that makes the most sense to us after we have a few chamber jobs under our belts.

I suppose it really doesn't matter which method a fellow uses as long as concentricity is strived for and no assumptions are made as to the accuracy of the setup.

Brian Bingham

I have question on "spiders", Well more of comment really, based on many years of professional manufacturing experience making everything from machine tools themselves through aerospace, automotive and gun parts.

The jaws on most chucks of the size we (here in this board) use to make gun barrels have about 3" of bearing surface on the gripping part of the jaw. If you use a four jaw chuck and align the bore dead nuts; then put a spider on the back of the head stock and align the bore dead nuts out there by adjusting the jack screws,(Remember that 3" of bearing surface acting on the barrel 18" away?), all the spider is doing is bending the barrel to make the center of the bore *appear* to line up. The chuck would have to have point contact on the barrel and not linear contact on the barrel. What the four jaw is doing is no different than if you were to machine a matching taper on the barrel that matched the Morse Taper in the spindle and stuck the barrel into the spindle taper; just like a dead center. There is no way that a spider is going to do anything other than bend the barrel, it can't overcome the linear clamping load imparted by the chuck to make a true straight line out of the bore. **It is physically impossible.**

I know, I know, I have all (well most) of the books written by all the "masters" too, most of them advocate the use of a spider. Hell I almost made one myself till I sat down and thought about why I have never seen a spider used in actual industry to line up a bore. Unless you have a chuck with spherically ground jaws (perpendicular to the axis of the spindle centerline, giving point contact) the spider will do nothing but fight the chuck; and because the chuck has far more holding power than the spider, the barrel will bend.

Now just slapping a barrel in a four jaw and indicating center isn't going to be the most accurate either. How do you know the bore is parallel with the OD? You don't. The most accurate method is to place the barrel between centers, and create a known parallel, and zero run out diameter, this known parallel and run out free surface goes in the four jaw, then the chamber can be reamed.

Now the use of a spider to control barrel whip and kill vibration; that is a totally different animal; not to be confused with axial alignment.

Asbestos underwear is on, extinguisher at the ready. Flame away all you want.
Rusty's Action Works

Rusty I use 2 spiders. One on each side of the headstock. I do this because I have a headstock that is too long for a 4 jaw and a spider. I agree with you on bending a barrel. I proved it to myself a long time ago. I think Pat B. suggested that I use soft copper or soft aluminum wire between the barrel and jaws or spider. It lets the barrel to pivot without bending it. For those that indicate on both ends of the headstock, after you are done put one of Dave Kiff's 4" rods with the appropriate bushing on it into the chamber end. Now set up 2 indicators 3" apart on your rod and check your reading. You will see how crooked the bore runs out. Rusty you can do the same and you will have run out on the rod. Don't take my word, try it.
Butch

One thing that seems to be missing in this discussion is the axial alignment of the spindle with the lathe ways. That's the first check to make. Then, if you are chambering off of the tailstock center. Does it have the same alignment with the spindle? Simply dialing in the chuck to the tailstock doesn't really tell you much. It does tell you that you are dead on at that particular point. What happens when you advance the tailstock quill? Is it still dialed in? Probably not to the kind of top level accuracy we are striving for.

One other method that I have always questioned was pre-drilling, boring or reaming with a roughing reamer. That's all done to save the reamer, not produce the best chamber. I want the reamer to follow the bore not a hole that is hopefully aligned with the bore. It's false economy anyway. How much does a reamer cost? How many chambers can you ream with it? I've never counted exactly, but it's quite a few. Now, how much time to ream, bore or drill prior to engaging the finish reamer. It's not worth the time to do it, plus it setting up the finished chamber to be slightly off. Even if you do everything exactly right, the chamber isn't ever going to be exactly true. So you are only exaggerating the problem when you do it twice.

Not trying to step on toes, but think about it. Roger Kehr

Rough and finishing with different tools is the norm in industry. Let the rougher take the abuse, get nicked, chipped whatever. Then the finish tool (which stays sharp and true much longer) comes in it cleans up the "mess" made by the rougher. Quite often when the finish tool is worn, it gets re sharpened into a rougher. This way you get a lot of economy out of one purchase; you want to get every last nickel out of that reamer because your barrels are only about $55-75 bucks a piece completely finished. There isn't enough profit margin on them to waste time going slow and easy with a finish tool to do the job complete.

For custom guns where the cost of the barrel is several hundred dollars and there are relatively few chambers cut in any one caliber per year, you are absolutely correct about roughing being a false since of economy.

However when a company is making thousands of barrels a year the manufacturing technique has to be different. A rougher can run at twice the feed rate of the finisher. It is cut differently and breaks the chips up for better sward clearing. So you pound out the chamber with a rougher, then tickle away the last .01-.02" with a finish tool. It’s a matter of time/chamber. And most production barrels shoot fairly well. Granted they aren't BR ready, but 99% of shooters aren't BR accuracy freaks either. When you spend $500-700 for a factory mass produced gun you expect a certain level accuracy. When you spend $2000-to-the-moon on a custom one-off gun you expect a whole lot more.

Malm, you are so close, but...
having the chuck jaws clamp parallel with the spindle center is only half the problem. Even if the jaws are parallel how do you know if the bore is parallel to the OD of the barrel. Notice I didn't say "run out". The bore can have run out and be parallel to the C'line of the OD, or it can have run out and be out of parallel. Truing the OD between centers cures these ills.

If you true only one end and place it in a trued up four jaw, then support the other end in a steady then you are golden. The accurate attainable is only limited by tooling and the machine; most of which is completely out of our control.

Rusty's Action Works

Roger, I'm not trying to be argumentative but I can set up a barrel, thread it, drill the chamber to with .1 deep, run a boring bar in to true the hole and then chamber with the finishing reamer in short order... To rough drill and run in a boring bar takes 3-5 minutes I'd guess. Then, since there is little metal to be removed I can run the finish reamer in probably 15 minutes. Let me clarify, I am speaking of a ppc chamber right now, 1.5" long.
I have chambered pretty much everything up to .375H&H. Of course the mags take longer. Since my main interest is the ppc and being able to use a proven reamer as long as possible I try to take care of it.. At the moment my ppc reamer has chambered well over 100 barrels and is still going. BTW, when I indicate a barrel in I use a

.0001 indicator with a long stem so I can indicate where the throat is going to be, after all, that is the first place the bullet makes contact.
You can use a piece of heavy copper wire in your 4 jaw between the jaws and the barrel. Then the barrel will pivot when indicating the muzzle end.. Many ways to skin this kitty.

Pat B

Rusty,

Mark Stratton shows a neat set up to replace using a spider in his book. He turns and fits a piece of Delryn to fit his spindle taper and bores it to fit the barrel and uses that to support the barrel sticking out of the back of the head stock. Rick 0311

That's what a spider is supposed to do, control whip and vibration.
In every tool room I've been in we used a strip of cardboard box and/or duct tape to build up the diameter of a long rod. The built up section works just like Mr. Stratton's piece of Delryn. Just a lot less high tech. 

My bitch was with another gentleman’s use of a spider to jack the barrel around till the bore ran true on the back side of the head stock.

Scroll cutter, if your post was directed at me, So be it. The guy's setup is incorrect. If somebody doesn't make it clear that using a spider to fight the chuck is wrong he will just keep doing it and never know any better.

There are half a dozen or more very accurate and fantastic methods to chamber a barrel. They are all in this thread.

TRUST ME, I have made my fair share of embarrassing total F*&K up's, I am not God's gift to machinist's, and I am constantly learning new and better ways of doing things.

Rusty's Action Works

----------Yet another thread ----------

If you are, for instance, re chambering a 30/06 to a 300 Win Mag that pilot isn't going to touch no matter what you do. For the first 3/4 inch or so the pilot will be unsupported.
Re chambering can be a much greater problem than cutting a new chamber for a number of reasons most of which have to do with factory quality control (or the lack thereof).
In our 30/06 to 300 scenario we have the following things to be concerned about regarding the original chamber:
1. Chamber cut eccentric to bore.
2. chamber misaligned (angular).
3. Chamber out of round.
4. Chamber chattered
5. Chamber neck oversized
6. All of the above. (I've seen it).
All of these things make it difficult to end up with a good result. Generally speaking, if you start crooked, you finish crooked. Since a gunsmith is also trying to make a living at this there is also a limit to how much time can be spent in the attempt to re chamber.
Assuming the original chamber is pretty straight, there are a couple of ways to proceed.
In the first, the barrel is set up in the 4 jaw chuck with a spider on the outboard end and the chamber dialed in.
The second system sets the barrel up in the steady rest. Some like to run the steady on the threads and if they are concentric to the chamber (unlikely)this is fine. If not, a collar can be threaded on to the threads then, with the chamber supported on the tailstock center, this collar can be trued. The collar will then run in the steady.
In the actual re chambering process, after the barrel is set up, the lathe is run at around 90-120 rpm and the reamer

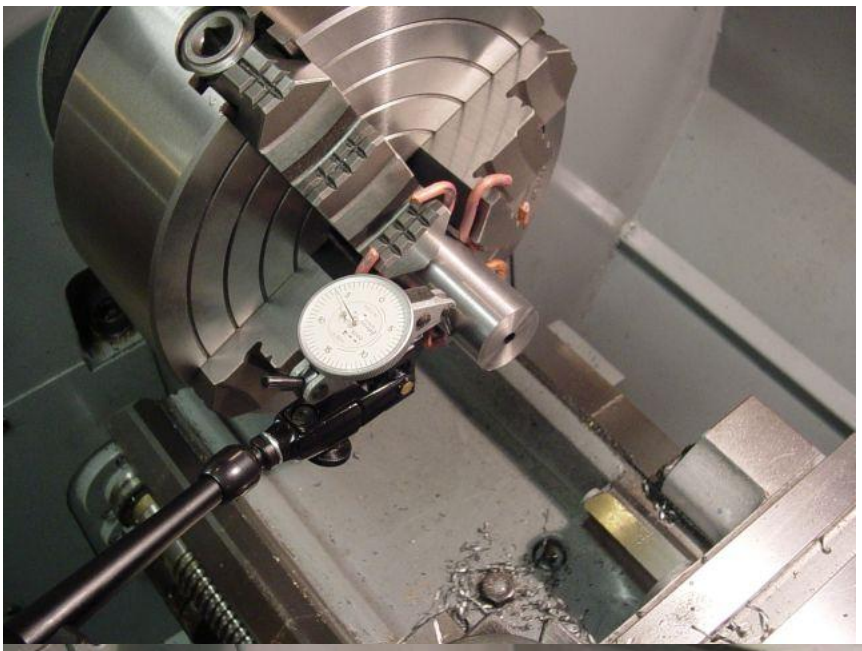
fed into the work. The reamer may be held in one of a number of reamer holders or may be supported by the tailstock center and driven with a tap wrench, crescent wrench, or as one friend does, a pair of vise grips with brazed jaws!
Because the pilot is unsupported there is an increased possibility of starting a chatter. This is especially true if there was any chatter present in the original chamber. This is most easily avoided by not being too chicken when feeding the reamer in. If it does start to chatter there are methods to correct this before it gets out of hand. Anyway, if it doesn't chatter, we just continue cutting (removing the reamer to clean out the chips periodically)until we have reamed to the appropriate depth as determined by our careful measurement of the action. If we have done everything right we have a 300 Mag chamber that is straight, concentric, and smooth enough that polishing is nearly unnecessary.
What if the original chamber is eccentric to the bore?
Well, in that case we have to try and get the bore running as true as possible by setting up in the 4 jaw chuck and dialing the bore ahead of the throat. This is not easily done because of the flex in the extension on the dial require to reach in 2 3/4 inches but it can be done fairly well. With the bore dialed in and running true we take a truing cut with a boring bar for the length of the body of the original cartridge. We now have a hole that is concentric with the throat area and the reamer will run true to the bore. By the time we ream past the bored portion, the pilot is engaged and the body of the reamer is also offering enough support that the neck will clean up providing the dimensions of the reamer in relation to the chamber will allow it to do so.
What if the neck of the chamber is too big to clean up? Well, then the barrel has to be set back enough to clean up the neck and throat.
If the barrel threads were eccentric to the bore they still are. Happily, this probably will not be a real problem, within reason, and the rifle will likely shoot well.
All of the flaws mentioned are quite common on factory barrels. I recently had to re chamber a 280 Remington which was custom barreled by a pretty respected smith and it exhibited all the flaws except for chatter. In the end it was vastly improved and, in fact, looked good to the owner even with the bore scope. The throat was still eccentric though by maybe a couple tenths and I could see it. (As I get older I can see less and less so my work looks better and better)
So to answer the question. Yes things can go wrong when re chambering and it isn't always straightforward. Many smiths simply run the reamer in and trust to good luck and their floating reamer holder for a good result. The good result is seldom achieved and misaligned and out of round chambers are common.
I've carried on a little too long so will shut up for now! Regards, Bill.

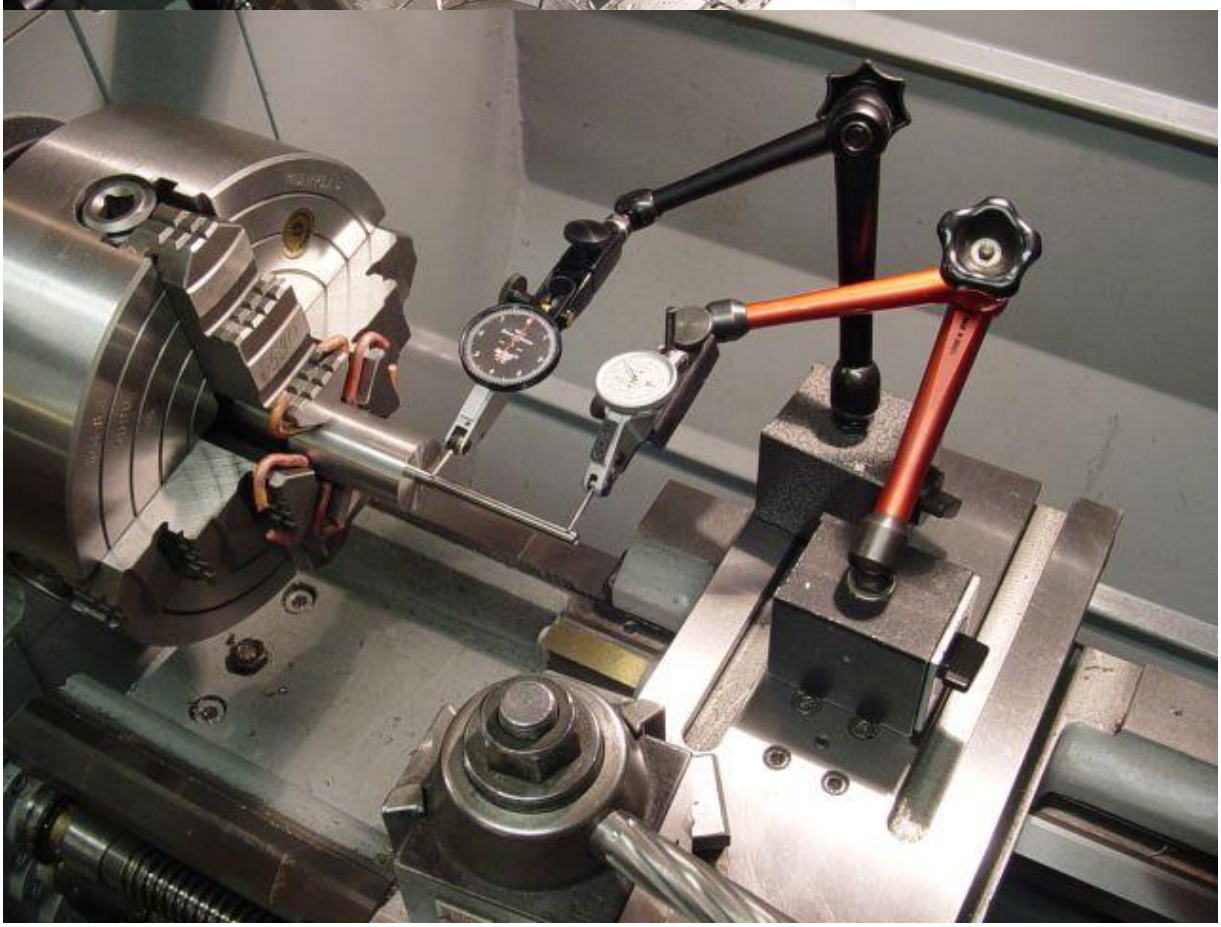
---------- Yet Another Thread

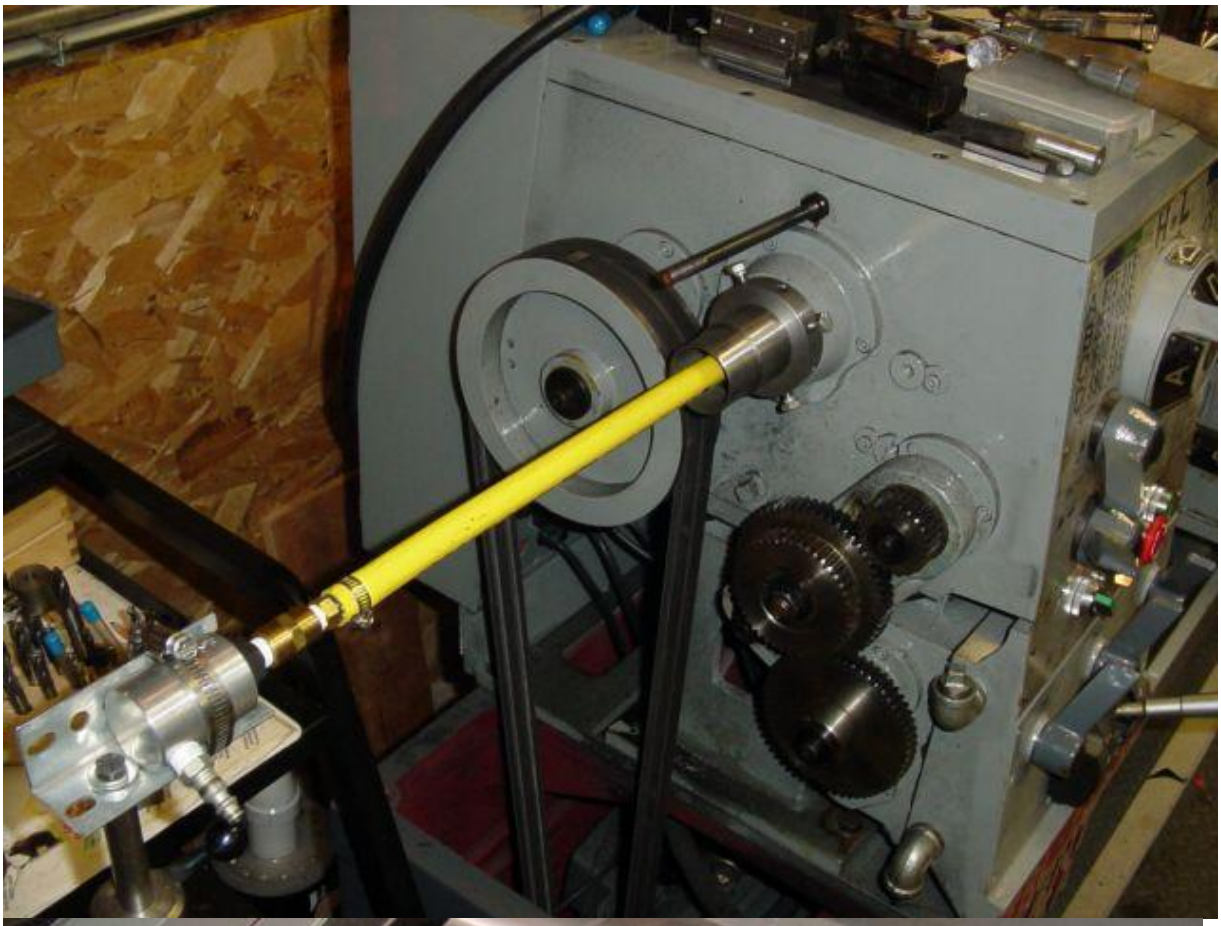
I've been meaning to post these for quite a while. I found a new program to resize my pictures and that saved me lots of time.

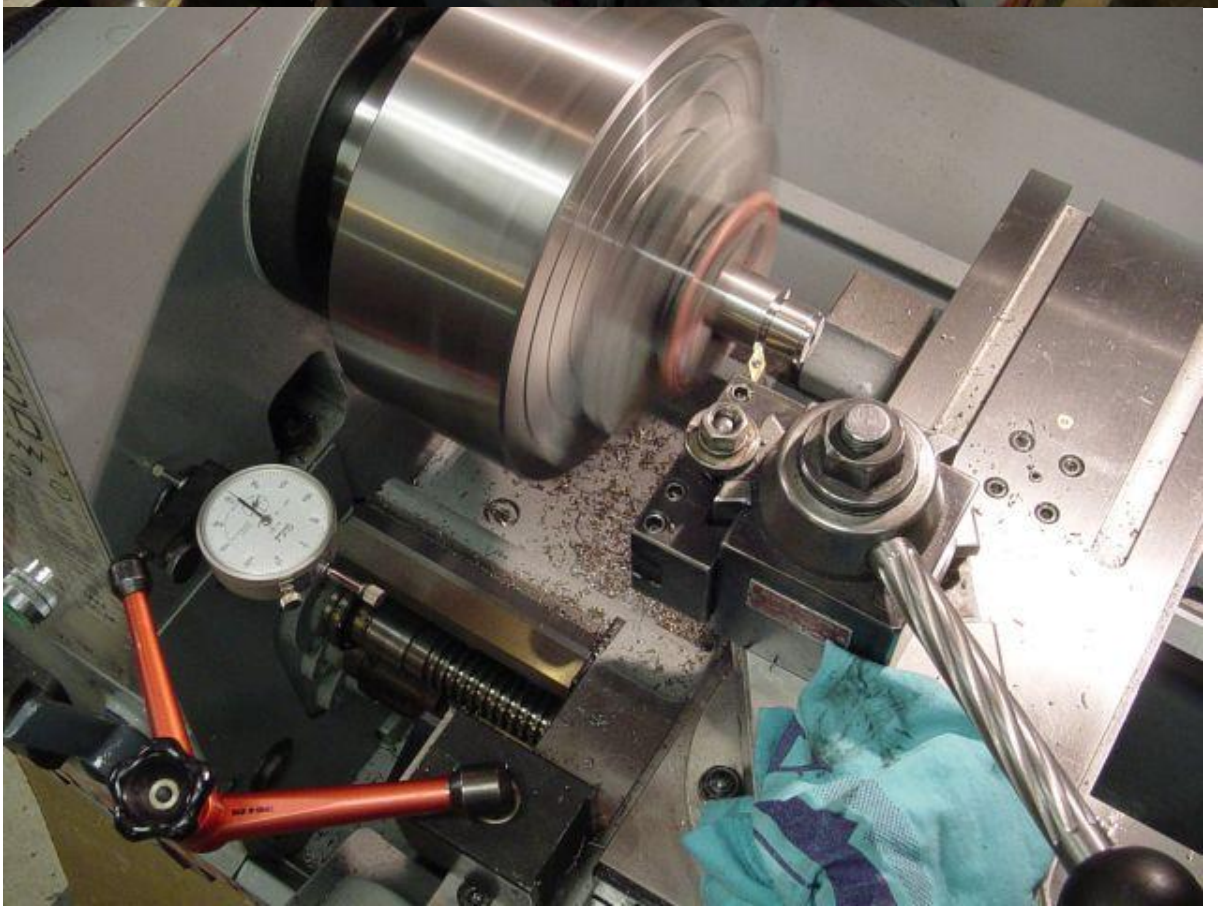
Here's a chambering setup that I came up with. Started with chewing the fat with David Christman. I purchased a video from GreTan and spent some time researching on bench rest central forum. My pumps, gauges and rotary coupling are off flea-bay. Press on hose fittings, hose and filter housing from McMaster-Carr. Oil is Mobilmet 766. Dave Kiff told me to mix it with some Type F. That's why the last picture is red. I bought some super magnets to help pre-filter some of the chips out. I also made a cheap magnetic filter from a 1/2" plastic coupling and two hose barbs. I installed this ahead of my high pressure pump. The bypass valve on the right side of the gauges is from MSC. I couldn't buy a cheap pump motor from flea-bay and purchased a new 1/2 HP one for $100 from Dayton. The pumps are carbonator pumps. I've got about $40 in each. The one that is hooked up now and works very well is a rotary vane that pushes 250psi @ 125gph. Much more than needed and the bypass valve works very well. My backup pump is a gear pump. Also a carbonator pump. I tried the vane model first and it runs very quiet. I'm sure the gear pump would be quite loud in comparison. They both attach to the front of the motor with a simple hose clamp looking thing. Not a normal motor with a shaft sticking out. The shaft is split and a flat key couples the pump and motor. You can see the extra pump on the shelf next to the Deublin rotary union. $70 for 2 new ones on flea-bay. There was a post a while back asking about indicators and the first few pics show some good setups for them. I use two on the range rod so I don't have to run one back and forth. There's a bunch of different ways to set up and chamber. I'm not saying my way is better than any else's. Just a little different. It does speed up flushing the chips out and I only have to pull the reamer out of the barrel 2 or 3 times and the

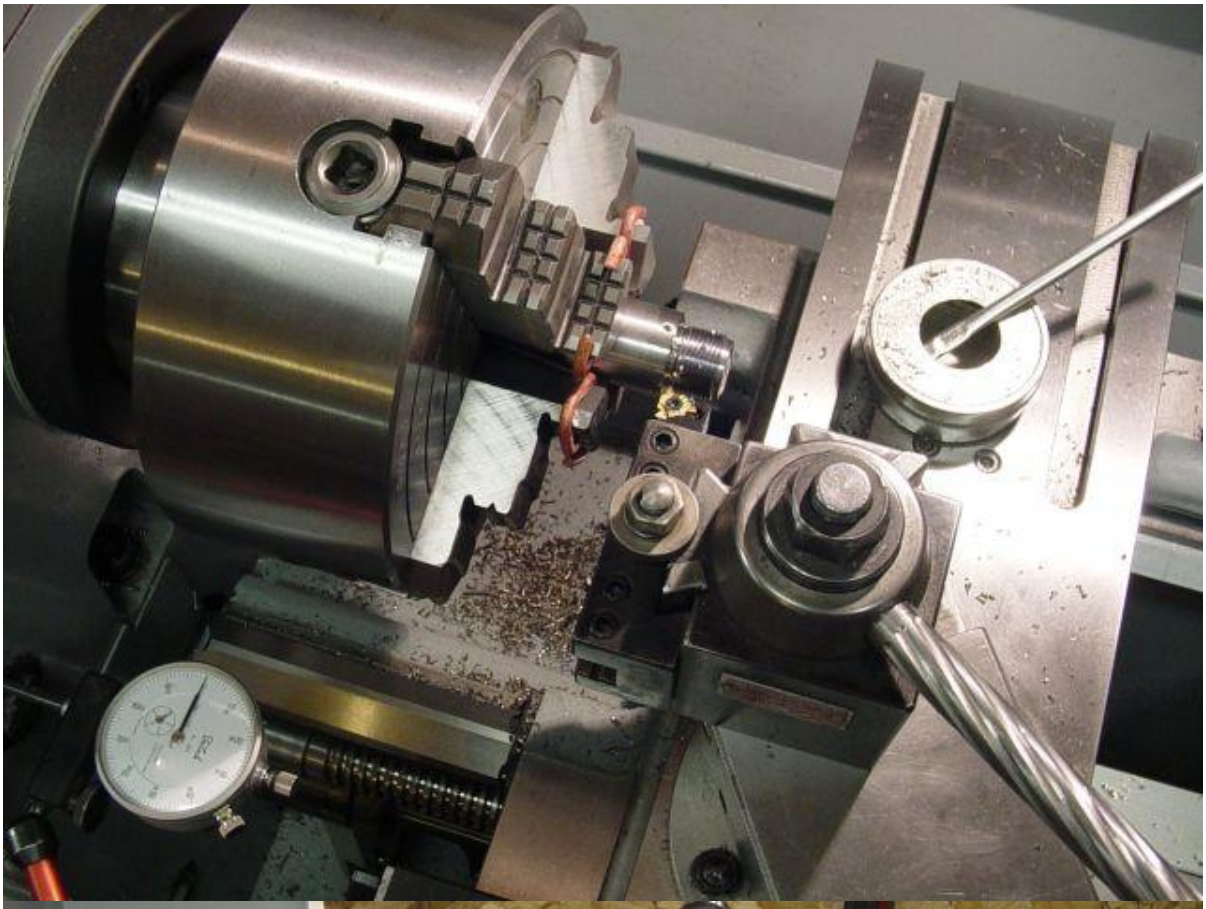
chamber is complete. No pre-drilling and some say you can chamber a 7 mag in 15 minutes. I haven't pushed it that hard yet.

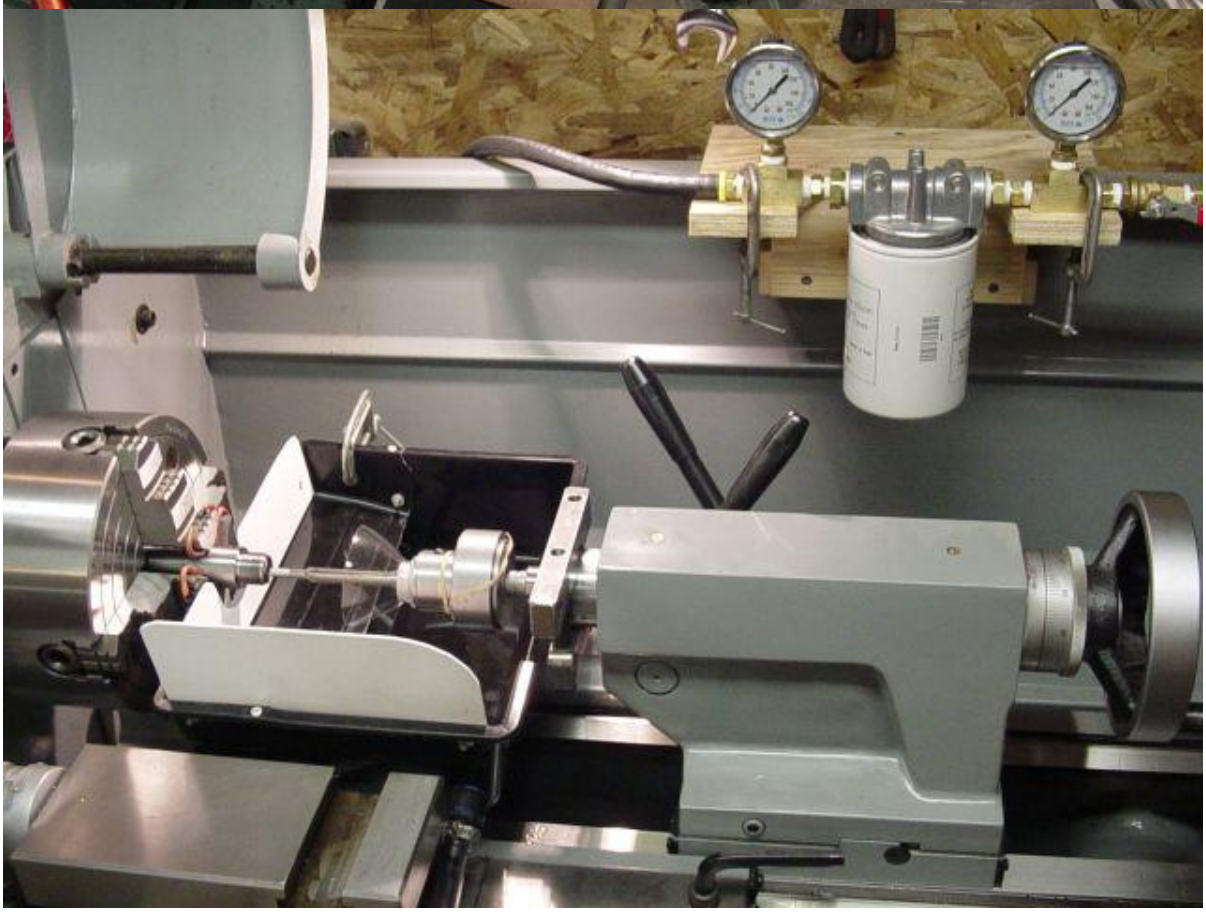


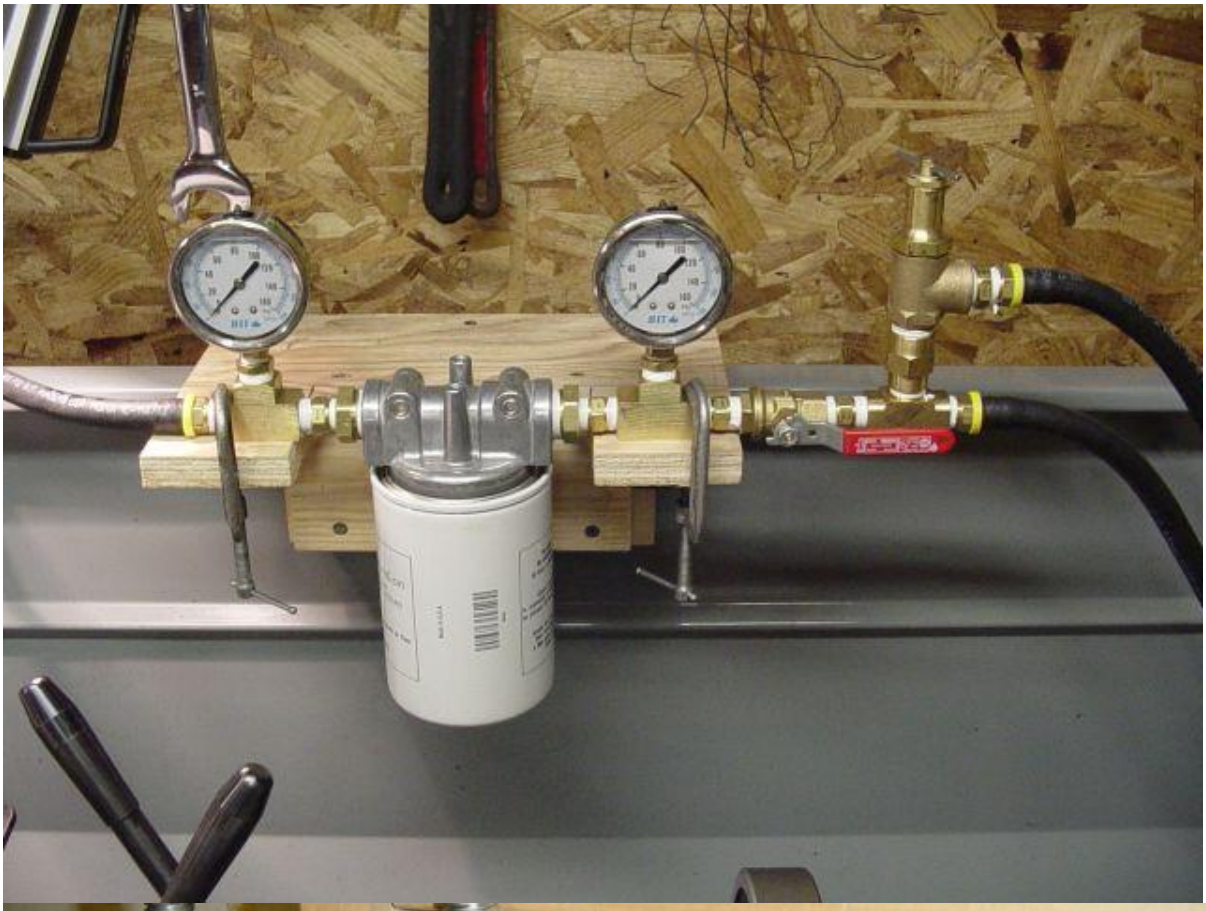




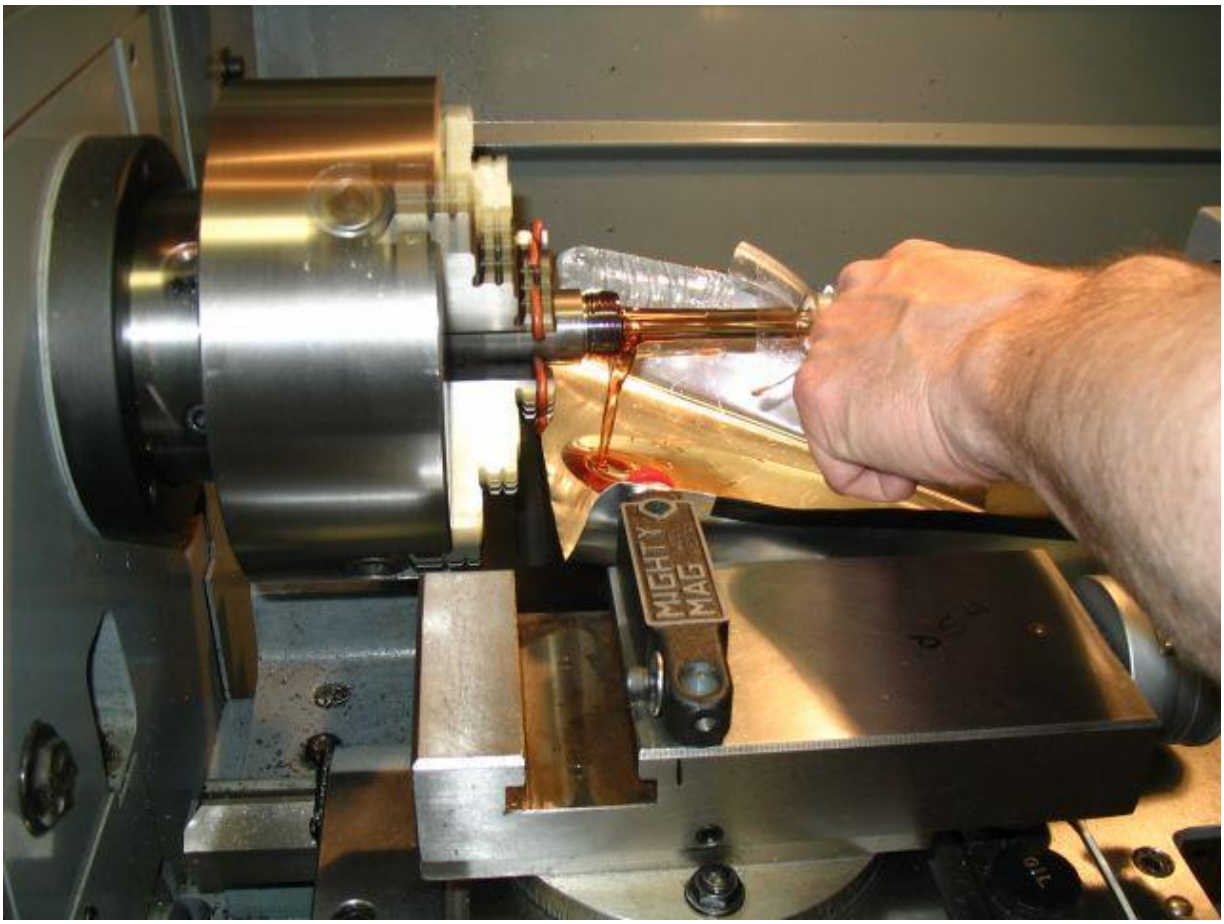









DEUBLIN
HIGHOFER
HD YAMA



Here's a better pic of the reamer holder. It's a copy of what they used at the Army Marksmanship Unit Ft. Benning. The only difference is the ball detents I put in to quickly pop off the reamer and dunk it in solvent and clean oil. The AMU model was threaded. The third year instructor at TSJC worked for the AMU for 25+ years. I built this floating holder in school back in 1992. Pretty simple design. The plate with the slots in it is hardened and the rest is soft. The only problem with this kind of holder is that you have very little feel while reaming the chamber. That's why you see me holding the reamer with a baby vise-grip in the last in the string of pictures. Since I haven't chambered very many barrels with the power flush, I'm now holding the reamer by hand for the first 2/3 of the chamber to get a feel of how fast I can push it. Then I put in the floating holder and finish the chamber as close to the size of the reamer as I possibly can. The little splash guard is the top of a water bottle with a cap from a end mill tube pushed in the neck. I drilled the cap the first step smaller than 7/16" on my unibit. The far side of the splash guard is cut out to speed the draining.

The two muzzle cutoffs in the top right of the picture show the attachment. I just turn a nipple on the smaller barrels and pipe thread the larger ones. I would have used the Gre-Tan attachment but, my headstock is too long. The Gre-Tan rotating coupler didn't fit inside my headstock.

When I crown the barrel, I set it up with the range rod just like chambering. I bought some DOM tubing in different sizes and have made some false breeches to screw on the chamber end. I figure It's cheaper to buy a hole than drill it. After cutting the barrels to length, they are sometimes too short to reach the adjusting screws on the left end of the spindle. The false breech also takes the abuse from the adjustment screws much better than the finish polished barrel. I aligned my adjustment screws differently than I've seen others do. They are 45 degrees off the 4 jaw chuck. This I feel, makes it easier to dial it in taking less pressure on the outboard side to align the muzzle.

We all know that the a chamber on a wood-stocked no-glass rifle that is cut with the time tested method of three-jaw holding the muzzle and a steady rest holding a concentric section of the cylinder with the reamer held with a

lathe dog, hand held, creates a very acceptable level of accuracy for a hunting rifle. How's that for a run on sentence?

The only practical benefit I see with getting carried away using bench rest methods on a wood-stocked custom rifle is the extra edge the shooter has hopefully giving them more confidence in shooting. Like playing pool. If you know you can sink it, you will. If you have any doubt then you might not.

Marc
I bought my BXA holder used in "like new" condition. Like new meant the handle was bent like a banana. I made a new handle and had to try out my spiral attachment on my TM-UM Hardinge mill. I spent a ton of time years back machining all the gears and hardware for the spiral gearbox on my little TM-UM. I learned a lot cutting gears, but I've only used them once.

Post by Ben Hooper from a thread in practical machinist:

Some questions to think about.

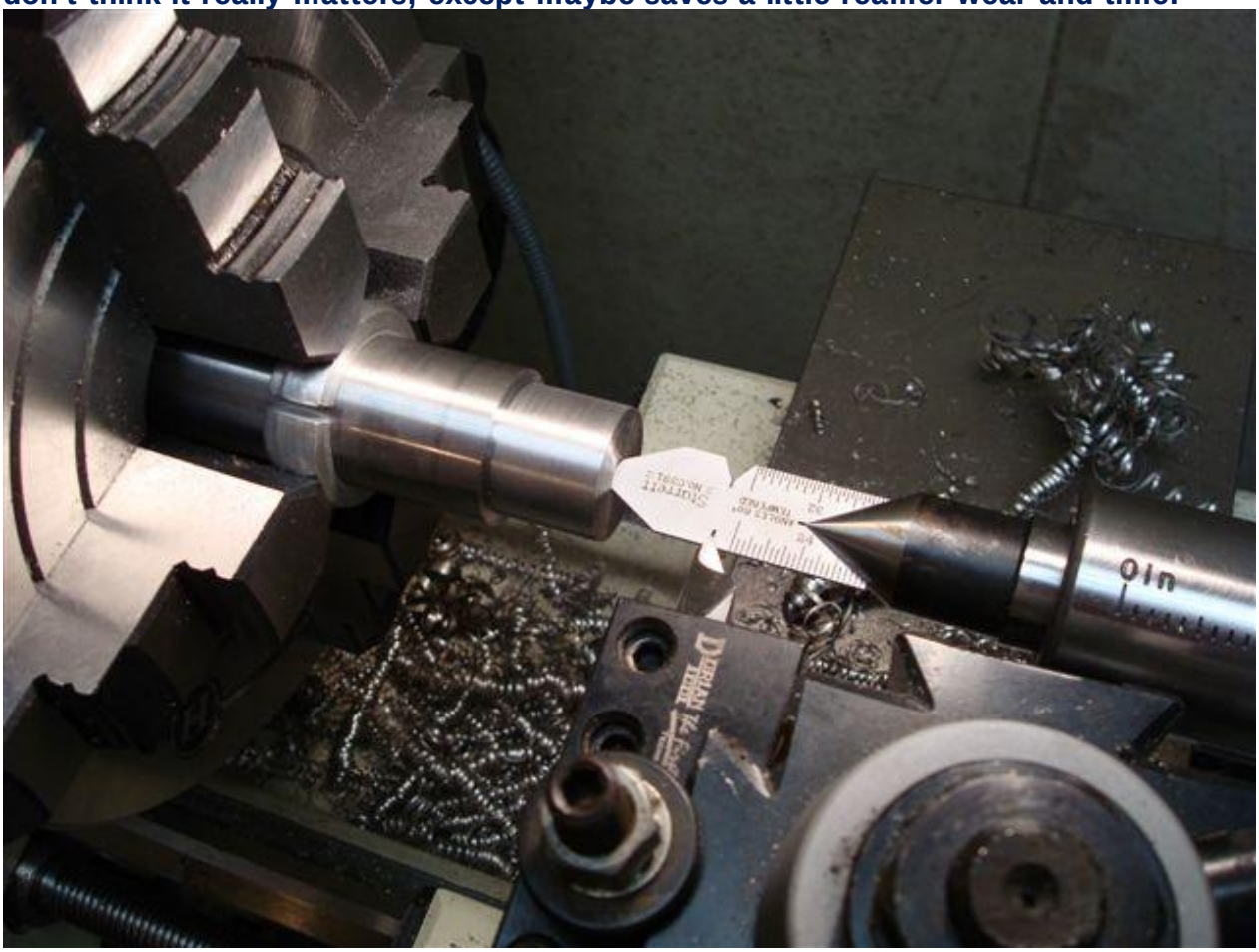
Why re barrel a rifle if you're not concerned with accuracy?
Why not support the muzzle end with a spider or bushing?
I would only consider using a steady rest to chamber if I could not reach the spider (short barrel)
I would only consider chambering an unsupported barrel if I couldn't reach the steady rest

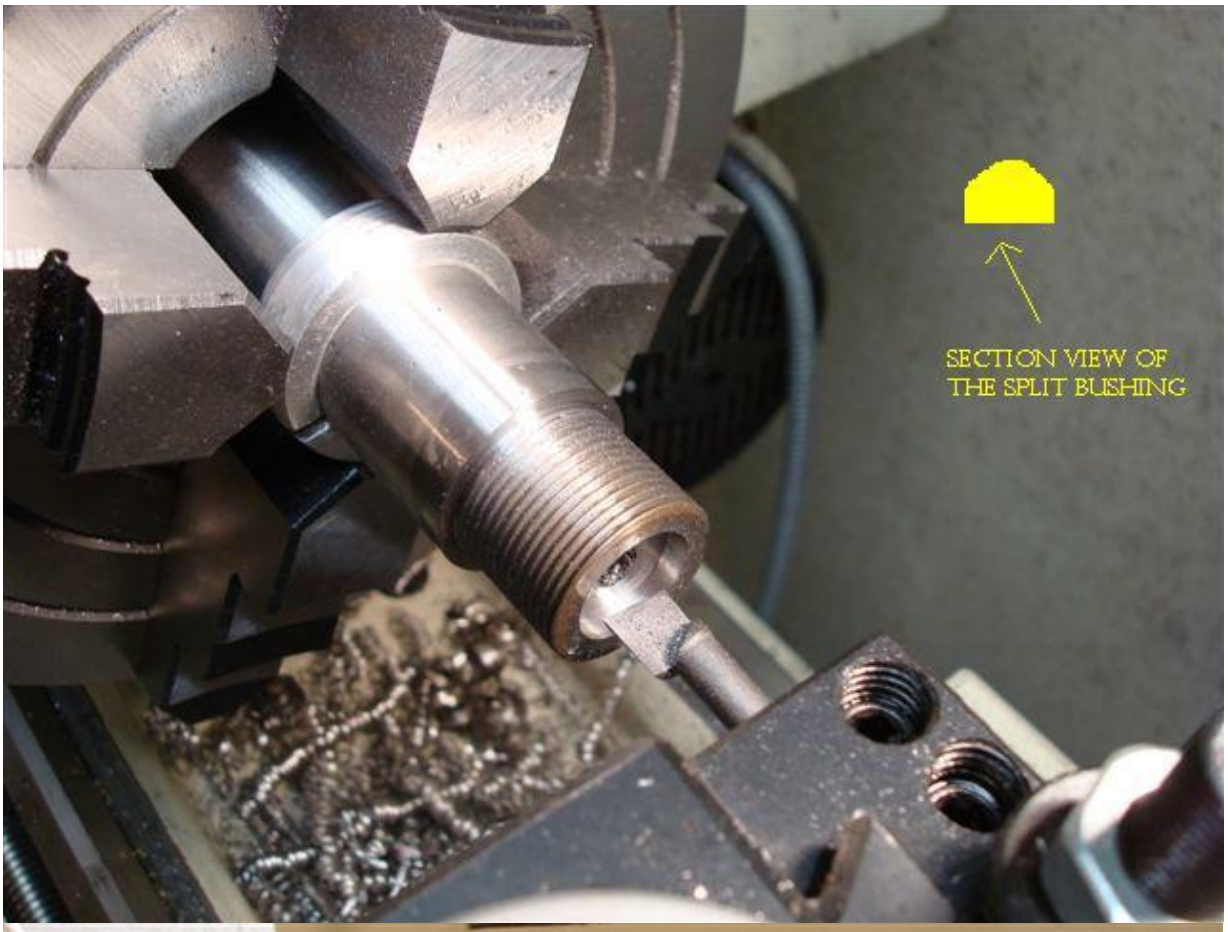
(really short Barrel)

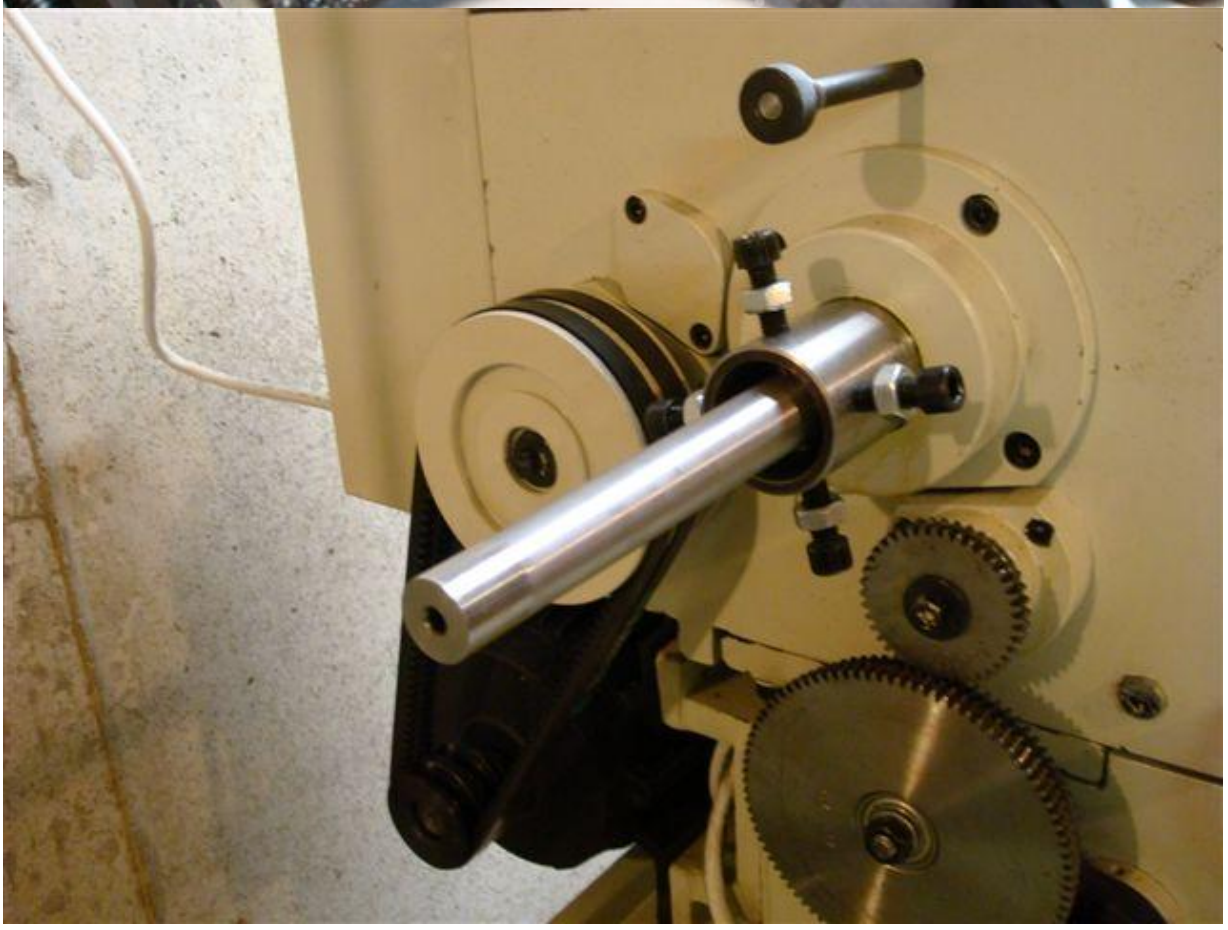
My opinion of this discussion.

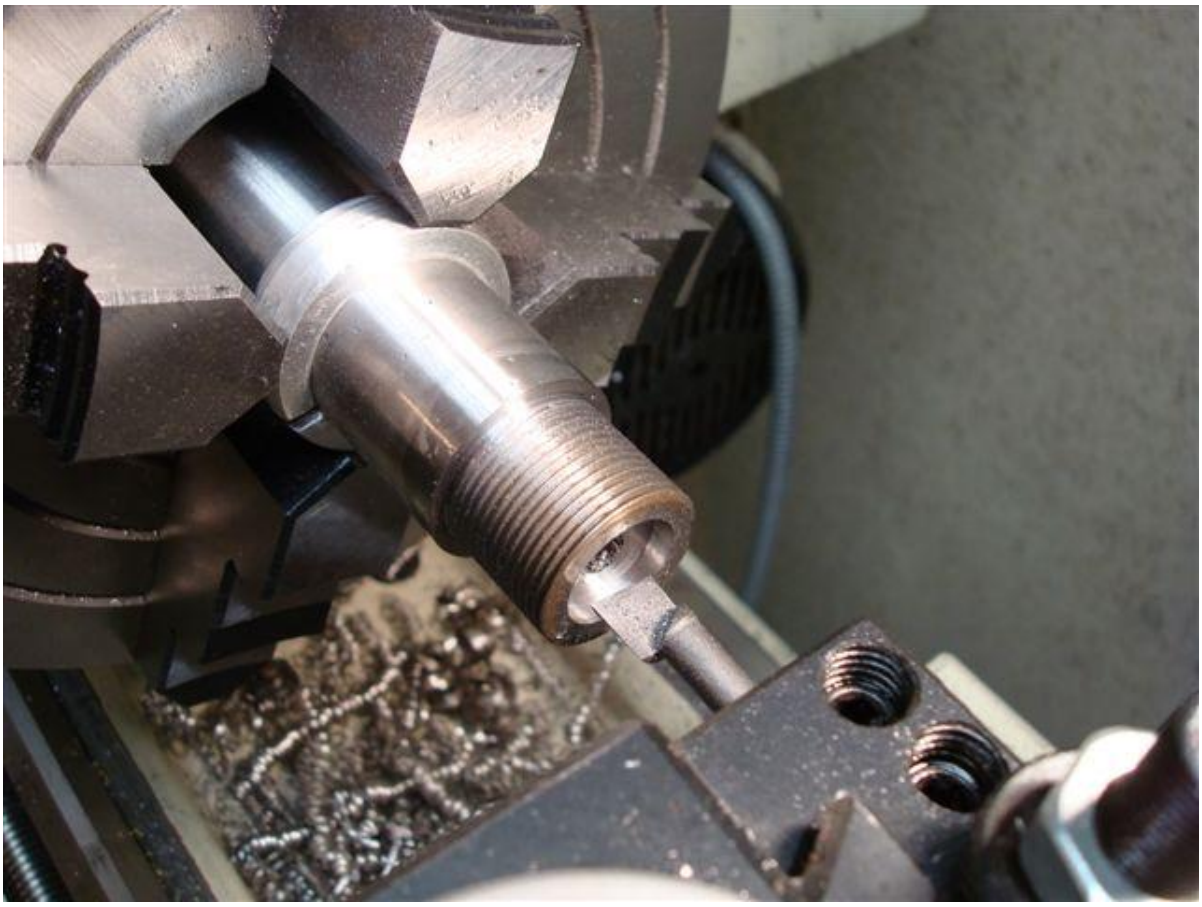
To each his own though.

Chambering pics in the headstock. The aluminum bushing allows for muzzle alignment without bending the bbl. Sometimes I drill and bore before reaming, sometimes not. I don't think it really matters, except maybe saves a little reamer wear and time.



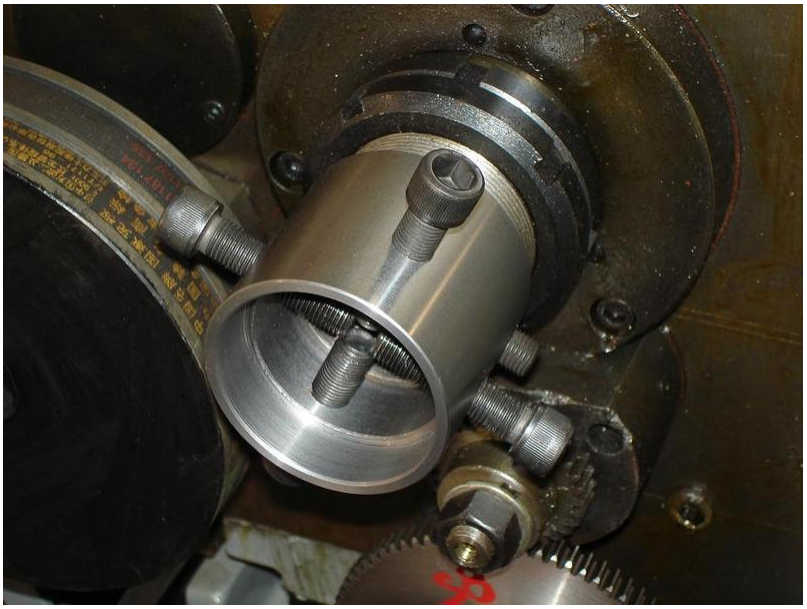

SECTION VIEW OF
THE SPLIT BUSHING





Another post from the same Practical Machinist Thread, the by 300Sniper:

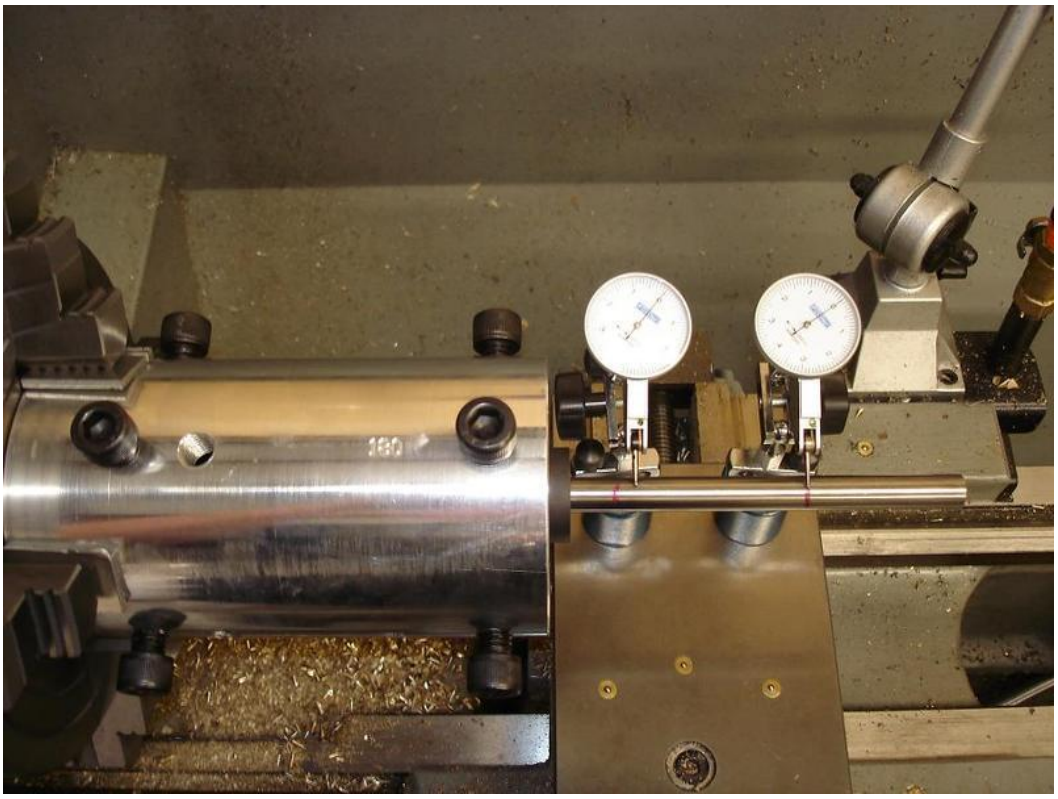
here is a spider I made for the back of my spindle. it was originally made it for something else so there is a step on the inside that is not needed. I will protect the barrel from the screws with a piece of copper wire.



I did this for the action truing fixture. I may still do it for spindle spider but I have been

busy with other things. these are the ones for the action fixture. in hindsight, I should have used 1/2-20 instead of 1/2-13 but it still did the job.

and while I am posting pictures, here is the fixture I made to true my action. it is basically the same idea as the barrel through the headstock.



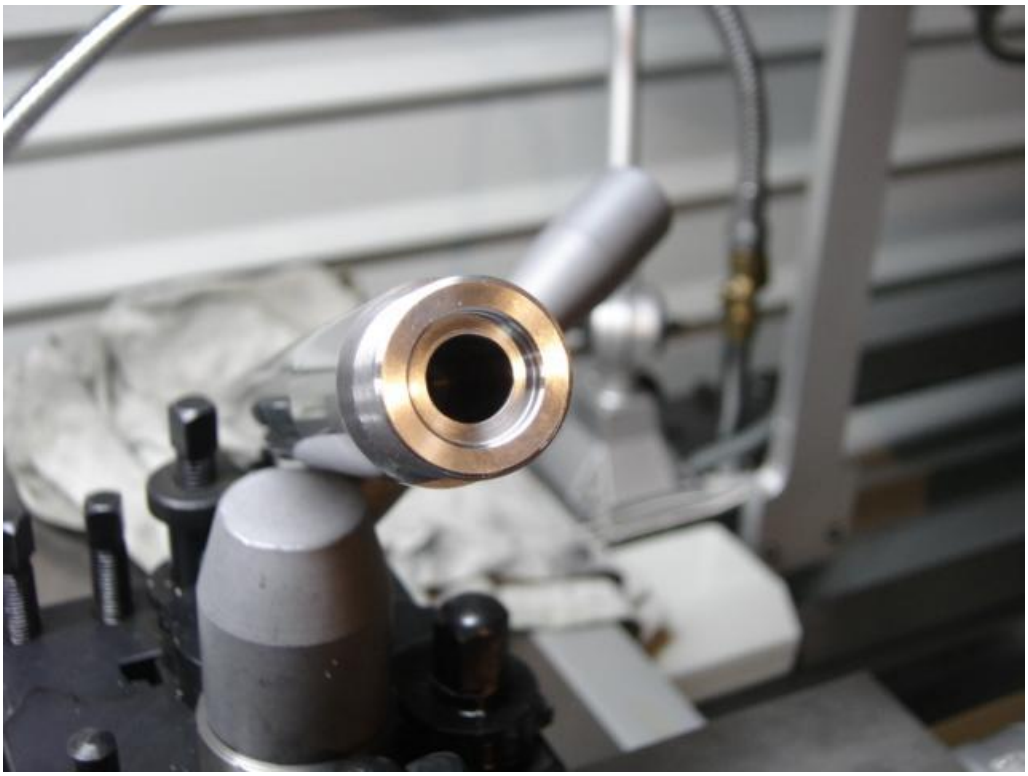
By pigfaini:

This is a "cathead", sometimes also called a "spider". It's used to dial in the bore using a ground spud. The muzzle end can be dialed in using a cathead mounted on the outboard end of the spindle, or the barrel can be driven with a faceplate and dog. the center centering the bore at the muzzle. The former method makes it easier to blow the chips out of the chamber before re-inserting the reamer. It's especially useful when working on octagon barrels. I initially dial the cathead body in the steady rest using a co-ax indicator in the tailstock.

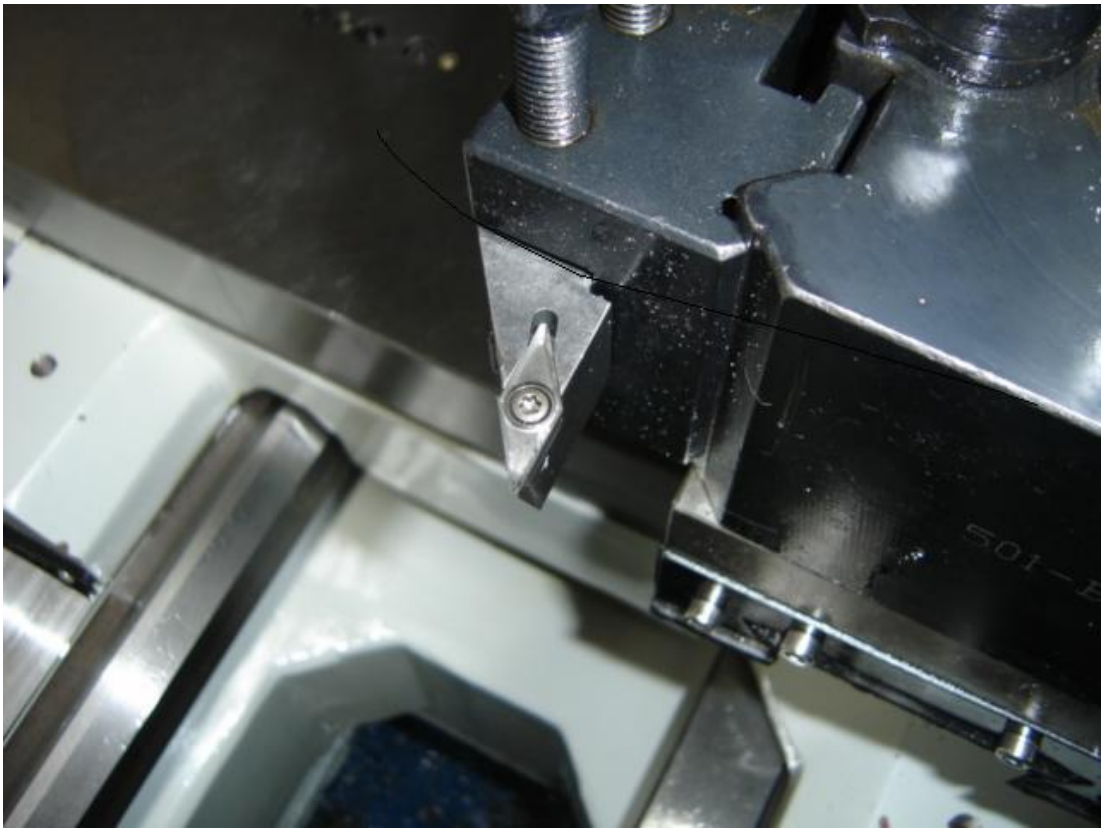
I've only had manual machines, and have been doing it this way for fifty years. I must admit I'm impressed with your equipment, never even operated a CNC machine, myself. Paul

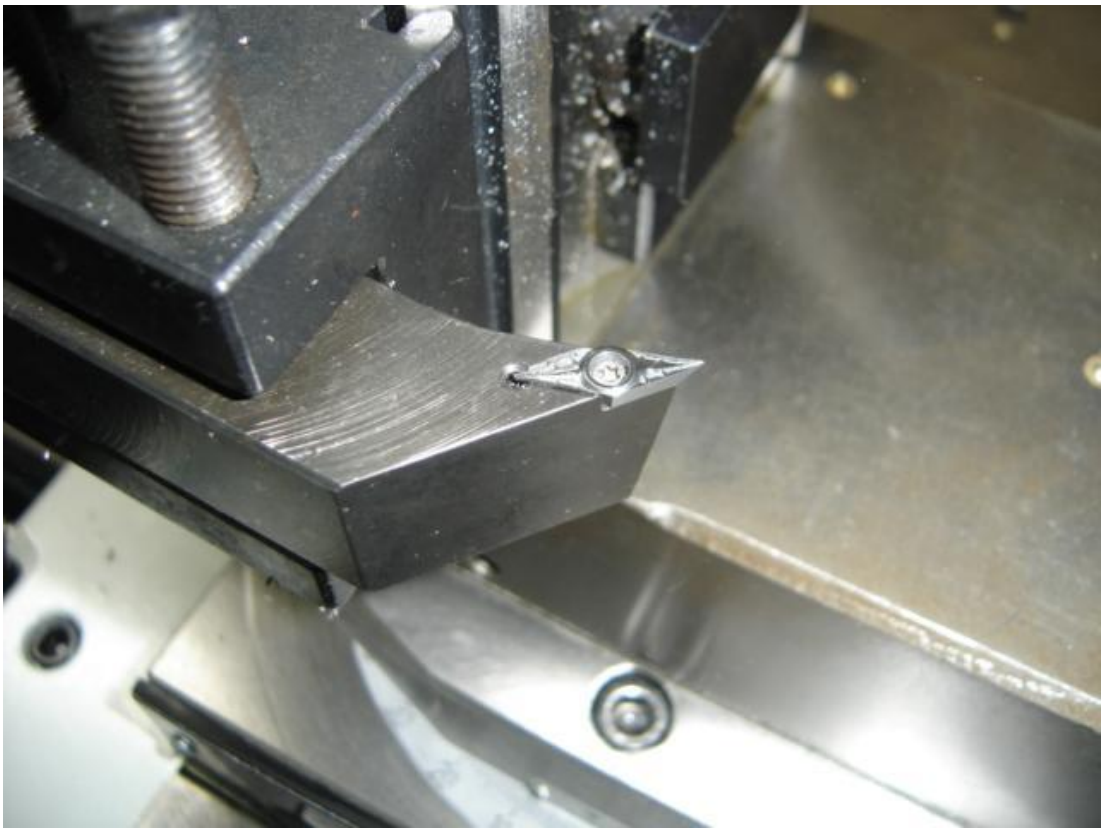
From thread on crowning:

I single point cut my crowns at 2000 rpm using kennametal aluminum high speed finishing inserts. These inserts are polished carbide with a high rake both .002 or .004 radius tips work. No need for cratex sticks or anything finish looks like a mirror straight off the cutter.
Here are some of my pics.



Here are some pics of the tooling used for crowning cheers wal

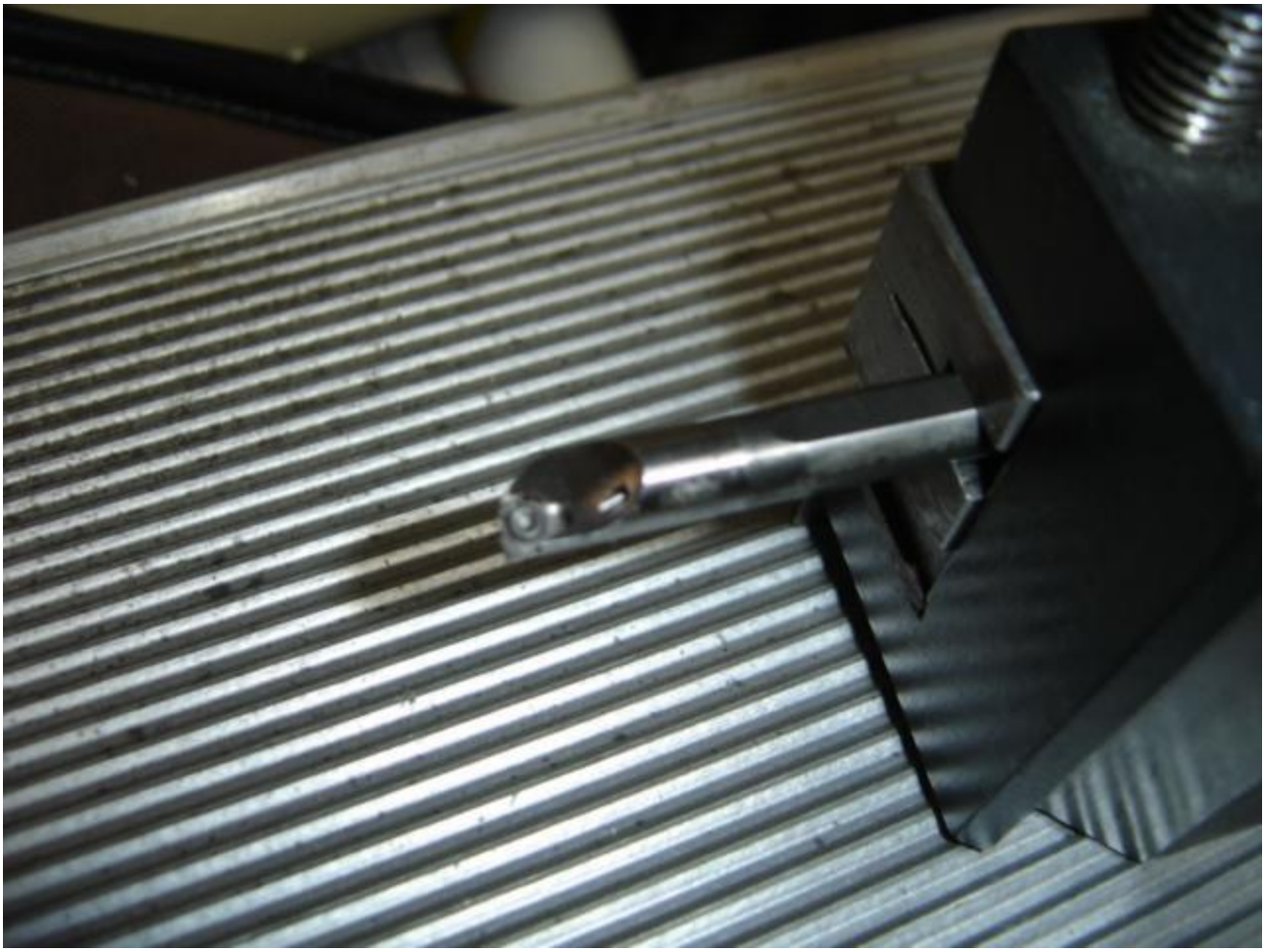




The .004 radius insert is a Kennametal polished carbide high speed aluminum finishing insert.
The .002 radius insert is a Valinite product which gives a much better finish I will find my order sheet and give you the part numbers.

The insert you asked about.
Wide Valinite part number VCGT 110302-AL3 HW-K15
This is a .002 radius polished carbide insert for high speed aluminum

They also make some nice carbide boring bars with inserts.



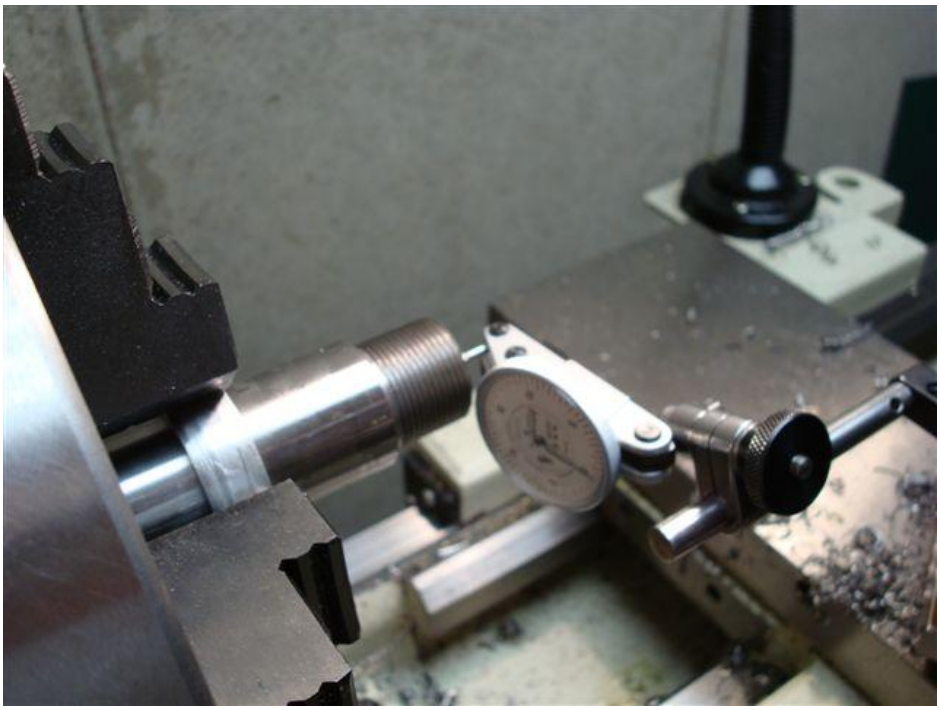
Butch…..where were you when the boys on the BR forum were crucifying me for crowning/chamfering with a single point tool? Ben Hooper

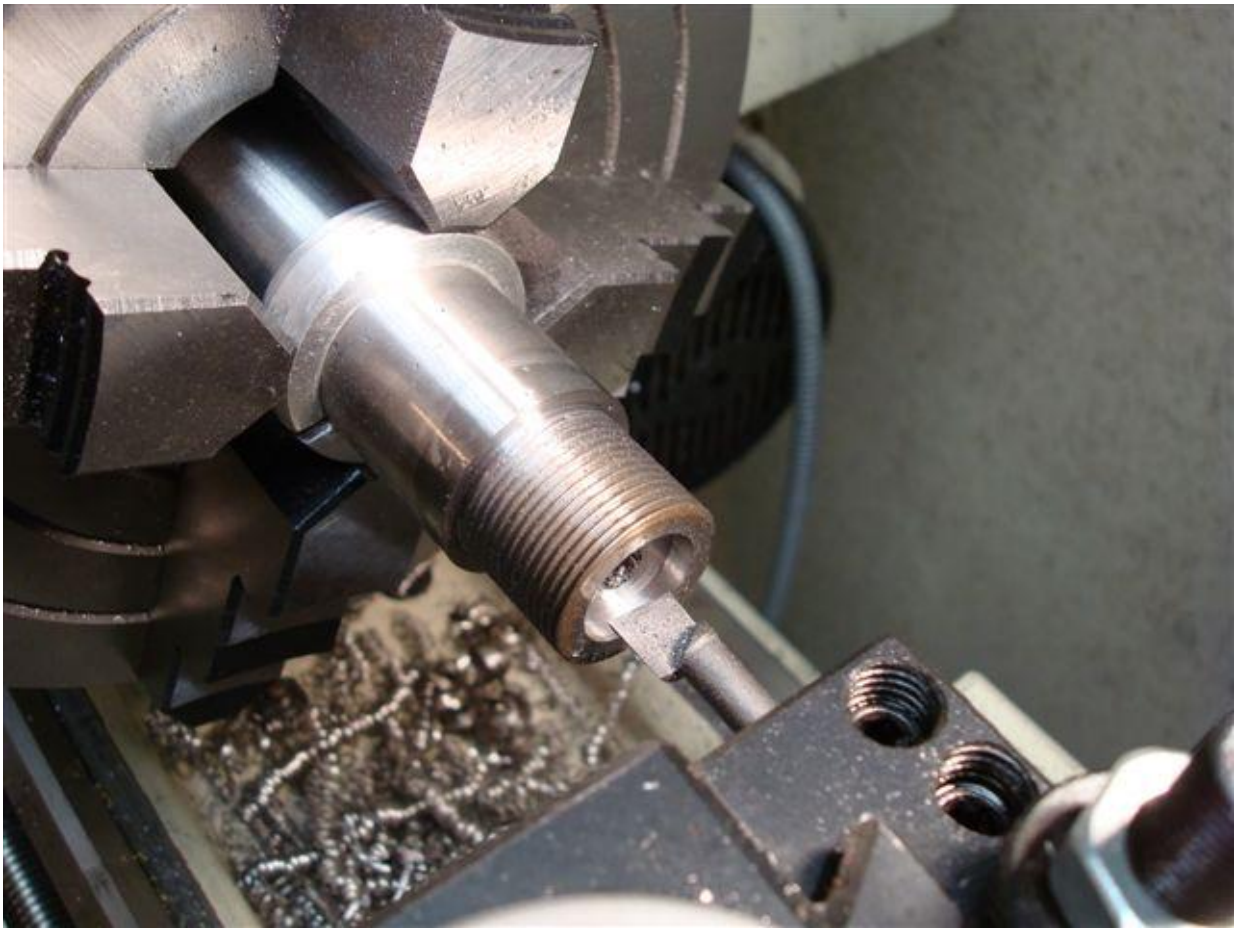
---------- More from Ben Hooper ----------

Yeah, but the beauty of the long stylus is that you can check land and groove and bore for concentricity after you bore.

Butch's method is solid. Anyone can sit and knit pick, but I have chambered 25 barrels this year with this method (for the most part) and every rifle shoots hole over hole, except one that was bent, and I sent it back and it was replaced.

Start with a good straight blank, use solid indication practices and the little details are irrelevant.....





Been Hooper's Method

Rem 700 action, Krieger barrel, PTG reamer

I cut 1.5" off the muzzle In the 3 jaw first thing, clean up sharp edges.

I put a dead center in the tailstock and attach 4 jaw and put the barrel through the spider Breech first, using the dead center to get me in the ball park on the 4 jaw end.

I machined a split aluminum bushing to clamp on in lieu of the shims, and copper wire, I tried those methods and found it sloppy and difficult for me, at least. (see pic)

Lathe was out of gear

I eyeballed the muzzle end the center of the spider and adjusted the spider bolts by hand, until it was in the ball park, all the time, keeping it up on the dead center.

I gently closed the 4 jaws one at a time. The tailstock was slid out of the way.

I dialed in the outside of the barrel with a dial indicator on a mag base, this takes me about 15 minutes to get both ends <.001"

With a parting tool, I removed a 1/2" of the breech to get into fresh metal. I faced it off an cleaned it up with a small chamfer.

I then use a PTG indicator rod an test indicator to get me <.001 as near to the barrel as possible.

I then run my other test indicator with the long stylus up into the throat area. It was very close with no adjustment. I tweeked it, for 30 minutes or so, and removed the indicators.

I tape the rag over the muzzle to catch chips. And set the lathe up with a turning tool. 1.062 dia, with a clean faced shoulder. I use a depth micrometer to determine the length of the turn, adding the thickness of the recoil lug, and leaving .003" clearance.

I grind a 60 deg. tool and adjust it in the lathe (see pic) Thread the tenion at 70 rpms as close to the shoulder as I dare. When I approach the calculated depth of thread, I screw the action on with some XX fine lapping compound and clean up the threads.

I then put in a boring tool (see pic) and cut the recess for the bolt face. I measure this from the old barrel.

I screw the action on, with the bolt and check endplay with indicator to make sure I still have .003 lug to barrel, and the bolt face is not touching first.

I clean everything up with solvent/air/rag.

I put the test indicator stylus back in and make sure it had not moved. On this barrel, it required a little tweaking. .0005" or so.

I reamed the chamber, with a finish reamer, at 70 rpms with cutting oil, .050 progression. I set the Micrometer stop on the reamer .010" short and work it, with my go gauge to get the bolt to close slightly firm, but not hard.

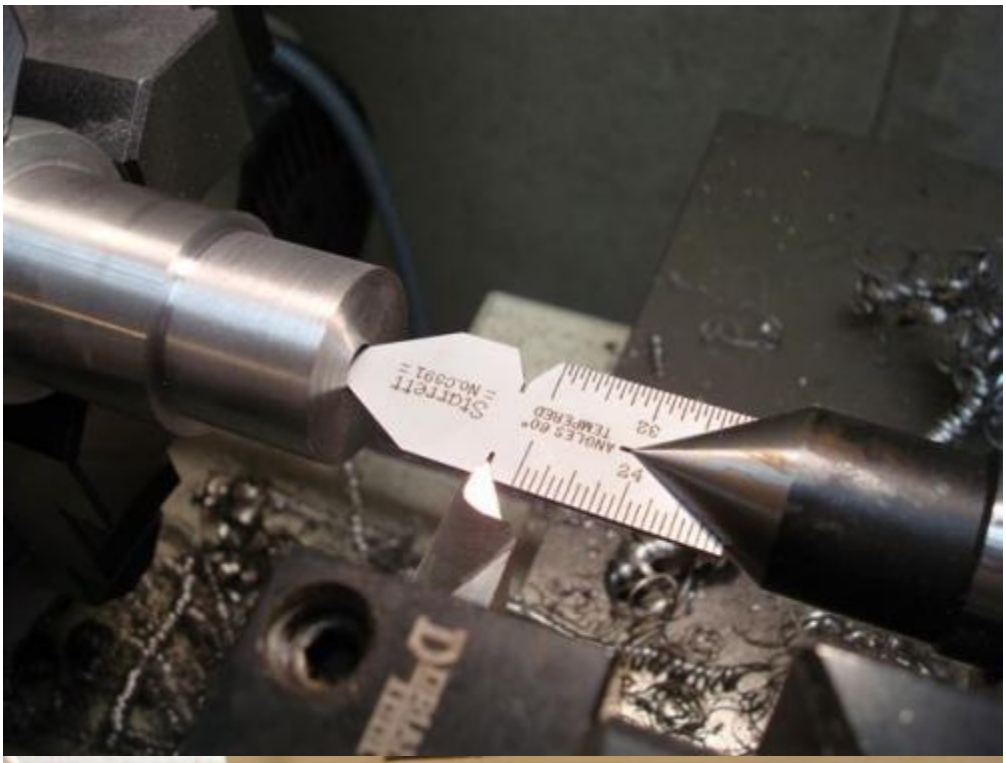
When I get close, I screw the barrel/recoil lug on with the go gauge in and use a feeler gauge to determine how much I need to go.

This process takes some feel and practice, but I have never had to be cut a barrel in the dozen or so I've done. I just take my time and make small progressions.

I turned the barrel around and indicated the muzzle in on the ptg rod to <.001" and face off the muzzle and cut a small chamfer with a sharp tool at high speed, checking for a burr with a Q-tip. Clean up and polished a bit with steel wool...washed with lectra clean.

I tightened it all up and put it in a stock.

Shoots hole over hole.


Starrett
No.C591
ANGLES 60°
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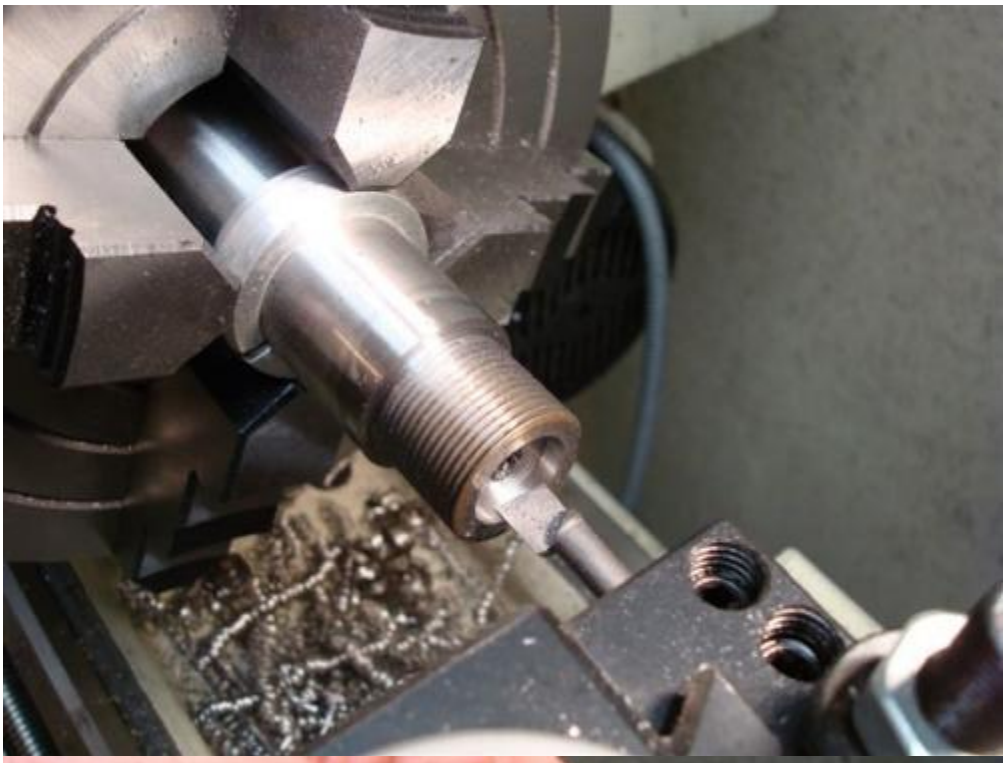
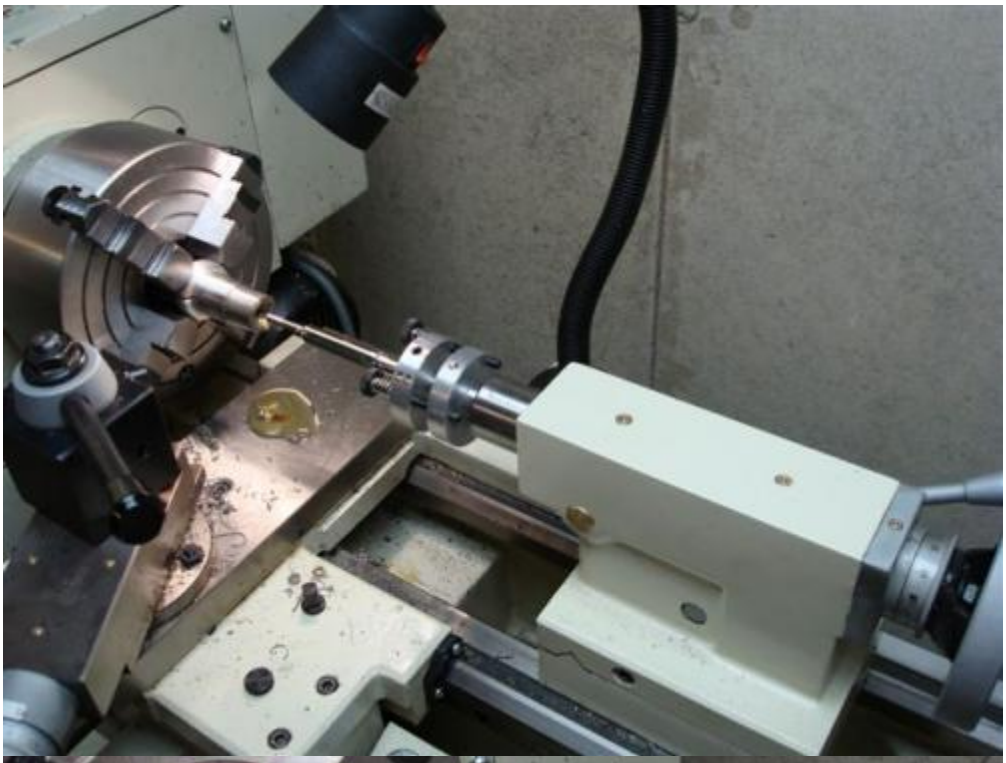
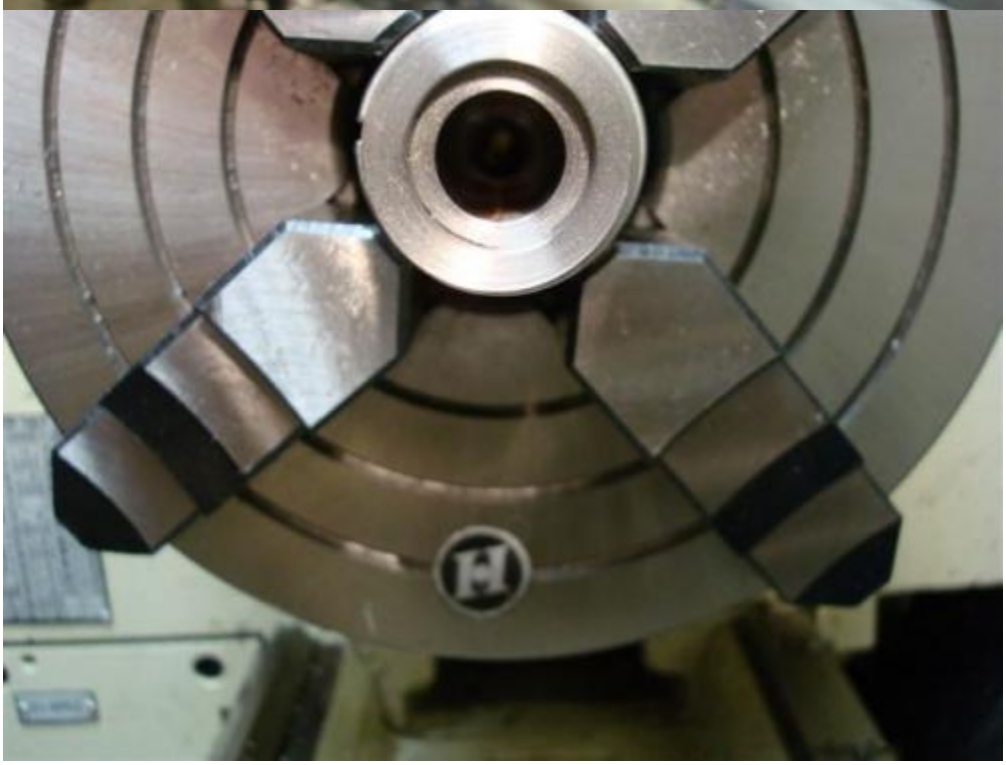
24







.....when you remove the reamer after the first .050 cut, did you remove the whole set up as in slide the tailstock way back or just back out to clear the chamber? The first one I did I slid the tailstock way back and removed the complete set up in order to clean the reamer flutes and blasted it off with air over a waste container, oiled it again, reset and made the next cut . When I reinserted the reamer I just went in far enough to feel the "cut" pick up and reset my indicator once again to .050 and proceeded. May not be the correct way but it works. I could not back out the tailstock dial far enough to clear the chamber to clean up without the morse taper coming loose in the tailstock so I just took it all the way out and cleaned.

Jan,
I slide the tailstock back, but when I slide it forward until it is against the carriage which I have locked down. That makes the tailstock stop at the same place every time. I don't have to use any feel of the reamer starting to cut.
Butch

Quote:

> Originally Posted by stumack65
> *Hey Ben*
>
> *Can you tell us about the reamer holder, how it works and how to dial in the reamer in the holder.*
>
> *Thanks*
>
> *Stumack65*

It's a simple device that allows for angular misalignment, and lets the pilot move the reamer.
It is important to indicate the dead center before using this. I use a mag base on the chuck.

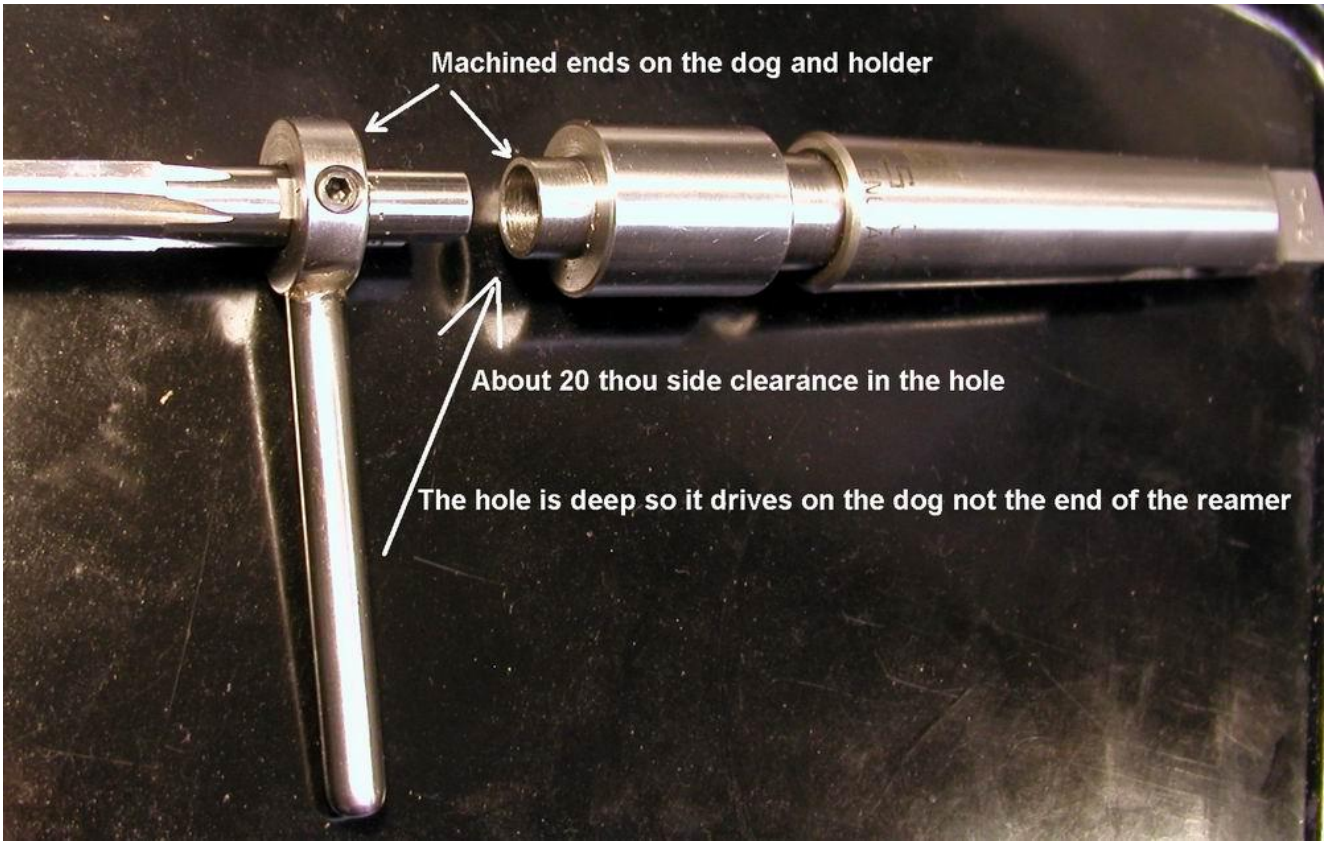
The point of the dead center sits in the center hole on the reamer. A set screw keeps the reamer from turning, and the springs/thumbscrews have some play in them.

You just adjust the reamer so it lines up with the bore freely, and operate it just like it was sitting in a Jacobs chuck.

It does not account for radial misalignment of the bore, therefore, precise indication of the barrel is still necessary.

Ben

Reamer holder



Actually, the credit doesn't go to me for driving the reamer like that. I just made it, used it and put it in the barreling article on my web site. Dave Tooley told me about it and is where the credit goes. I use a Sinclair case holder to hold the reamer and Albrecht chuck to hold the tube that pushes the reamer. The Bald Eagle floating reamer holder works similarly

Below is a photo of the Bald Eagle floating reamer holder.

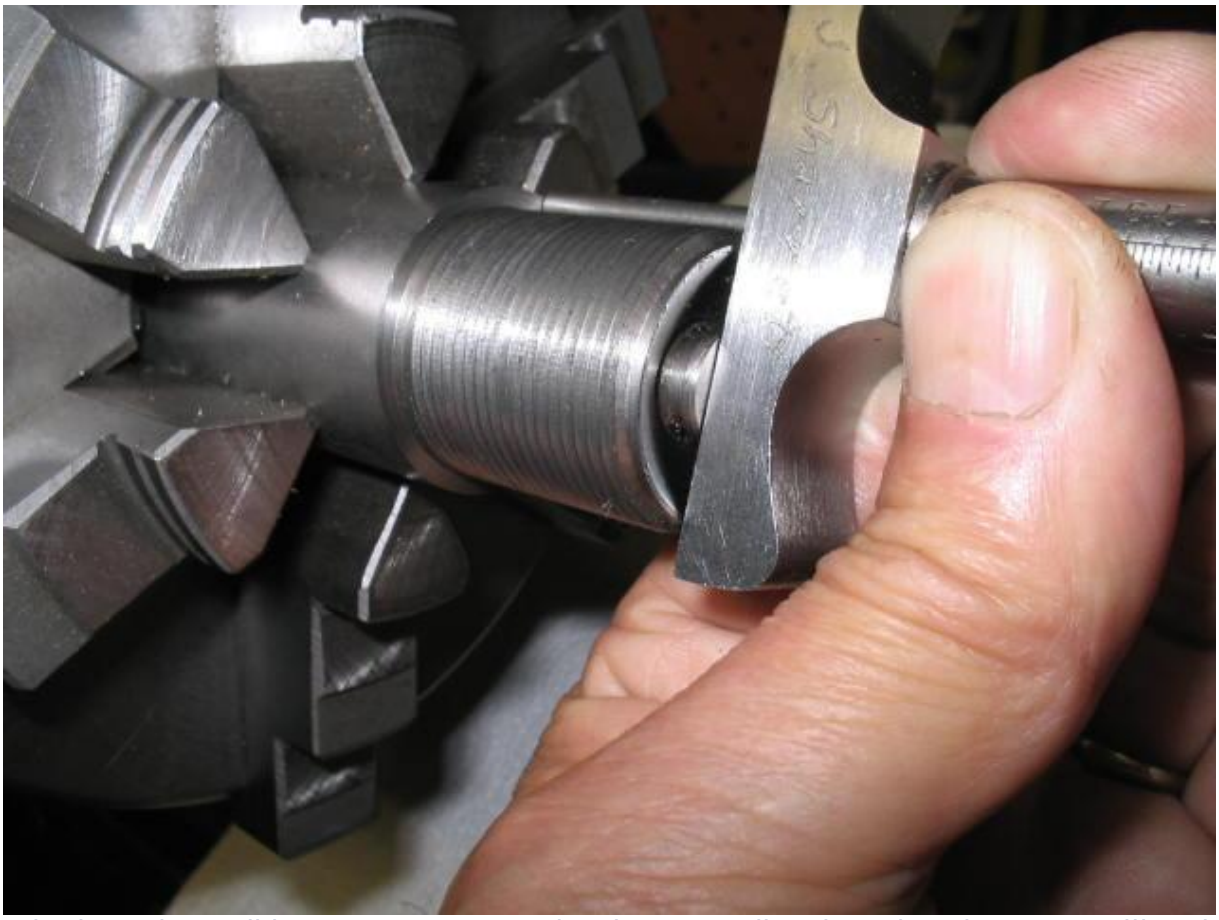
How can the tube push the reamer sideways? Don't over think this. It's basic machine work. The center is made to hold a work piece.

I have a collar that fits over the ram on the tailstock and I put a travel indicator on a magnetic base on top of the tailstock. Final pass I slow the lathe down and take all the slack out of the tailstock while pushing against the reamer. Lock it down and turn the hand wheel until I get the desired number. It's that simple. The tricky part for most is getting an accurate reading off the go gage. I use a round collar that fits over the barrel shank that has a large Starrett direct reading tenth micrometer thimble in it. I can measure headspace within a couple of tenths. It is calibrated to my depth mic. Works every time.

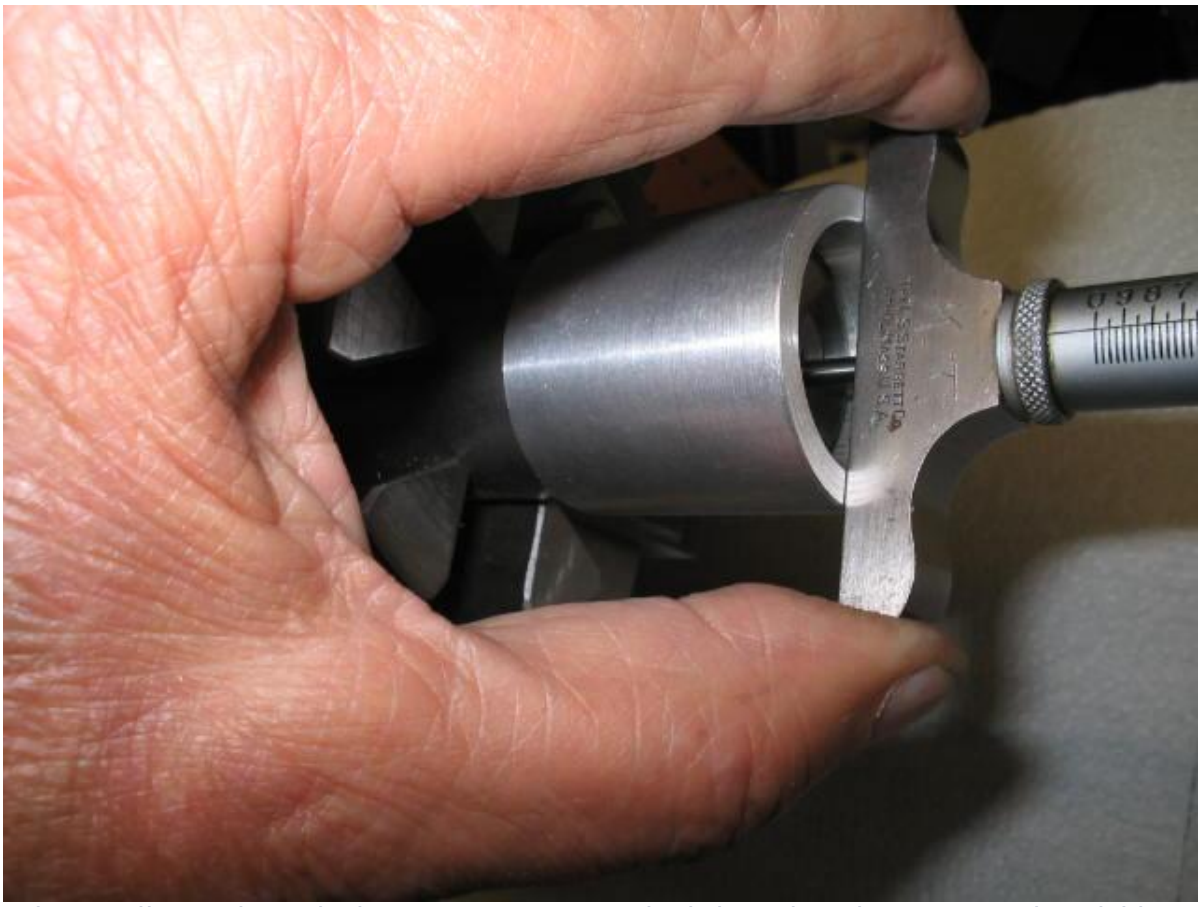
Dave

What Dave is talking about on headspace measuring is:

Don't do this-



It is almost impossible to get an accurate headspace reading since the micrometer will cock over and give a false reading.
Instead, make a measuring collar and do this-



Using a collar as shown is the most accurate method since the micrometer makes rigid contact on both sides of the collar and cannot cock over.

Making the collar-make the collar a known amount over the desired headspace, say 0.250" + headspace for Stoll Panda (1.115"). Collar would then be 1.365" and the correct mike reading would be 0.250".

When

I first bought my lathe (six years ago now), Butch told me how to make a duplicating tool. The below is photos and a write up I did about my tools. A thimble head micrometer head would be better for smaller lathes. Mine is a 16X40 with 4" of tail stock travel so I can back the tail stock quill out enough to use the long micrometer head without moving the whole tail stock.

The top gadget is a reamer pusher which is held in a Jacob's chuck in the tail stock. I know that lots of guys use floating reamer holders but my tool was easy to make and I have yet to end up with run out in my chambers (well, maybe a couple of tenths.) I use Mike Bryant's chambering method as outlined on his web site. The reamer has a bolt that was faced off in the lathe so as to make it parallel with the pusher face. I do dab a spot of grease between the reamer bolt and the pusher but I'm not sure why I do that.

The two head space/cone gages are for setting the headspace and Barrel cone. I thread and cut my shoulder before cutting the finished chamber or cutting the cone. The micrometer head will interchange between the two tools. The steel body fits a Viper tenion and the white Delryn body fits a Hall or Remington tenion (They're threaded inside to mimic the action threads.) I like to use Delryn as it's so easy to machine. I was a bit worried about the plastic being repeatable but it's proven to be as repeatable as the cold roll that the Viper tool was made from. To use one of these tools you would take a barrel that you want to duplicate, insert the go gage into the chamber and screw the gage body on till it jams against the shoulder. Then adjust the micrometer head till it's against the go gage and take a reading. Unscrew the gage body and replace the go gage with the little cone tool thingy and repeat the above step. You now have the measurements that'll be needed to chamber all future barrels for that particular action. You just run the reamer in till you get the measurements the same as the old barrel.

These tools allow me to duplicate my chambers so well that I can and do interchange my brass

between all of my actions without noticing any difference.

For those guys that haven't chambered for a bench rest gun but have chambered for hunting or other rifles, a bit of explanation is needed. If a rifle has a bolted in action a smith can use the action and feeler gages to set headspace and cone or the bolt to barrel clearance. But, with a glued in action the stock prevents the smith from screwing the action onto the barrel while the barrel is in the lathe. It's not feasible to remove the barrel from the lathe so as to check the head space and then put the barrel back into the lathe because the set up is a nightmare when you do that.

The little wood dowel is slotted so a piece of fine sandpaper can be put into it to polish the chamber a bit. I really don't do much polishing as I have a homemade, through the barrel, flush system and the chambers end up plenty smooth without polishing.

I know..... many will disagree with my tools and methods but they work for me with my machines.

Shelley

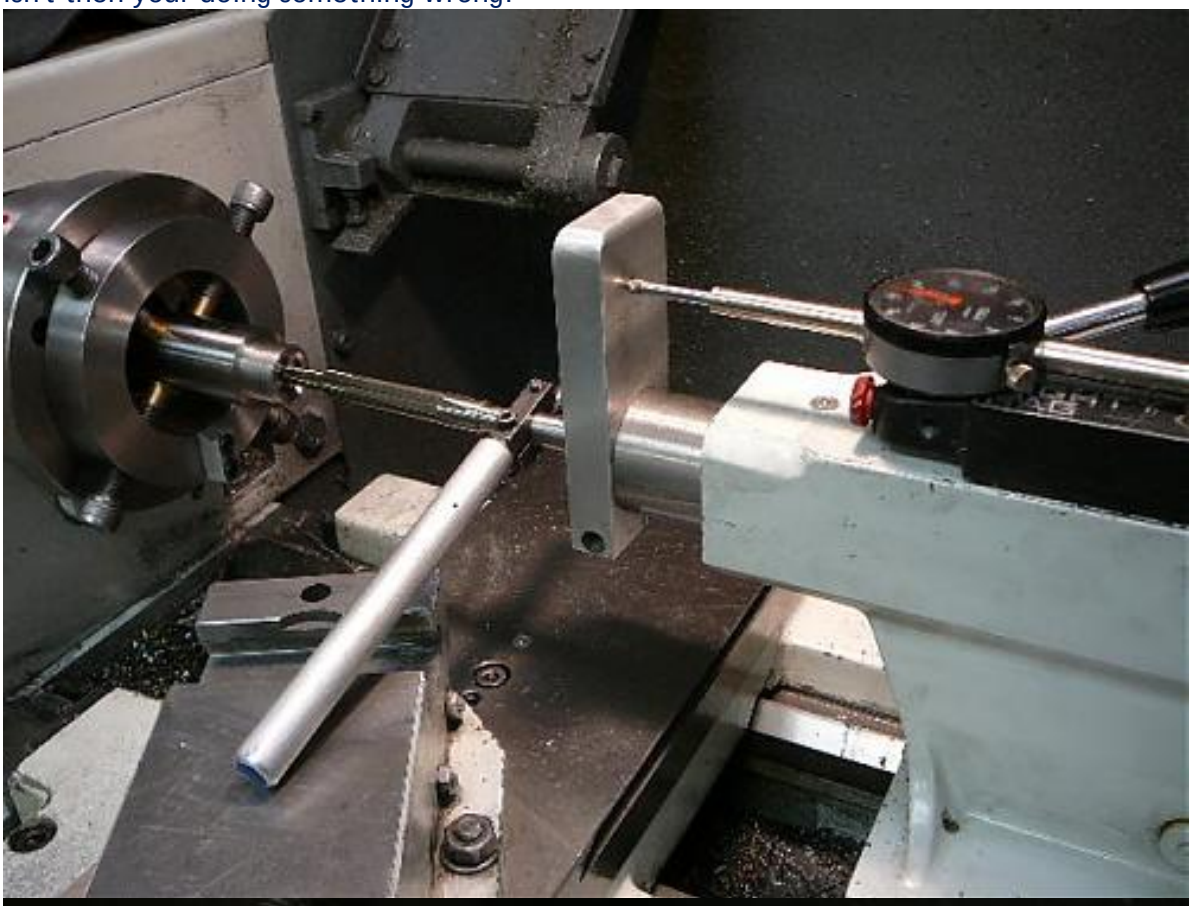
---

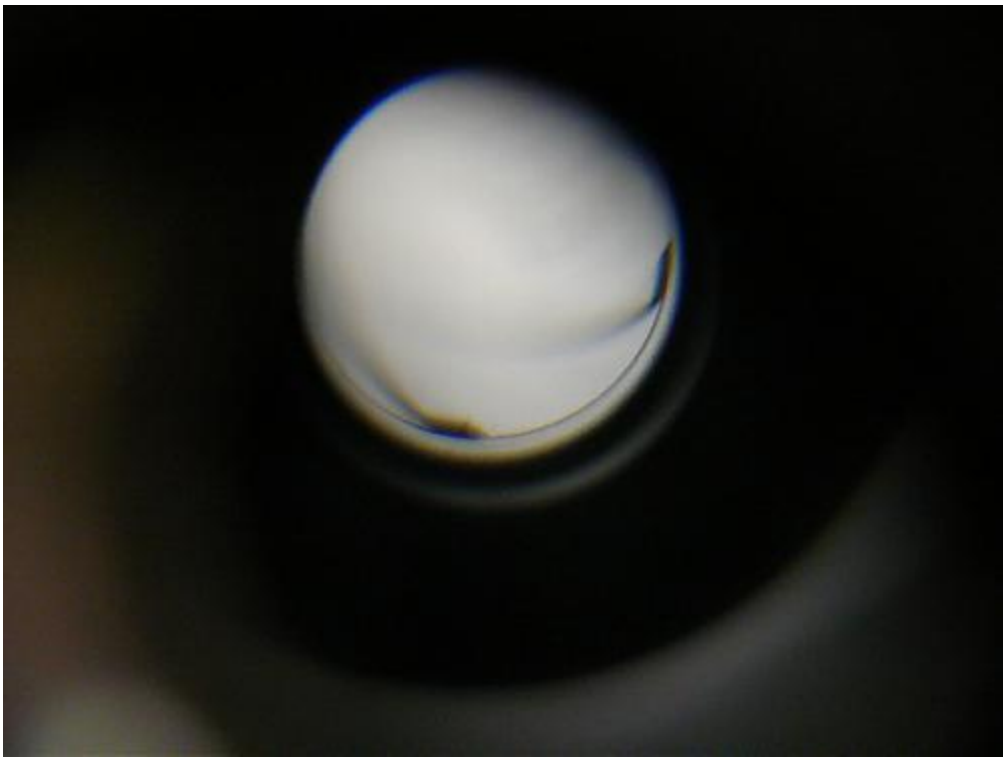
sorry this took so long.

This is my set up when I chamber and a couple of pictures of my micrometer headspace measuring tool. Also a picture of the the 25 and 30 degree gages I made to duplicate cone depths on PPC's. I use a drill chuck adapter that I drilled a hole in to push the reamer holder which is a Sinclair case holder with one end extended.
This was a Bartlein barrel, 30 cal. run out when I was done was 0.000 at the head of the case and .0001" TIR in the throat.

The last picture is part of the throat area. I used my digital camera and a jewelers loop that has a 4" focal length. That is all that is needed by the part time smith to check behind his chamber work. The freebore section, which you see in the photo should be uniform all the way around the chamber. If it

isn't then your doing something wrong.



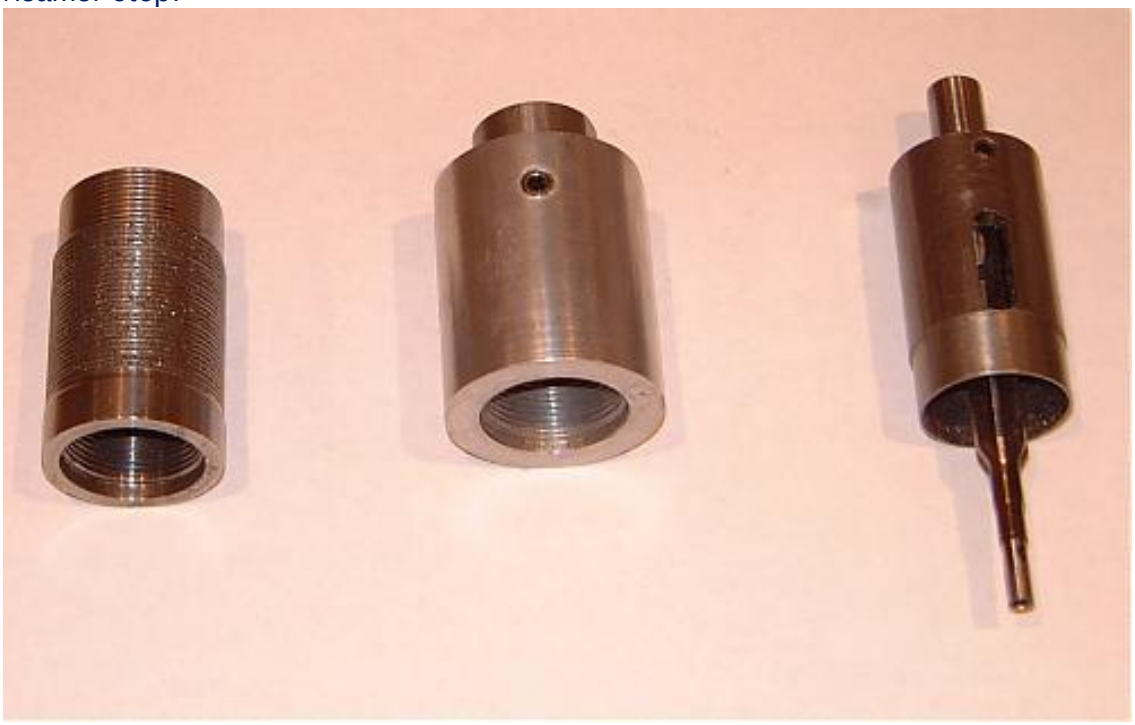


Dave

Join Date: Feb 2003
Location: Texas Panhandle
Posts: 1,316

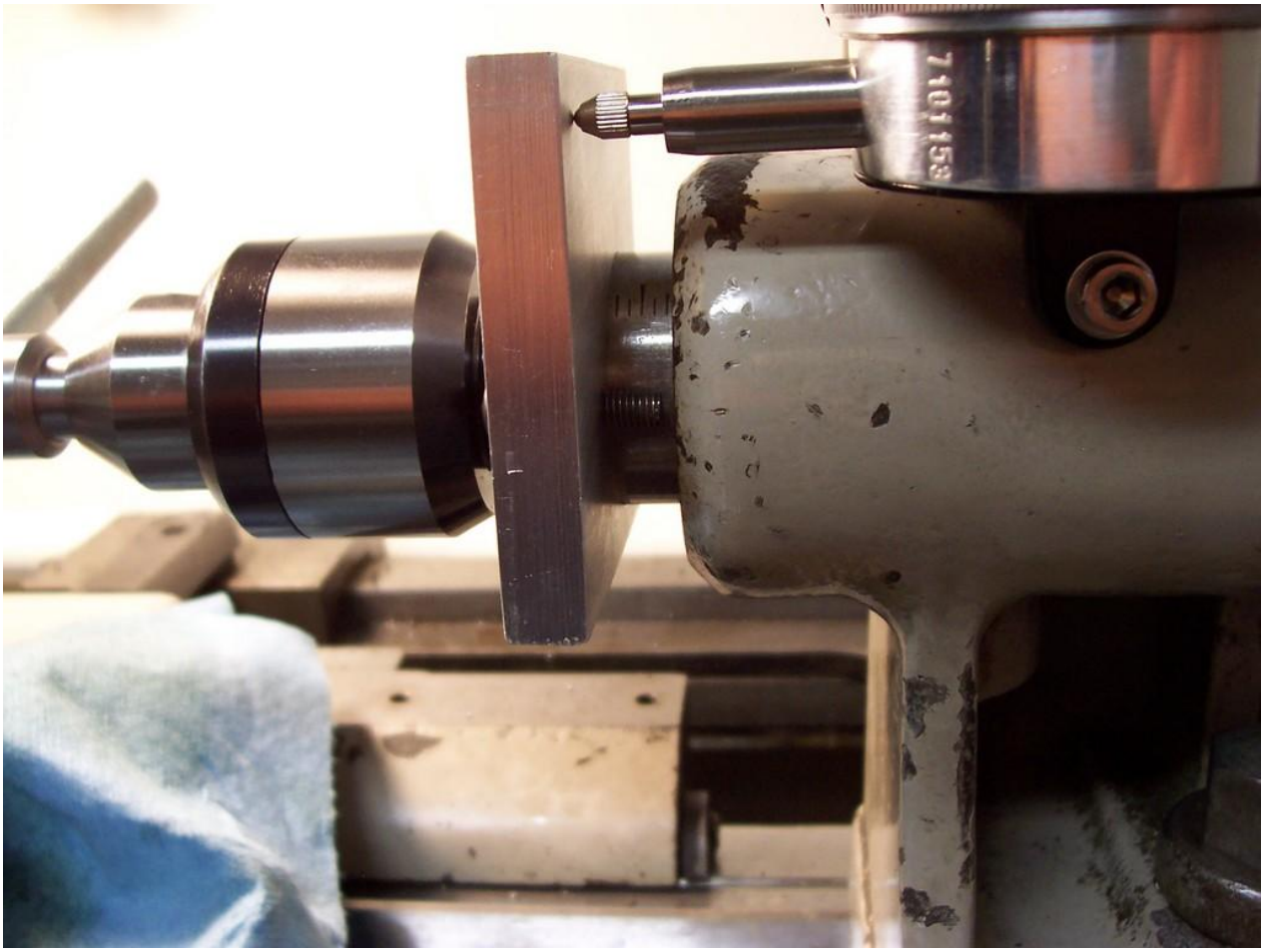
gunmaker, that photo certainly looks similar to your patent doesn't it? I use this one for duplicating cones and for headspace readings as well. I guess it just shows to show you that in machine work there isn't much that's original.

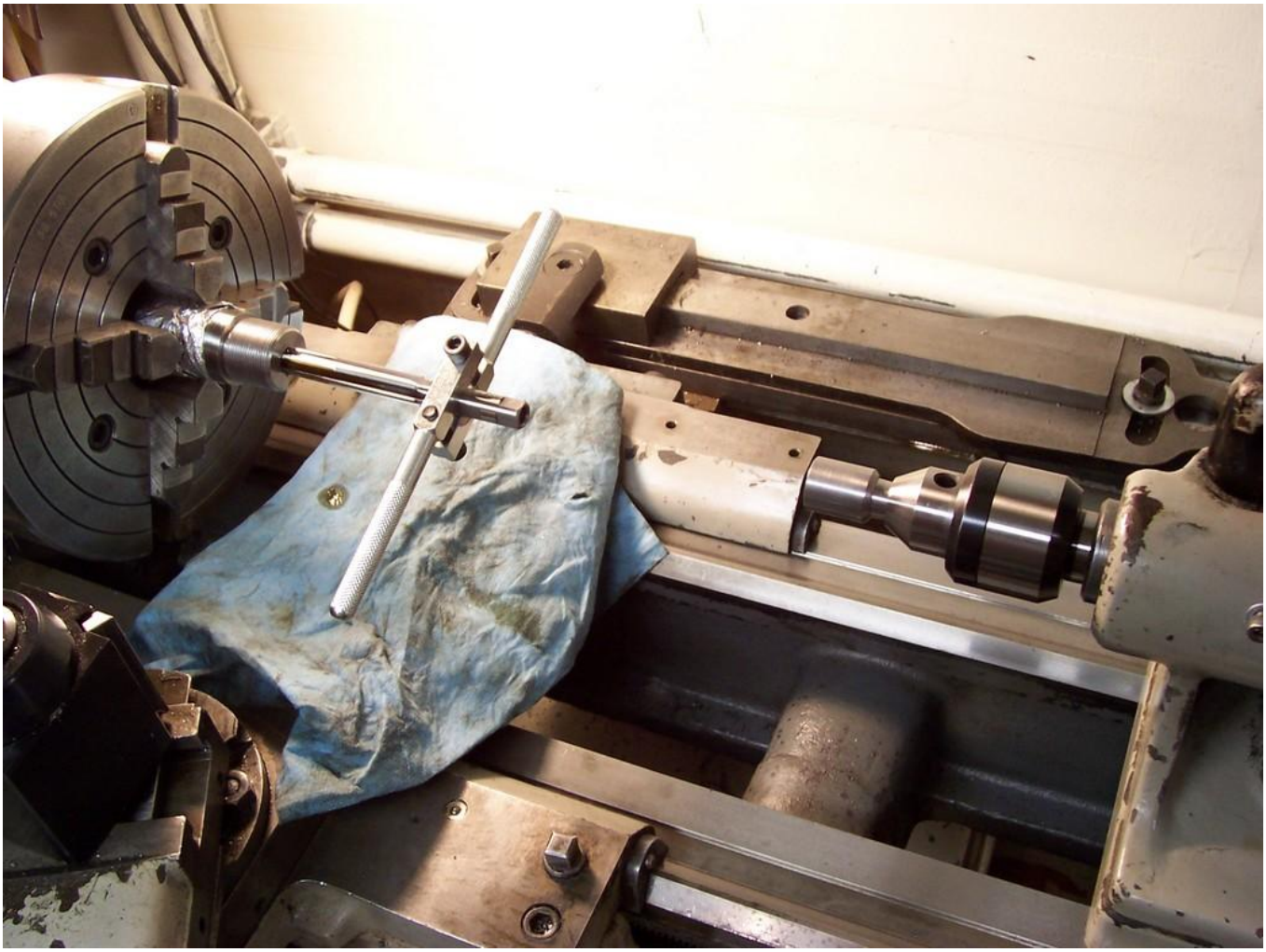
Reamer Stop.

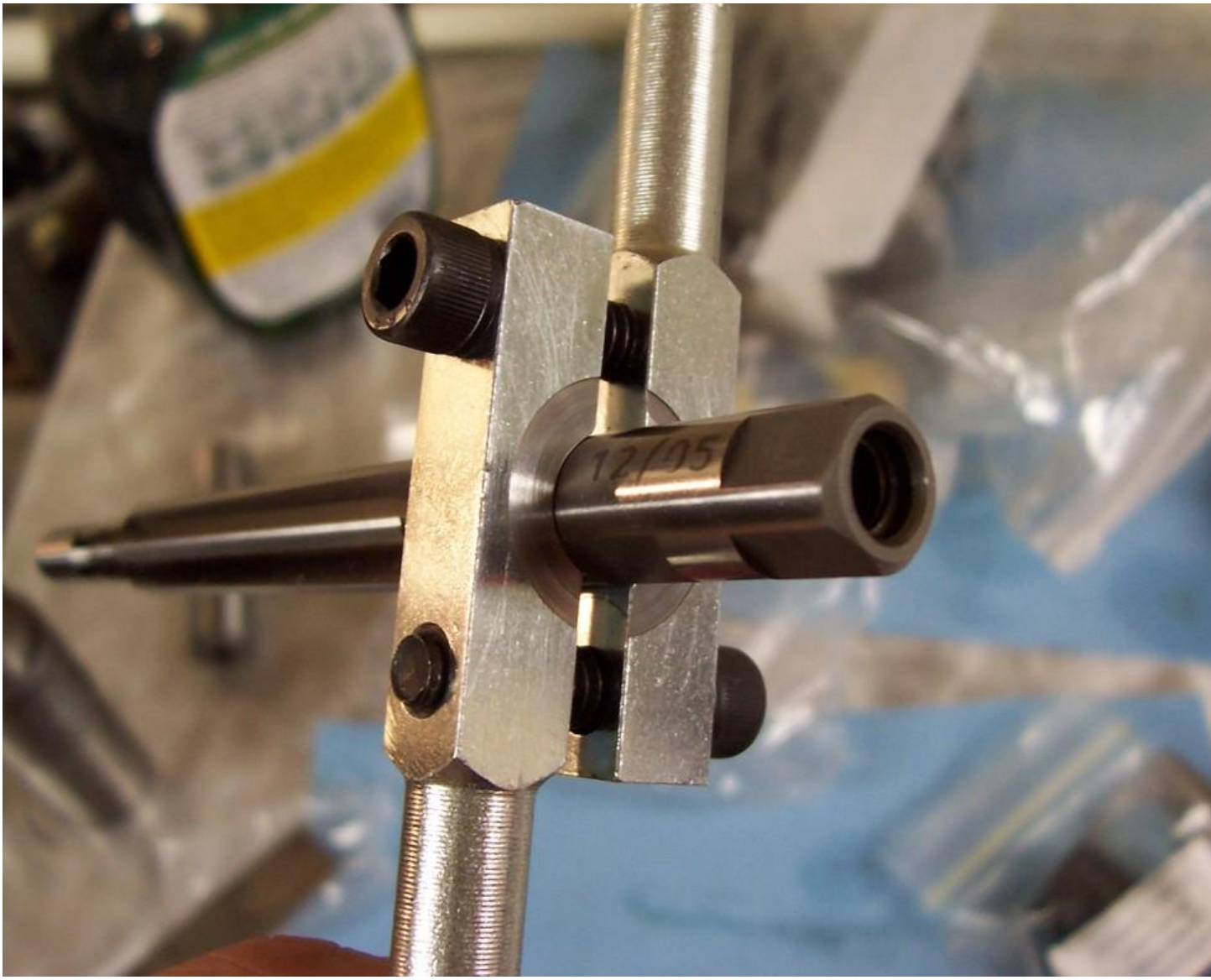


I did what Jerry did (Spot Faced) only my pusher fits the taper of my live center (Its one of those universal types with the differant tips) Here is some photos thats the only thing that ever helps me understand this stuff.

This is in no small part a product of everyones help here on the forum, and dam it worked good!







It Makes No Difference.....

how you chamber. You can carve it in there with a coal chisel.

But, what DOES matter is the results.

How many of you actually check your final barrel work to see just how well things really come out.

You have several areas that should be truly straight and square with each other.

Before you take the barrel out of the lathe after the final operation, do this.

Reach in with your long stylus and indicate the lands just aft of where the reamer stops cutting. Then, move it back and check the actual lead. Then, indicate each end of the chamber, from the neck to the big end. Then, indicate the face of the tenon where it butts against the action. Finally, kick the half nut in, take up the slack in the carriage, and place the indicator stylus between the V's of the thread, just like you were re-catching the thread lead. Roll the chuck by hand, being carefull to keep the slack one way.

All of these readings should be no more than .0003-,0004 out with another. The face of the action should be "zero"with the threads.

If you find discrepencies, and you are doing Benchrest Quality Chambering, then you might need to trouble shoot your set-up.....jackie
On longer chambers that I can not reach the throat area of the barrel with an indicator I use a tight fitting Deltronic pin inserted into the throat area and measure run out at the very end of it and about 1/2 inch in from the end.

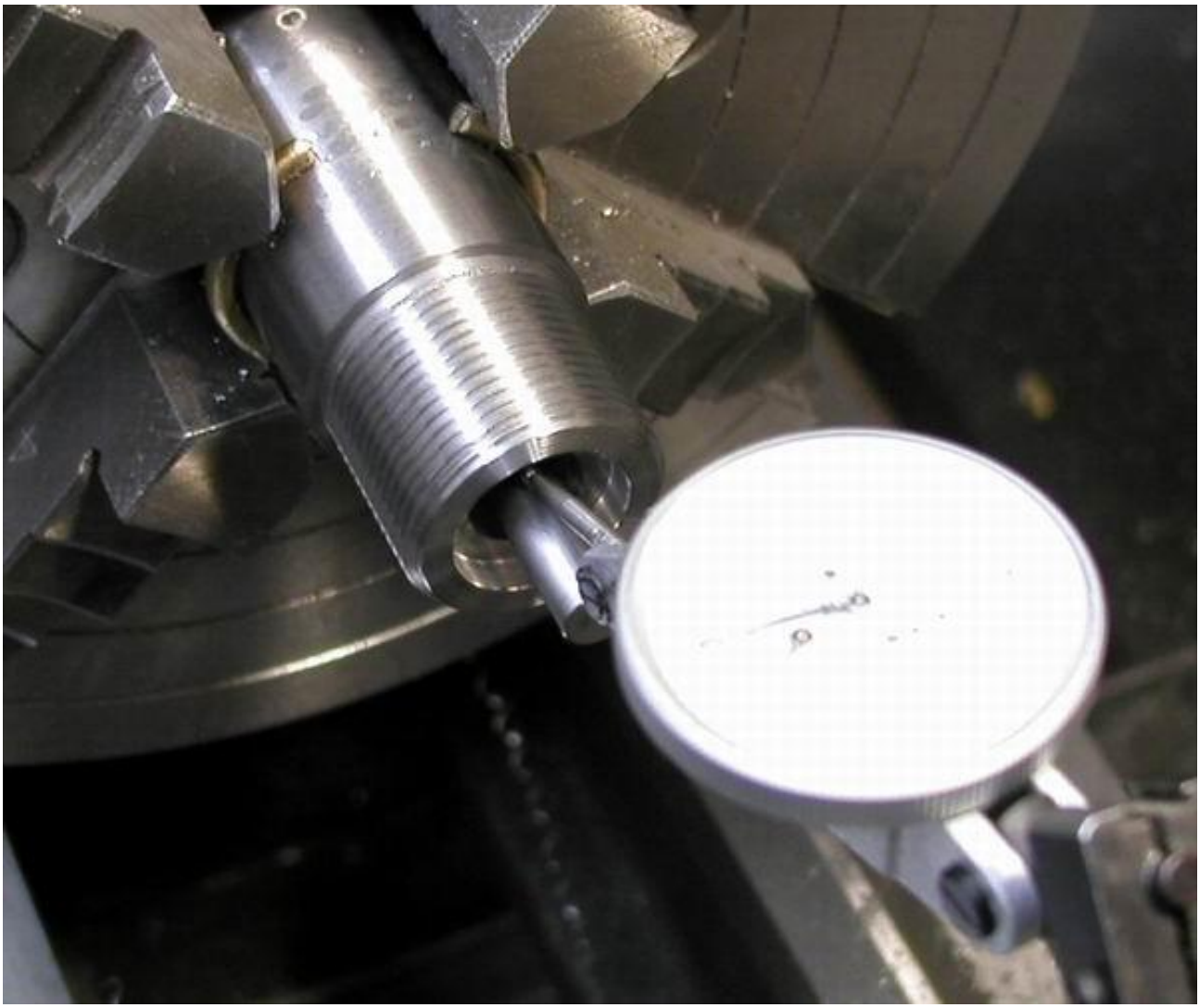
In this particular case the run out at both locations showed no run out within a 10 thousands of an inch. They usually don't dial in that perfect... lucky on this one...

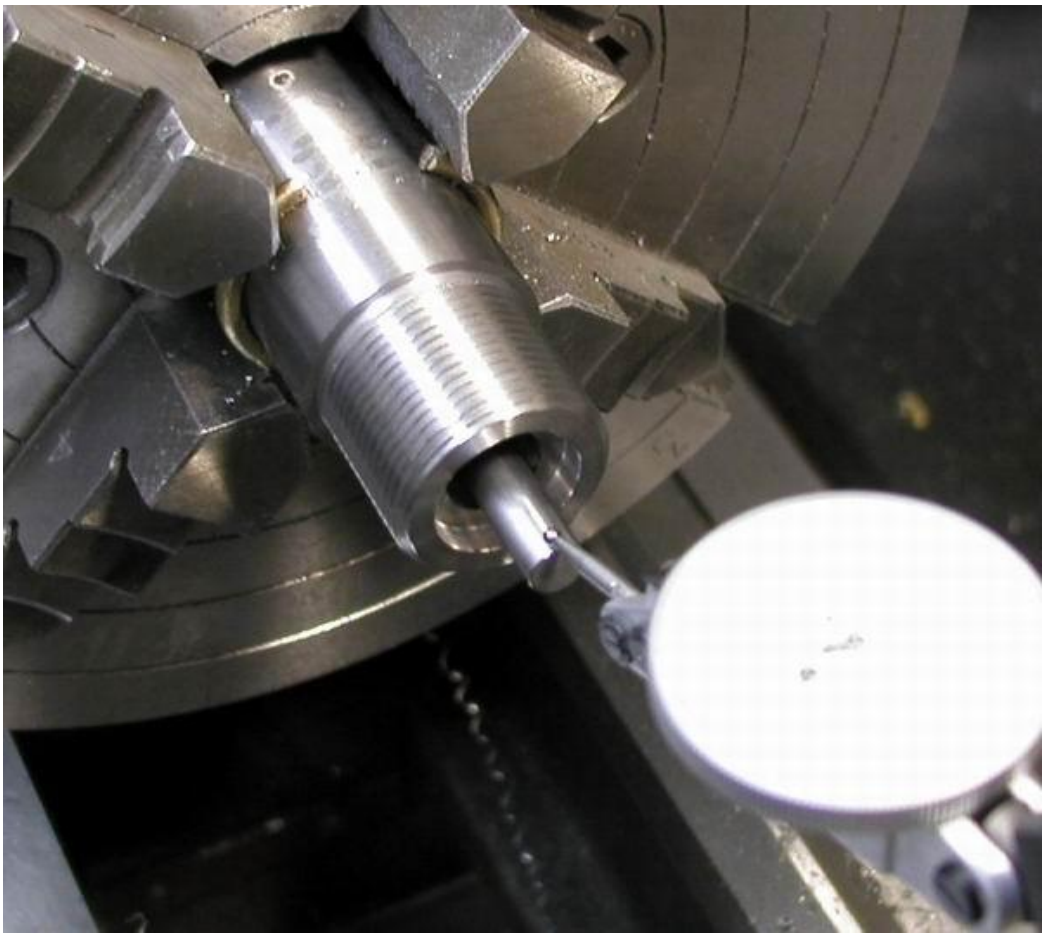
This remained the same before and after machining the threads, the shoulder and the bolt nose recess.

I will now bore the chamber and then use a reamer and when finished check the chamber run out... it usually is less than .0002.
... I have finished and in this set up I can not measure any run out at the rear of the case... This is as good of a result as I have ever had... usually a ten thou or two is about it...

Then the barrel will be removed from the lathe....

...inspecting the throat area it appears very uniform and centered on the bore...





These runout posts are very interesting reading. There seems to be two perspectives on setting up the barrel for cambering that include indicating the muzzle and breech end to run with each other, somewhat the same as between centers, and the other one being setting the chamber end bore straight without regard to the muzzle runout. Does anyone change their method depending on the amount of bore curve found in the barrel?

If there is a significant curve to the bore and you set the "ends" to run together, and then indicate 0-0 at the throat location of the chamber end, are you guaranteeing yourself some chamber misalignment. After all, the pilot for the reamer is beyond the throat location when the throat is being cut. If you have only indicated the bore at the throat location then that's the only point the the bore will run true. Pre-boring will keep the reamer straight as long as it doesn't have to fight with the pilot too much.

Indicating the ends of the barrel to each other will keep the barrel located in the stock channel better, but is the bullet really aligned with the bore in the best way when the round is chambered. I know it won't be off much, but it will be off depending on the amount of curve in the barrel.

Using a range rod to set the chamber end bore straight can be done fairly accurately depending on how "round" the bore is and how closely you ground you rod. Using a rod purchased rod from PTG having a good fit on the pilot and a slow taper can also be reasonably accurate.

My biggest problem is rechambering when there isn't enough length to cut the whole tenon off and start over. Everything is a compromise at that point. The threads have to be extended and kept concentric with the original threads while the chamber is running out .004 to .005. Now you have to straighten the chamber out to the bore. I have seen chambers cut with the "end to end" alignment and from those who just use the O.D. of the barrel for alignment, where the side of the bullet actually gets shaved by the throat while the concentricity of the loaded rounds showed within .002.

Each to his own method as they will both work depending on the amount of bore curve, but I think there needs to be an evaluation of how much curve is in the bore your dealing with before you settle on the best way to go. But then again if the barrel curve is that bad maybe it should become a "jack handle".

As far as testing the result of your work ,I did one barrel where the shooter has come within one point on three different occasions of breaking the national record at 600 yards, 900 yards and 1000 yards . . . is it the chamber or the shooter? Of course I think it's the shooter.

Jeff

A Different Twist to Benchrest Barrel Fitting

by Mike Bryant

At the NBRSA Nationals in 1991 at Midland, I had the good fortune to be shooting next to Ed Shilen. I was needing a new barrel for my Sporter and, of course, when you are shooting next to Ed all week that barrel wound up being a Shilen. When I went over to his motor home to pick up the barrel, Ed was having a conversation with T. J. Jackson and Allan Hall. Since I do my own gunsmithing, I am always interested in the ways that different people do their barrel fitting. I asked Ed what method he uses at Shilen to chamber and thread his barrels. He told me that they do all work between centers and chambered on the steady rest. This a method commonly used by quite a few bench rest gunsmiths.

While we were talking Allan asked , "T. J., tell us how you go about chambering barrels." T. J.'s way was definitely different than most. T. J. said that the first thing that he did was to slip an O-Ring over the chamber end of his barrel. He then placed the barrel in his headstock with the muzzle going through the headstock and the lathe chuck lightly closing down on the O-Ring. He then proceeded to indicate the muzzle end in with the use of a collar with four bolts mounted on the backside of his headstock. He explained that the purpose of the O-ring was to act as a pivot point for the barrel in the indicating in of the muzzle so that the barrel would not be in a bind. After the muzzle is indicated in, he then indicated in the chamber end of the barrel using a super long indicator that reached into the grooves and lands at the point where the throat of the finished chamber would be. This is one point that is different in the way that T.J. barreled rifles than most people. Most people just indicate in on a point a tenth to a quarter of an inch into the barrel. T. J.'s indicator would have been approximately an inch and a half or more up into the barrel. He felt that the point where the bullet started into the lands was the point that was critical to be centered and not the back end of the chamber. He said that when he tightened the chuck indicating the chamber end in, he crushes the O-Ring to tighten the barrel in the chuck. He then did his chambering and threading, if the action was in hand and not glued into a stock. If the action was already glued-in, he did his threading between centers.

I later asked Allan what method he used. Not too suprisingly since he had started off working at Shilen, he threaded between centers and chambered in the steady rest. One thing that he did differently though, was that he roughs out his chamber with a twist drill bit. This is not a piloted drill, bit but just an ordinary twist drill bit. He explained that he then trues up the hole with a small boring bar to give a true hole to start the chamber reamer into the barrel. This also allowed for less wear and tear on his finish chamber reamer.

After listening to everyone, I filed all the information away in the back of mind and took my new Shilen barrel home and fitted it to my Stolle completely using Ed's way of threading and chambering between centers and on the steady rest. I took indicator readings at every step. When I set the steady rest on the barrel threads to chamber, the barrel indicated in to 0.0002". After the chamber was cut and the barrel still turning on the steady rest the chamber still indicated in to 0.0002". A good chamber job in a good barrel that shot well.

I had a barrel for my HV that I couldn't get to shoot. I felt that the reason for this was that all chambering and threading had been done in the headstock and that when I was through with the chambering, the chamber measured 0.001" of run out. So, I proceeded to cut off the chamber and re chamber the barrel completely using the between centers and steady rest method. When I was through with the chambering, the second chamber measured 0.001" of run out. It made no difference whether it had been chambered in the headstock or chambered in the steady rest. The barrel still didn't shoot well and by this time it was too short to try to re chamber again.

I now have settled on a method that works for me. It is a combination of T. J.'s, Ed's and Allan's methods. I use a six jaw adjustable chuck and a spider with four bolts. I run the tailstock of my lathe with a dead center up to within a few inches of the headstock. I push the barrel through the adjustment collar at the back of the headstock, through the headstock and push the chamber end of the barrel up tight against the center in the tailstock. At this point, the jaws of the chuck are not touching the barrel. With brass shims between the 4 bolts in the adjusting collar and the muzzle end of the barrel, I then indicate in the muzzle to 0.0002" reading on a Deltronic's pin gage. The dead center on the tailstock allows the barrel to pivot similar to what T. J.'s O-Ring did. *(I no longer do this with the dead center, but use the method at the bottom of the page going back to a method similar to T. J.'s O-ring)* After the muzzle is indicated in, I then tighten the six jaw chuck . After the chuck is tightened, the barrel is indicated in with the dial indicator reading on a Deltronics pin gage. I use two Interapid dial indicators one at the chamber end and the other at the muzzle end. Both reading on Deltronic's pin gages initially. The chamber end is indicated in to 0.0005" with the shortest indicator point for a true .0001" reading. Then using a Interapid dial indicator with the appropriate length point for the caliber being chambered, I finish indicating the barrel, but this time the dial indicator is reading at the point where the throat of the cartridge will be. Using the long indicator point, the reading has to be as close to zero run out as can be obtained. When the 1.5" or 2.750" indicator points are used the dial indicator no longer reads in true 0.0001". With the 1.5" indicator point, I try to get the reading to be 1 mark variation or less. With the 2.750" indicator point, I shoot for 1/2 mark of total movement or less with closer to zero variation the better. When you make your initial reading before adjusting run out the throat is usually not running as true as when the barrel was originally indicated.

At this point, I cut a rough barrel shoulder and barrel tenion with the length of the barrel tenion being same as the measurement from the action face to the bolt face. The diameter of the barrel tenion at this point is 1.075 for a Stolle and 1.005 for a Hall. This is .015" over finished barrel shank diameter. I then take a 3/8" drill bit and run it into the chamber end for 3/4 to 7/8". I then open the diameter of this hole with a 25/64" drill bit. After the barrel is re-indicated, I now take a cut with a small boring bar to true up the out of roundness from the drilling operation. I keep boring until I get a diameter approximately .010" smaller than the diameter of the chambering reamer shoulder. Each pass is set to take off only .001 of metal at a time. After I am through with the boring operation, I take another reading with the dial indicator this time on the bored hole to determine that the bored hole is perfectly concentric. Every time that I do an operation to the barrel, I check it with the dial indicator. If you check out every step, every time, you know that each step is done right before you go to the next step. If you don't check it, you don't know if its right or not.

At this time, I run my chambering reamer into the barrel 0.100" short of finished depth. The chambering reamer is driven by a simple holder on the tailstock that allows the

reamer to float slightly and held by hand with the aid of a Sinclair case holder. Holding the wrench by hand it is easy to tell if you try to feed the reamer in too fast. Using reamers with removable pilots, a pilot is selected that is .0002" under the largest pilot that will fit into the barrel. The pilot is selected by using a special shank that will allow the pilot to be inserted to the finished throat area. I use a high grade cutting oil (Texaco Transultex H) and coat the pilot and reamer and also squirt the oil into the barrel. I will at first go 0.100" deep with the reamer before I withdraw the reamer. I, then blow chips off the reamer and out the barrel with compressed air. I, now, re-oil the barrel and the reamer and go in another 0.100" withdraw and repeat the whole process. When the chambering reamer shoulder starts cutting into the barrel at the bottom of the bored hole, I quit taking 0.100" and reduce to 0.050" deep until I get to 0.100" short of finished depth.

At this point, I check my nearly finished chamber with the dial indicator. The closer the dial indicator reads to 0.0002" on the back end of the chamber the better the chambering job is. Run out on the chamber job is greatly enhanced by chambering into the bored hole instead of trying to let the chambering reamer do the whole job of reaming the chamber. It also should help the chambering reamer last longer, too because the chambering reamer is doing less work. I now re-indicate on the back end of the chamber, if necessary. That is if the run out is greater than 0.0002". I have yet to have a chamber that has run out to as much as 0.0005" using this method. If the action is in hand, I go ahead and turn the thread shank diameter down to finished diameter(1.057" for a Stolle, 0.995" for a Hall). (If the action is in the stock, whether it is a glue-in or I just don't want to remove the action from the stock. I can either thread between centers and cut the cone on the steady rest or use a thread mike and a cone measuring device and do everything in the headstock.) I will now thread the barrel starting with .005" to the pass gradually working down to .001" passes the closer I get to the barrel screwing on to the action. I try to get as tight a thread as I can that I can thread the action on by hand to the shoulder and off again by hand. I will now take a very fine pass across the barrel shoulder to make sure that the shoulder is square to the threads. Harold Broughton told me that when a barrel tightens up against the shoulder the front part of the barrel thread and the rear of the action thread are the only part of the thread that will make contact. There will always be clearance on the back of the thread and it doesn't make any difference whether this clearance is .0002" or .001", its still clearance and won't affect the way the barrel shoots. That means that a tight thread fit or a loose thread fit won't have any effect on accuracy. Even though I know that, I still prefer a fairly tight thread fit. A very thin layer of layout blue should be applied to the action face. The action should now be tried to the threads. If everything is right the barrel shoulder should have a full circle of layout blue when the action is removed from the shank.

I now set my compound to 1/2 degree less angle than the bolt nose. With a Stolle, I set the compound to cut a 29 1/2 degree angle. For a Hall and Bat actions, I set the compound to cut a 24 1/2 degree angle with the angle being such on the barrel tenion that the farther that you get from the chamber the greater the space will be between the bolt nose and barrel. I gradually start removing the metal for the cone. I check for fit by screwing the action onto the threads with the bolt closed in place in the action. I can then measure the gap between the barrel shoulder and the action face with dial calipers at first and then later with a feeler gauge as the gap decreases. When I get to the point that a 0.010" feeler gage will fit in the gap. I take one more pass removing 0.015" metal leaving a gap of 0.005" between the barrel and bolt nose. The bolt nose should not contact the barrel. It is very important to keep clearance between the bolt nose and the end of the barrel to a minimum. I like to have no more than .010" clearance between the cone on

the barrel and the cone on the bolt. If there is more clearance than that, the case head will not be supported and can result in case head failure upon firing with the case blowing out and releasing gas and shrapnel down the bolt raceway or worse. Keep headspace to a minimum fit on the go gage and bolt clearances to a minimum for the utmost in safety.

We are now fully threaded with proper bolt fit. We are still not completely chambered. The final 0.100" left to go on full depth of chambering will now be gradually done. The depth of the chamber is measured with a go headspace gage inserted into the chamber and measured with a depth micrometer from the face of the headspace gage to the barrel shoulder. This measurement should measure the same as the measurement from the action face to the bolt face when the chamber is finished. When the chamber gets to the point that it still has approximately 0.020" left to go using the depth micrometer, I change to what I believe is a more accurate method of achieving final headspace. That is to screw the action with bolt in place onto the barrel with the go headspace gage in place. The gap between the barrel shoulder and receiver face can now be measured with a feeler gage just as it was when we fit the coned bolt. Go slow in finishing the chamber as it is a lot easier to do if you don't go too deep. The bolt should just close on the go gage with the action screwed down against the barrel shoulder.

After the front end work is done, I now turn the barrel around in the headstock , set the compound to cut 11 degrees and crown the muzzle. I have crowned barrels using a good sharp tool and cutting a 60 degree center, taking a ball bearing and working from 320 grit down to 600 grit sandpaper or using a ball and lapping compound. I can't tell that one works particularly better than the other. But, with the ball it is possible to push metal into the bore resulting in a fine bur completely around the muzzle. You can tell by taking a q-tip and running it around the crown. If there is a burr, it will catch on the q-tip. The crown has to be burr free.

After the barrel is chambered, threaded and crowned, I will take thread mike readings on the barrel, cone length readings with a special dial indicating fixture and record depth mike readings for headspace readings. Also, I have a fixture made for indexing the caliber engraving on the barrel. All of these are recorded for subsequent barrels on the same action without having to have the action in hand in the shop. *(This is done on the custom actions only with 1 1/16" barrel shanks. I'm not set up to measure the cone on barrels with shanks larger than 1 1/16". There is too much variation in production actions and do not keep those measurements.)*

So, how well does this method work? Well, the first barrel that I chambered like this was a Broughton 9-groove .22 Waldog . I finished the barrel job on Thursday. Shot it that Saturday in a registered match in Oklahoma City. I was second at 100, won the 200 and finished by winning the grand. Then the next month won the grand again. The competition at the Okie Shooters Range is tough. Some of the hottest shooters in the United States shoot Oklahoma City. The method outlined above has been slightly changed and updated over the years since the Oklahoma City matches, but is basically still the same procedure and step as used then. Steps that have been changed since then are that I used to drive the reamer with a dead center. I no longer do that. The simple reamer holder that I use is pictured below. It works much better than any manufactured floating reamer holder that I have used.

The Simple Reamer Holder. The holder is bored .020" oversize of the reamer shank.

Pictured above is the collar, not mentioned in the article above, that I now use to go around the outside of the barrel on the chamber end. With the collar around the barrel and the collar held tight in the 6 jaw chuck, you can take the muzzle end of the barrel and move it anywhere you want in the spider end of the headstock and it will stay where you move it. This indicates that the barrel isn't being bent. The collar has a 1/4" ring that is 1.350" in diameter and is undercut directly underneath the ring as you can see in the photo. When the chuck jaws are tightened down, they only bear against the 1/4" ring. If the ring is not used and the jaws are tightened directly against the barrel, you can push the muzzle end of the barrel, let go and the barrel will return to the original location in the spider. This indicates that if you adjust the barrel in the spider that you are actually bending the barrel. The collar solves that problem.

Pictured above is the tool that I use for measuring the cone on previous barrels. Also, can use it for a direct reading off a headspace gage.

Below is a photo that I took of a Bald Eagle floating reamer holder that a customer sent me to use with his reamer setup. Unfortunately, I couldn't use it as the reamer holder has a #2 Morse taper and my Kent lathe uses a # 3 Morse taper. The Bald Eagle reamer holder is a little more polished version of the tube that I use to float my reamers.

I am thinking about buying my own reamer for the 30BR. I have always rented reamers before. My smith doesn't carry any. Talked with Dave Kiff (sp?) and PGT. He said I would need a rough in reamer to go with the finish reamer. My smith says he always step drills and then just goes with the finish reamer.

So what do you pros use on BR barrels? Tiny68

Yes many of the pros absolutely DO pre-drill and/or pre-bore (probably most of them) but there's another reason to get a roughing reamer, a GOOD reason.

First of all, understand that it's in no way "rough", it's just smaller than the finish reamer.....it's not even cheaper nor poorly finished nor nuttin', it's exactly the same quality as the chambering reamer only smaller.

And you can use it to make your fitted sizing die.

I order mine to be exactly .002 smaller in diameter than my chamber reamer but several folks more experienced than me use .002 or .003 at the shoulder and .0025 up to .004 the base, just above the web. In other words they set the taper of the die reamer to be subtly different than the chamber, not parallel the sides.

I've tried the above numbers and a bunch that're weirder and MY PERSONAL CHOICE is to size the finish reamer .006 bigger than the chosen brass at the butt and minimum taper on the reamer, like for my BR cases I like only .012 total taper in the body. I run .012 to .015 total body taper and have two reamers with only .010 taper and no observed ill effects. I don't know the logical limit to "minimum body taper" but have found .012-.013 taper to be very nice numbers. I also know of some folks running .004 of squish at the shoulder and slightly less at the web, reverse taper to the "norm". I've never tried this.

For ME, the "roughing reamer" or actually the FL Die Reamer is then sized .002 smaller, shoulder and web for PPC/BR/47L/308 cases.

I know why some of he others do it differently and I know why I do it the way I do.

If you get both reamers and use the one for your die, the cost of the second one can be used to offset the cost of a sizing die.

There is currently a bit of a problem with this method..... finding a 'smith who'll cut your die and have it hardened may take some time, if he'll do it at all.

Jim Carstensen of JLC will make you a hardened sizer from your actual chamber reamer and shrink it to fit. AFAIK only he does this.

Neil Jones will make you a Cadillac fitted die from the dimensions of your supplied brass and the Harrell's will make you one cheaper. But the Harrell bro's only do BR/PPC and the new 47L case. Neil does any chambering.

Another option which I'm currently in the process of trying is to have Lonnie Hummell of Hornady make a hardened sizer die..... going this route would eliminate the need for a roughing reamer.

BTW, I've got one HS steel 6BR reamer which has cut 5 chambers all by itself, no rougher, no pre-boring... and the reamer still cuts a good chamber. I don't know how many chambers a reamer will cut all by itself.

I do silly stuff like asking for a different diameter pilot on each reamer I order. Since the reamer comes with a pilot, I've now got 7 different 6mm pilots with no appreciable cost.

I'm a bit of a tightwad 

For your situation I'd probably just order a finish reamer ONLY and have the Bro's Harrell work their magic on your 30BR die. Dave will send reamers without a rougher to go along with it. This would seem to be the cheapest route based on your supplied information.

If you already own a 30BR you can send Kiff some samples of your fired brass and he can make you a finish reamer that matches your existing stuff..... Dave's a wiz this way.

hth

al

I don't want rehash some of this stuff but would like to inject this idea.

What is the single most important cutting edge on a reamer?

It's not the body.
It's not the shoulder area.
It's not the neck.

It's the lead angle on the throat.

That is the only part of the reamer that really matters. Everyone can say they are still cutting chambers with a good finish but who cares if the brass has a shiny ring around it or you have an ugly looking shoulder. The throat has to cut as cleanly as possible. Unfortunately that is the part of the reamer that cuts more than the other surfaces, thus it gets dull faster. All you guys that have more than 5 chambers on your reamers look closely, look very closely at your throat area. You'll see the edge starting to break down. When that happens it will start to plow metal instead of cutting/shearing metal.

Now what do you do about it. I keep an eye on my reamers and when the throat is breaking down I send them back and have just enough taken off that if you were looking at them on an optical comparator, the cutting edge will look straight again instead of scalloped. Usually .004" or less.

How long will it take to break a barrel in if you have rolled metal from the land into the groove? That happens to some extent in every chamber. That's why we have a break-in process to smooth up the throat. I do something to every barrel that leaves here now. I've tuned rifles up in less than 30 rounds because no break-in process was needed.

I've seen barrels where half the land was pushed over and sitting in the groove. I'll bet those were fun to tune up.

Dave

Dave T,

That's good info right thar! 

I think I might go down and drive a slug back into a couple new chambers, check for burrs.....

Now, when you have your reamer throats freshened do you have the whole reamer dropped back? Or do you just shorten the freebore? I'm guessing that my "good reamer after 5 hog-jobs" is pretty well SMOKED the throat!! Luckily I recut my own throats using Kiff's hand throater but yowsahhhh, you set me back there.....
Thank you
al

Dave has touched on a critical point. I use only finishing reamers (no roughers), and do my chambers in a high presure flush system. I treat my reamers with absolute TLC. I have all my personal reamers cut with .020-.040freebore and use a throating reamer to finish the chamber. A piloted finishing reamer cost to my door $152.00. A piloted throating reamer cost $69.00 to my door. I can give my customer a custom chamber to match his bullet seating.

Years back when I chambered by drilling, boring, reaming and cleaning at very low speed my reamers showed wear immediately upon use. Since I switched to a flush system (30 to 125 psi) and ream at a constant higher speed my cuts are made with a lighter feed. The smaller chips flush out under about 30 psi. Approximately every .100 I back the reamer out with the barrel turning and run the presure up to 75-125 psi. This allows for the larger chips to also flush. Before I finish the last .100, I remove the reamer and clean and inspect all the leading edges. The complete the chamber.

Reamers of 50 years ago and older had two cutting surfaces and were called half reamers. Todays reamers have 6 and 8 cutting surfaces, and one can get them in straight or heilical cut. They are made of tool steel and or carbide. These materials are significantly harder than the material they are cutting. Sharp tooling run at the cutting speeds they are made to cut at make chambering a more precise process. Running a reamer slow means the feed needs to be heavier this inducess heat, chatter, and stress in the metal to things a barrel does not need. Barrels cut with a flush system never get warmer than room temperature. Most of my work is on stainless steel and we all know stainless steel will work hardens in a second if it gets any heat in it.

When in machining school we were taught to run reamers at the slowest possible speed we kept them well coated with cutting oil. Chamber reamers are somewhat different than hole/bore reamers.

With hole/bore reamers the leading edge and OD do all the cutting. The chamber reamer is cutting on all sides, it is drilling/boring in the front and reaming on the sides. The smaller surfaces are going to take the most abuse. Again lighter feeds and positive lubrication/cooling/flushing only makes sense. When I talked with the engineers with Rustlic about my flush system coolant lubricant they recomended an extreme pressure coolant/lubricant. I use Rustlic 255R. My reamers are lasting literally 100s of chambers between regrinds where before I had them reground about every 10-15 chamber or as needed. With a little experience you can feel the difference in a sharp reamer and a dull one.
Reaming time takes longer and the tool wear become exponential.

This is my take on this subject.

Rustystud

Ken:

My sppeds vary depending on the caiber and chamber. The small stuff is run slower usually 75-125 rpms, The larger cases 308 and up I run 175- 225. I have run reamers as high as 400 rpm. I don't dwell on speed in rpms. I ream by feel. Reamers need to cut and not grind out the metal. My reamers make ships that are just thicker than typing paper.
Rustystud

Yet another method as posted by Jerry Sharrett on Bench Rest Central:

For the chambering;

First determine where you want the muzzle based on barrel taper and the weight you need. eg LV, HV Max HV, etc. I use Dan Lilja's program to calculate weight if I am not duplicating a previous barrel.

Cut the barrel off at the muzzle end to about 1/8" of finished length. In setting this up indicate the barrel OD sticking out of the tail end of the headstock. Using something like a South Bend Heavy 10 so you can work a barrel through the headstock down to about 18" long. On the muzzle end, indicate the OD at the cut point.

Some barrels will have concentricity errors from OD to ID as much as 1/16". Not a problem. You not working in the ID just yet, just cutting the muzzle end to near finish length.

Then turn the barrel around and indicate the OD on the chamber end and a gage pin in the muzzle end. Then cut to approx length with a parting tool just as you did for the muzzle.

At this point with the barrel spinning about 200 rpm look down the bore to see how much curve is in it. Over the years I have had to send 2 barrels back that I thought run out was excessive. Both looked like a girls 2-girl jump rope. I don't reorder from them again.

Now, with a snug fitting gage pin in the muzzle end position a dial indicator on that gage pin. I use an Interapid 0.0001" dial indicator with a probe long enough to reach the chamber neck area. Dial both ends in. The muzzle end dial in to the nearest 0.001" using the spider. Dial the chamber neck in to 0.0000" or as near that as you can get.

Rough the tenion to about 0.01" over finish size and to length. Pre drill the chamber body to about 1/64 under chamber shoulder/body finish size and almost to the finish shoulder (leave about 1/32" or so for the reamer shoulder to finish.

Next reindicate the muzzle end and the chamber neck. Didn't move so go on. On the chamber neck indicate the lands. That's where the neck pilot rides.

Bore the drilled hole to about 0.005" under the shoulder finish diameter then step bore a couple more 0.005" steps in the larger part of the chamber body taper. Don't try to taper bore the chamber body. Too many places to screw up oncluding cutting a surface the reamer will grab on. In most chambers the reamer pilot is already in the barrel bore anyway.

Rough the barrel cone if it is a cone bolt or the counterbore if it is something like a Rem 700.

Finish the tenion OD and shoulder. Make sure the shoulder is very square and no corner radius with the tenion OD.

Finish the chamber gaging off the tenion shoulder. Use a floating pusher that is shown in several posts on this forum.

Finish the barrel cone and thread.

Turn barrel around and indicate the muzzle ID with an Interapid indicator. On the muzzle end indicate the grooves because I sometimes put a 0.005" x 45 bevel. Indicat the tenion OD in this same setup.

When finished a barrel it will be on paper to within +/- 2" at 100 yards from the barrel just taken off if that barrel was done by this method.

---------- On chambering a Savage from Bench Rest Central ----------

I would like to know if there is a standard measurement for how much of the case should protrude out of the chamber end when running in the reamer. I am going to chamber a barrel for a savage target action in 30BR. I have never chambered a savage and I don't know how deep to run the reamer in. Any help will be appreciated. Ross

I usually true the bolthead face if it needs it. Usually they do because Savage uses a vibratory deburring operation on the boltheads and depending on how long it is left in, can cause the boltface to be dished. You have to be careful here so you don't remove too much or it will lead to extraction problems. After that, I depth mic from the bolt nose to the bolt face and add .oo4-.oo6 to that measurement and make the go gauge stick out the breech that much. Any less clearance then that and you risk not being able to close the bolt if you should happen to get a piece of unburnt powder or dirt in between the bolt nose and the barrel. You could safely go up to .010 and not have a problem, but I like mine a little closer. RFLSHOOTER

Are you saying that the go gauge should protrude 4 to 5 thou out of the barrel and that is the correct dept to run the chamber reamer in. I think the gauge would need to protrude more then 4 to 5 thou. I had a guy tell me that the case should stick out of the chamber between 120 and 125 thousands and then to screw the barrel on until the case contacts the bolt and tighten the barrel nut. Does this sound correct Ross

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Gordy is a good friend of mine but I don't agree with the way he sets his barrels up. It works to his satifaction and that's all that matters. Here is what he is doing.

He is aligning two points in the breech end of the barrel. He's doing this by holding the rod in the tailstock and moving it to two different locations in the barrel. Accuracy of the chuck or alignment of the tailstock doesn't come into play here. He adjusts the barrel on the outboard side and inboard side until those two radial slices of the barrel are in alignment. Zero runout on the rod in each location as he rotates the barrel. He thinks this aligns the reamer better in the barrel. When he threads the barrel he indexes it so it is pointing to the top of the action.

I've never tried Gordy's method but using a long stem indicator in the throat/neck area I've never felt I needed to try another method. I just did a 300 RUM Imp for a customer and had less than a .0001" TIR in the neck and chamber mouth. The needle didn't move on my .0005" indicator in either location and that's with the muzzle running under .0002". I can't get it any better than that.

Dave

Setting up barrels..

Not getting into what is better or who is right. There are several schools of thought on this subject. I have talked at length with Gordy and Greg Tannel who uses a simular approach. We all agree with one thing no matter the method, that deep hole drilled barrels have a wondering bore. Therefore the bullet is going to have a wondering path between the breech end and the muzzle. Many smiths feel

they get a better shooting rifle ifs they align the bullet and case both coaxially and concentrically at the breach end. This can only be accomplished by moving the muzzle off center. There are many smiths that feel that both the breach end and the muzzle end should be centered independently. There theory is a bullet started off straight and ending up straight is the best theory. Jackie often talks of stacked tollerences. Barrels no matter the method a barrel should be shimmed in the headstock so they can turn without flexing. Both methodologies work and I am not one to say one is better than the other.

Shooters today are expecting more and more out of their equipment. The BR crowd at 100 and 200 have to have a rifle capable of shooting groups in the single digits on good days. The Long range BR shooters are seeing 600 yard groups under an inch on good days. The 1000 yard BR shooters are shooting groups right at 3" on good days. Yesterday I had an F-Class Open customer shoot a 200 with 14 Xs at 600 with a Savage Target Action and 31" Broughton 1:8 5C in 6mmBRX. He had a 5 shots in a row, in a 1.75" spotter disk before nocking the center out.

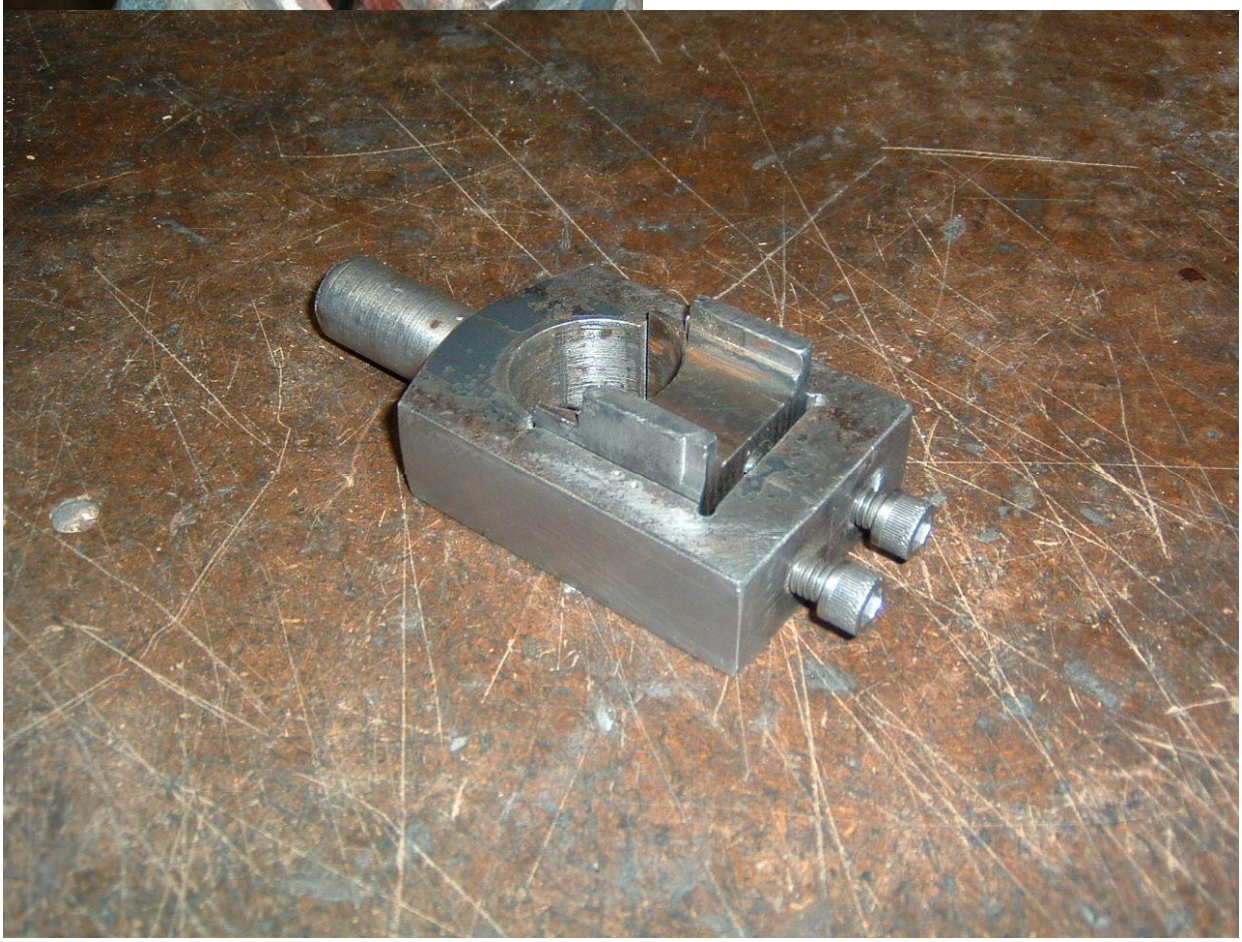
Guns and the ammunition have gotten so much better in the last 5 years.

Gunsmiths like Dave Tooley, Gordy Gritters, Greg Tannel, all have record winning guns and for good reason. They are learning from each other everyday. I wish everyone of these guys would make DVDs on their barreling processes.
Rustystud

---------- Related to barrel vises and getting barrels loose. ----------

If you do not intend to re-use the barrel, I would set it up in the lather and turn a portion near the receiver to a diameter to closely match the bushings I use in my barrel vise. While you're at it, take a thin parting tool and make a cut close to the receiver to relieve some of the barrel/receiver tension.

Here is a picture of my action wrench for a Rem 700 and barrel vise.

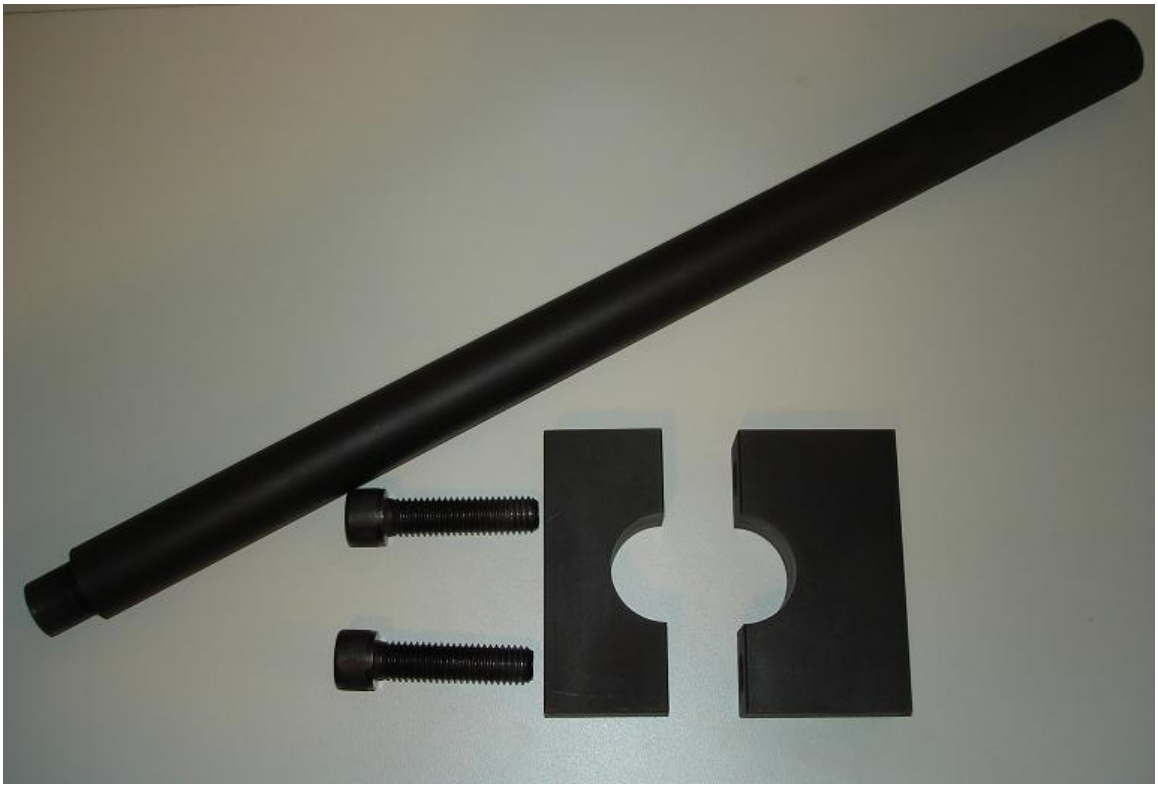


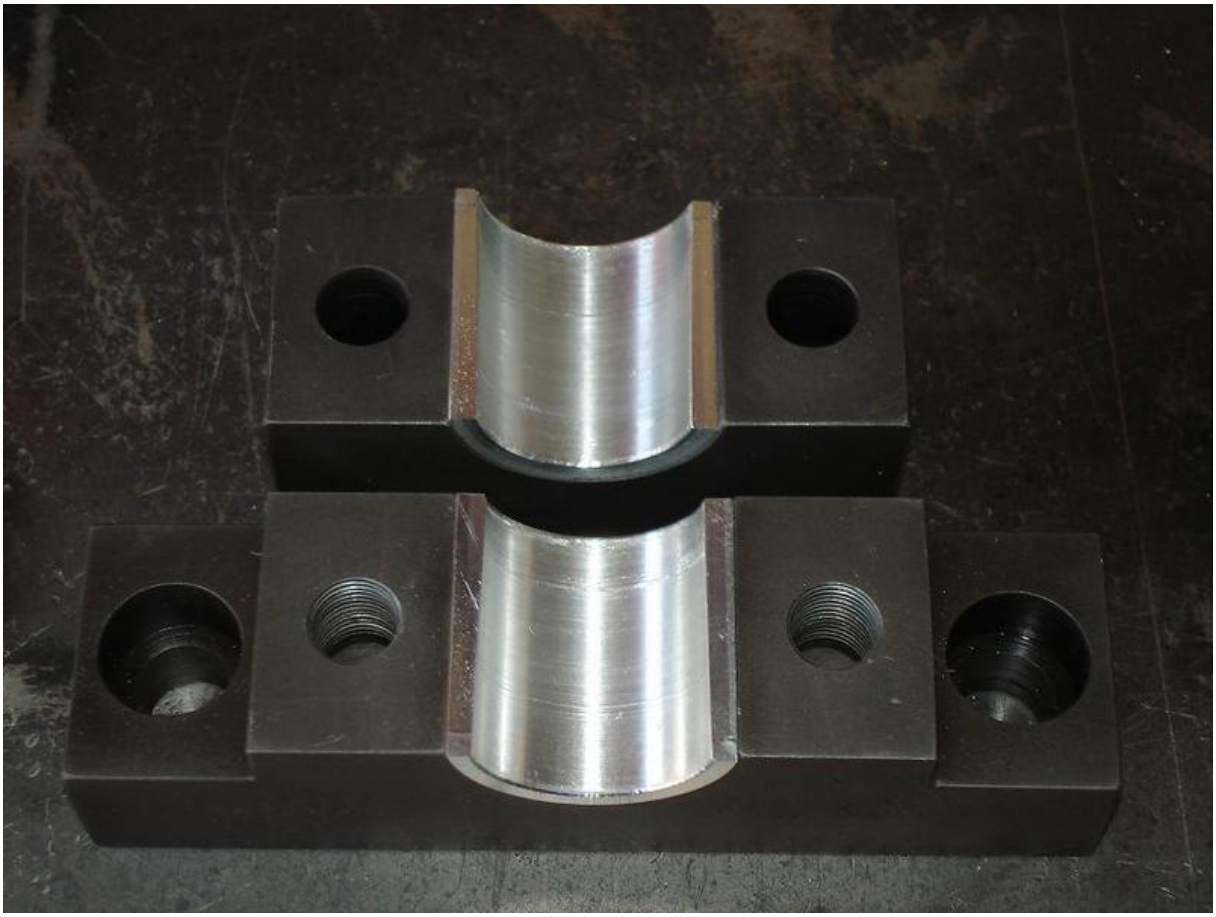
This is the set up I've been using for 30 years.
I use steel bushings and delrin.

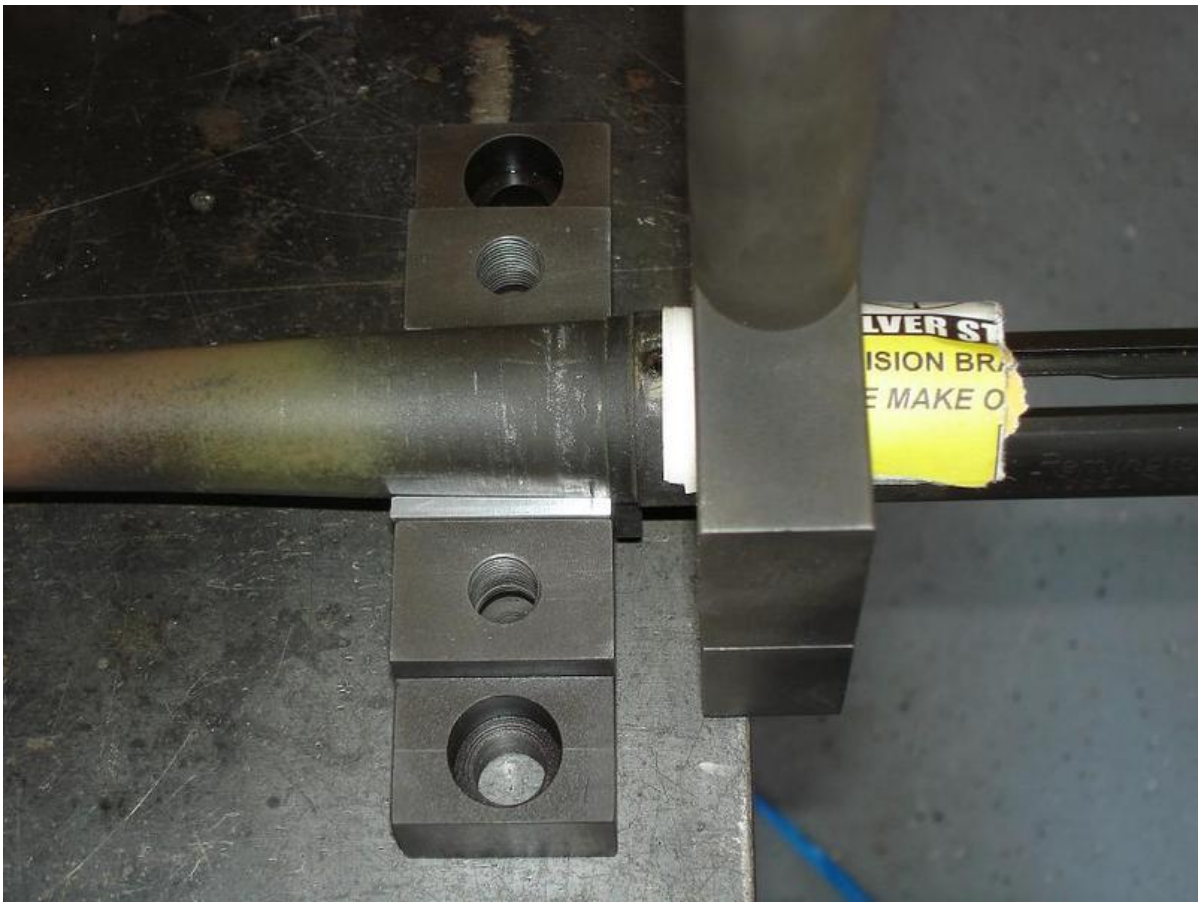
The first photo is staged so one can see the set up. I actually clamp onto the barrel as close to the receiver as possible.

some of your posts had me concerned about removing my first barrel from a 700. I made my barrel vise and action wrench similar to some commercial ones I have seen pictures of. I sprayed some "pb blaster" into the action threads and let it sit while I was making a bushing to fit the barrel contour. it probably sat for an hour and a half before I got it clamped in the vise and wrench. the wrench has a 16" handle and I just gave it one quick hit with the palm of my hand and it broke free. maybe I just got lucky on this one or the pb blaster is some good stuff.

what type of action wrench did you break? here is mine. I think the action would be in bad shape before this wrench broke.



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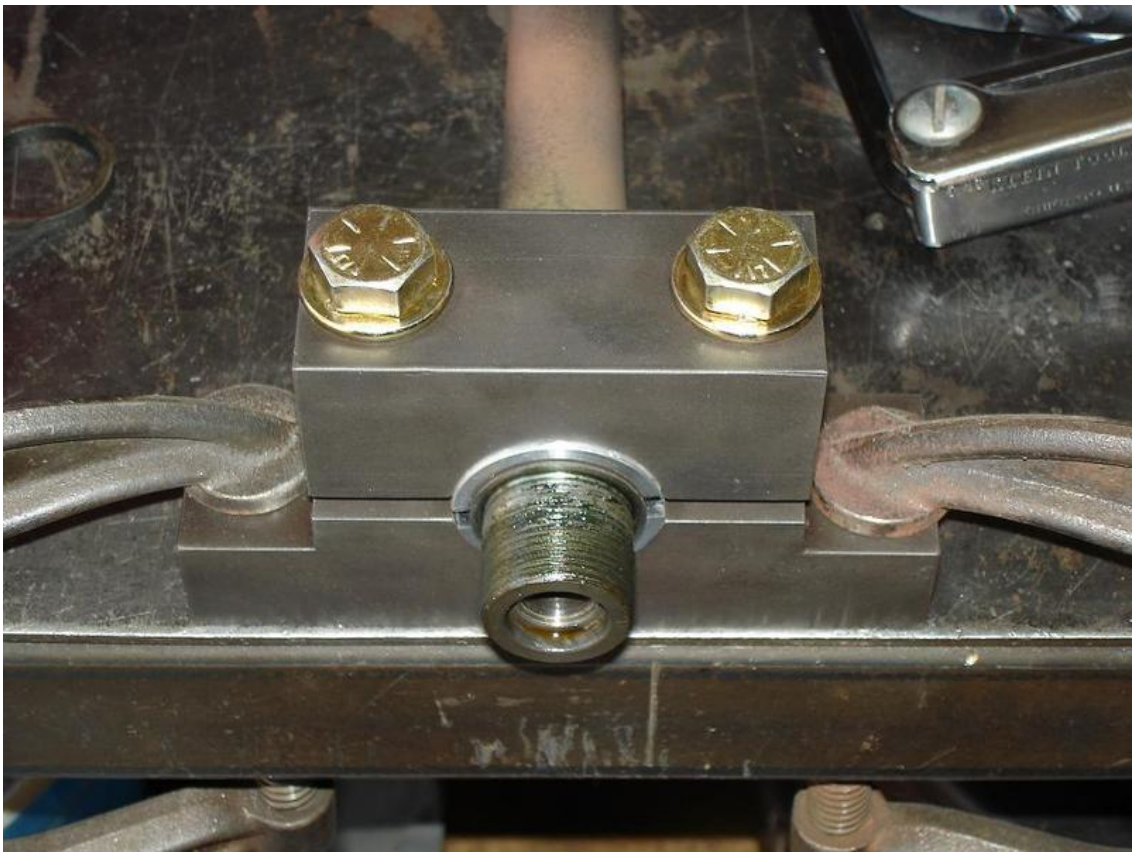
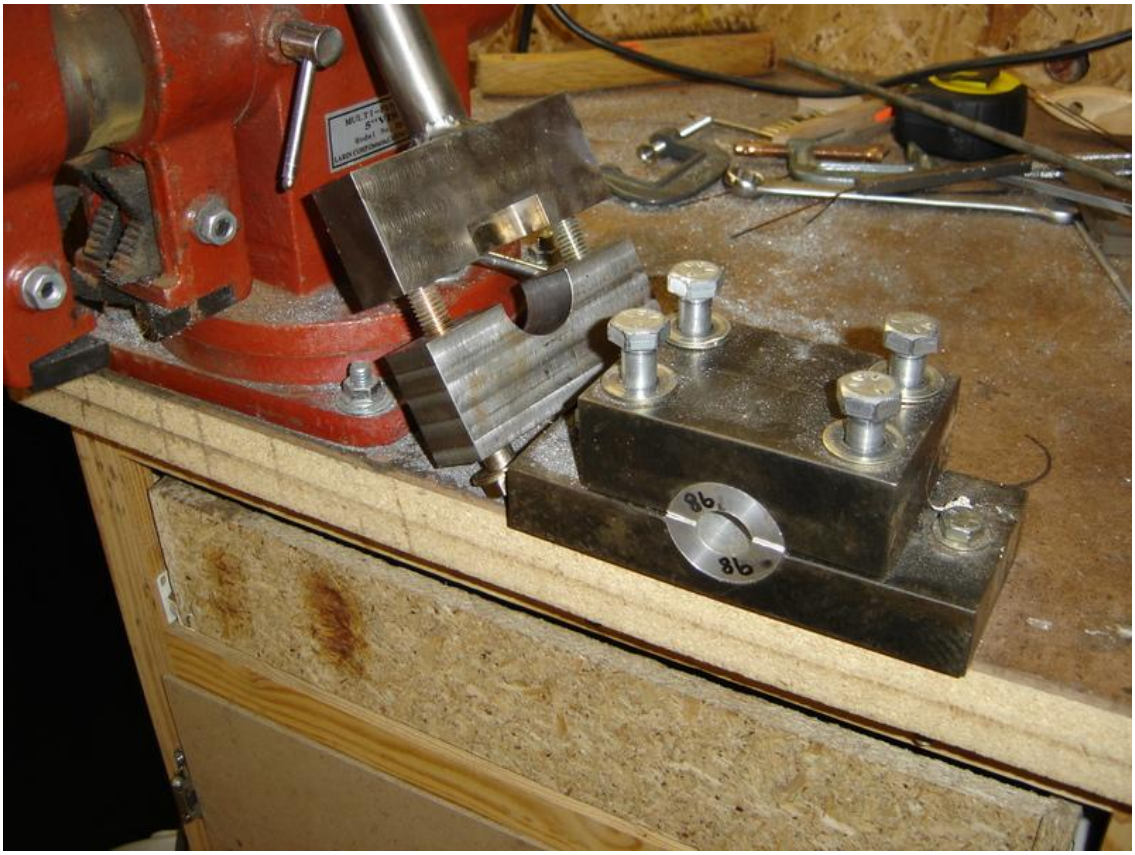


Here's the set up I made. I made the vice years ago and just did the action wrench a few weeks ago. I sized it the same as brownell so I could use their bushings is I didn't feel like making my own. Same thing with the action wrench brownells heads will fit.



Don

---------- EBAY Advertisement ----------

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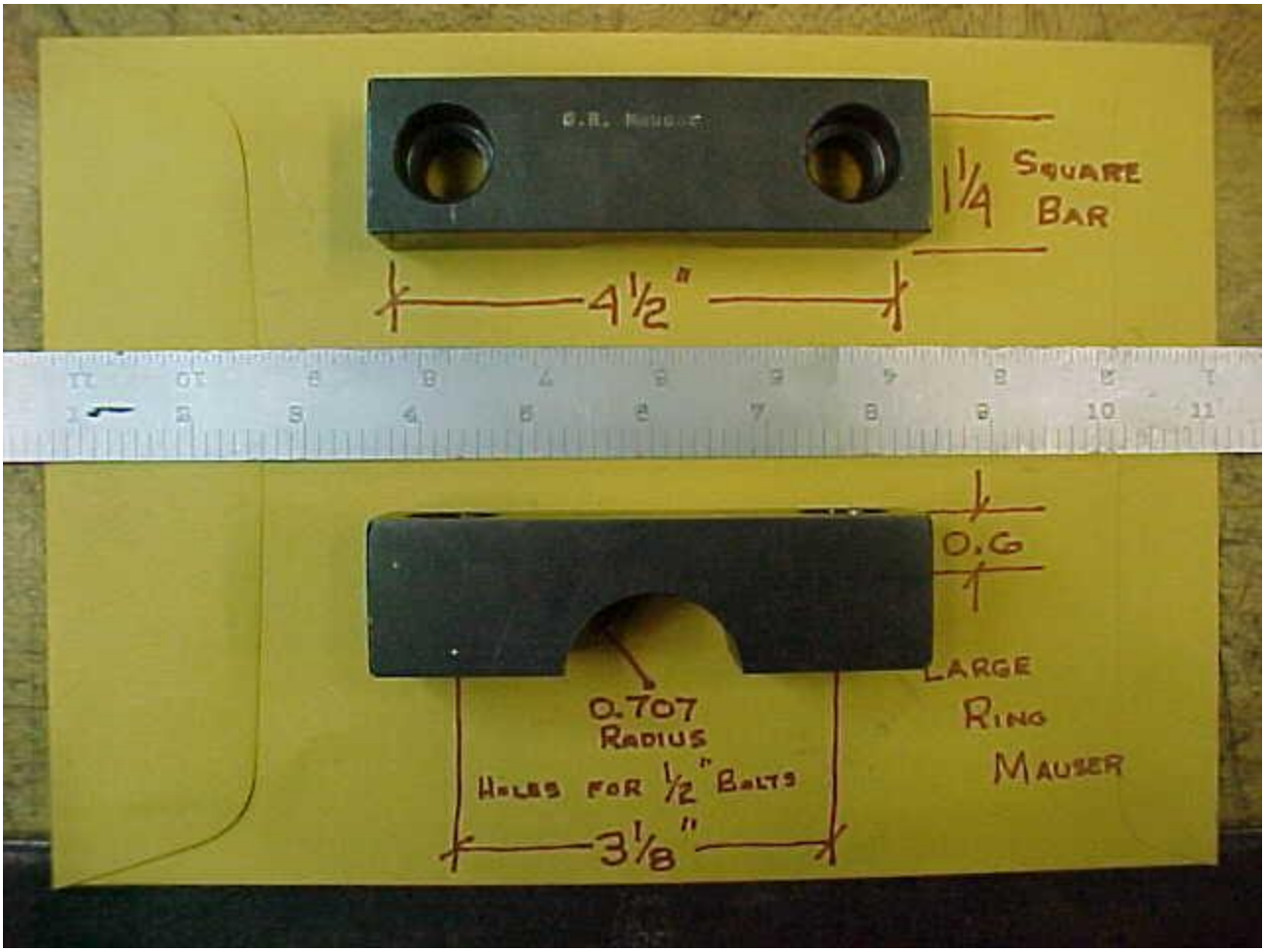
UNCONDITIONAL LIFETIME GUARANTEE on all steel parts

Budget Action Vise (Wrench)

As I have said in the other texts that compose my web site, I think Brownells makes and/or sells the best thought-out gunsmithing items available. I believe that is especially true of their action vise (wrench) system. The "system" consists of a handle and various heads, the heads being selected for the action at hand. The Brownells wrench for the Large Ring Mauser (handle and head), along with a Small Ring Head is shown below. The Large Ring Mauser wrench (handle and head) costs $83, with no discount allowed. The individual heads purchased individually cost $33 each, so it would be fair to say the handle costs $50, even though you will pay $62 if you buy it alone.

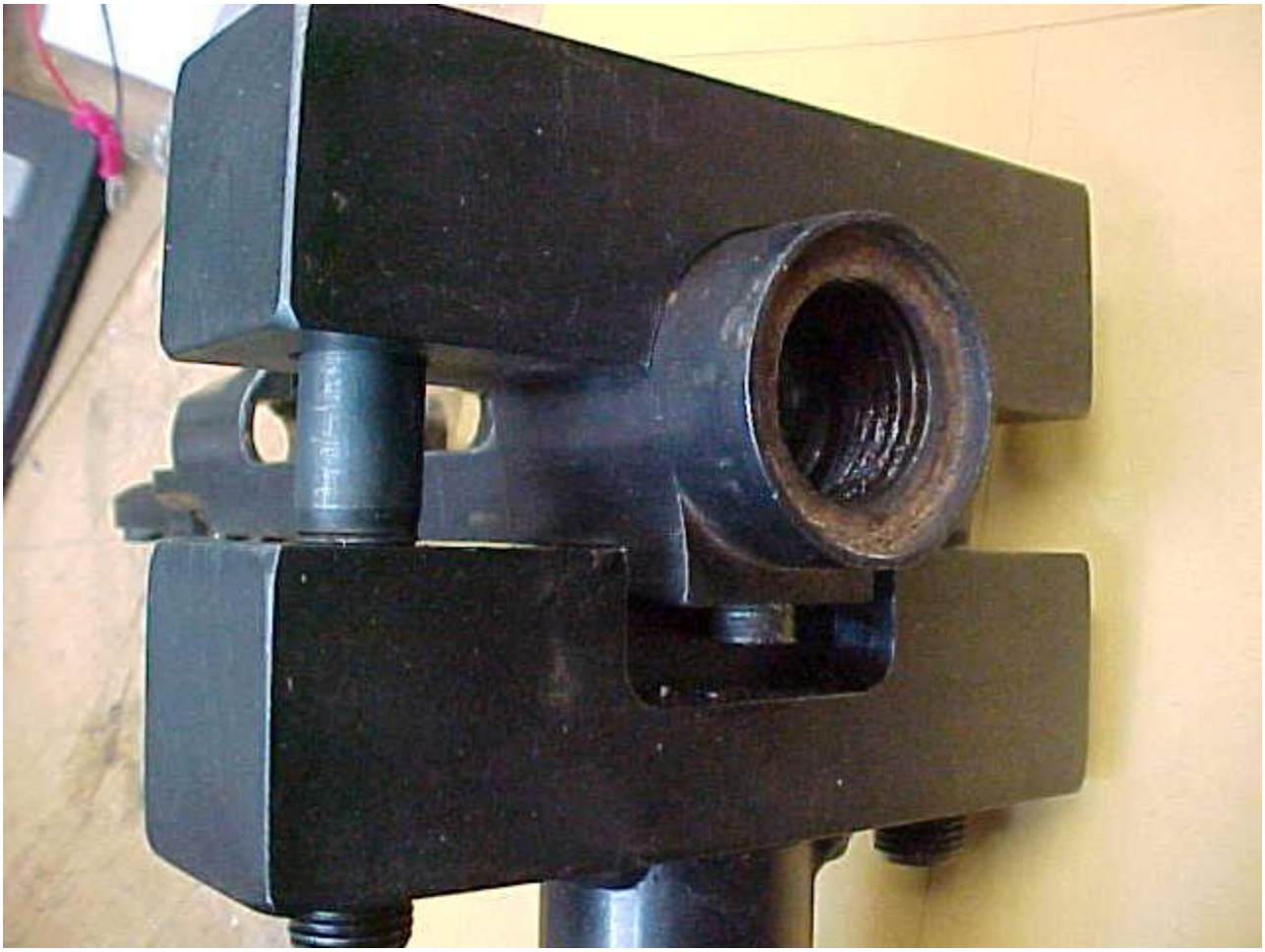
The bolts used by Brownells are 1/2 x 20 tpi socket head cap screws, they take a 3/8 inch Allen wrench. (I think you get a set of bolts with the purchase of a head but it has been too long to be sure **J** .)

If you could make the heads, you could save $33 each.

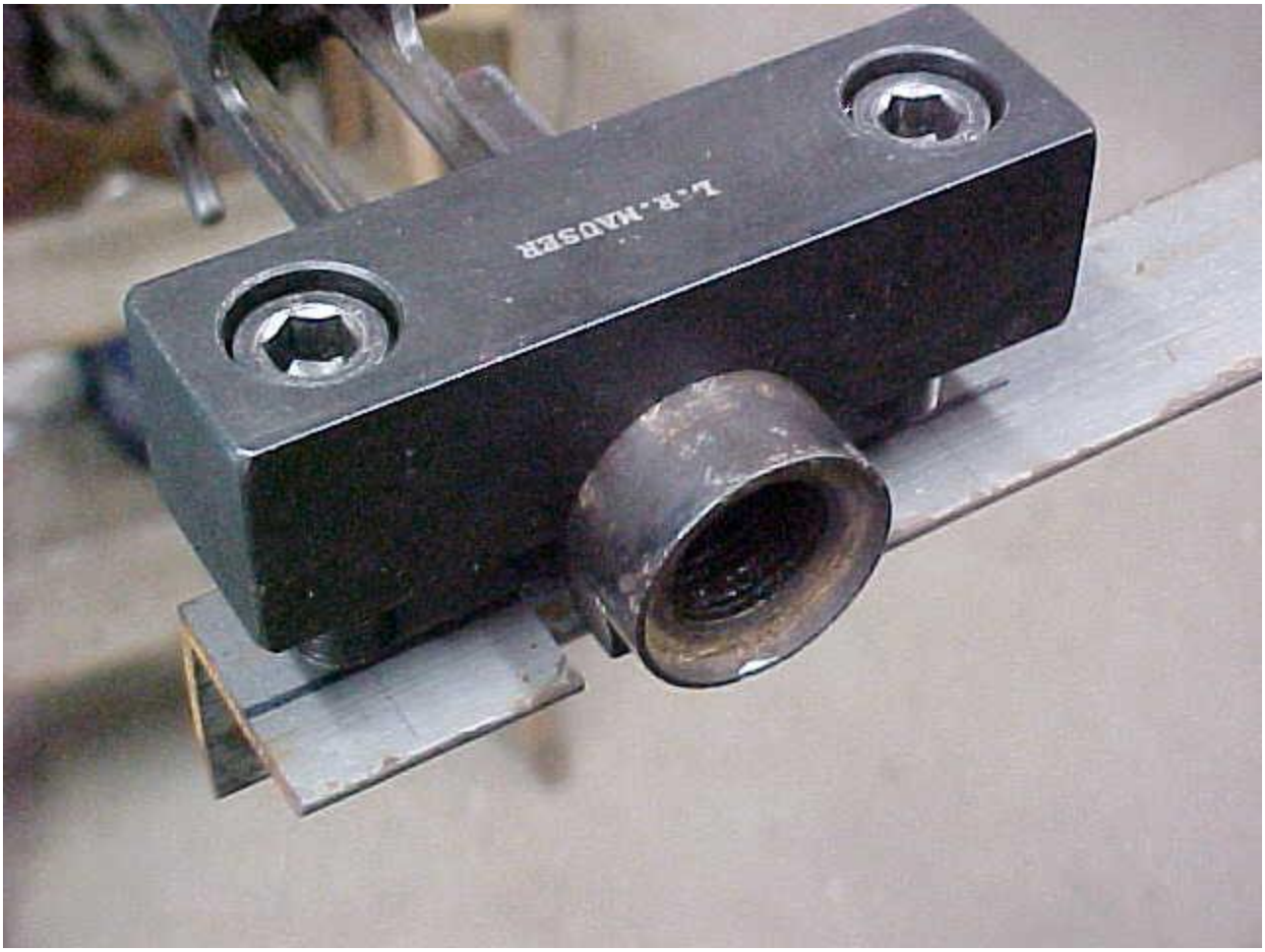


My suggestion is that, if you make your heads, you use dimensions such that you could later buy heads or handles and everything you have made will interchange. After all, if you change/rebarrel enough Turks, you'll be rich, and will be able to buy anything, right? Brownells heads are made from 1 1/4 square bar 4 1/2 inches long. Centered on the bar are two holes, 3 1/8 inch Center-to-Center for the 1/2 inch bolts. Brownells' counterbores the holes for the cap screw heads, a nice touch. Centered between these holes, but on another face, is a partial semi-circle with a radius of 0.707 or better 0.710 inches, with the extra 0.003 inches allowing for an aluminum shim made from a soda can. 0.600 inches of metal remains above the cutout.

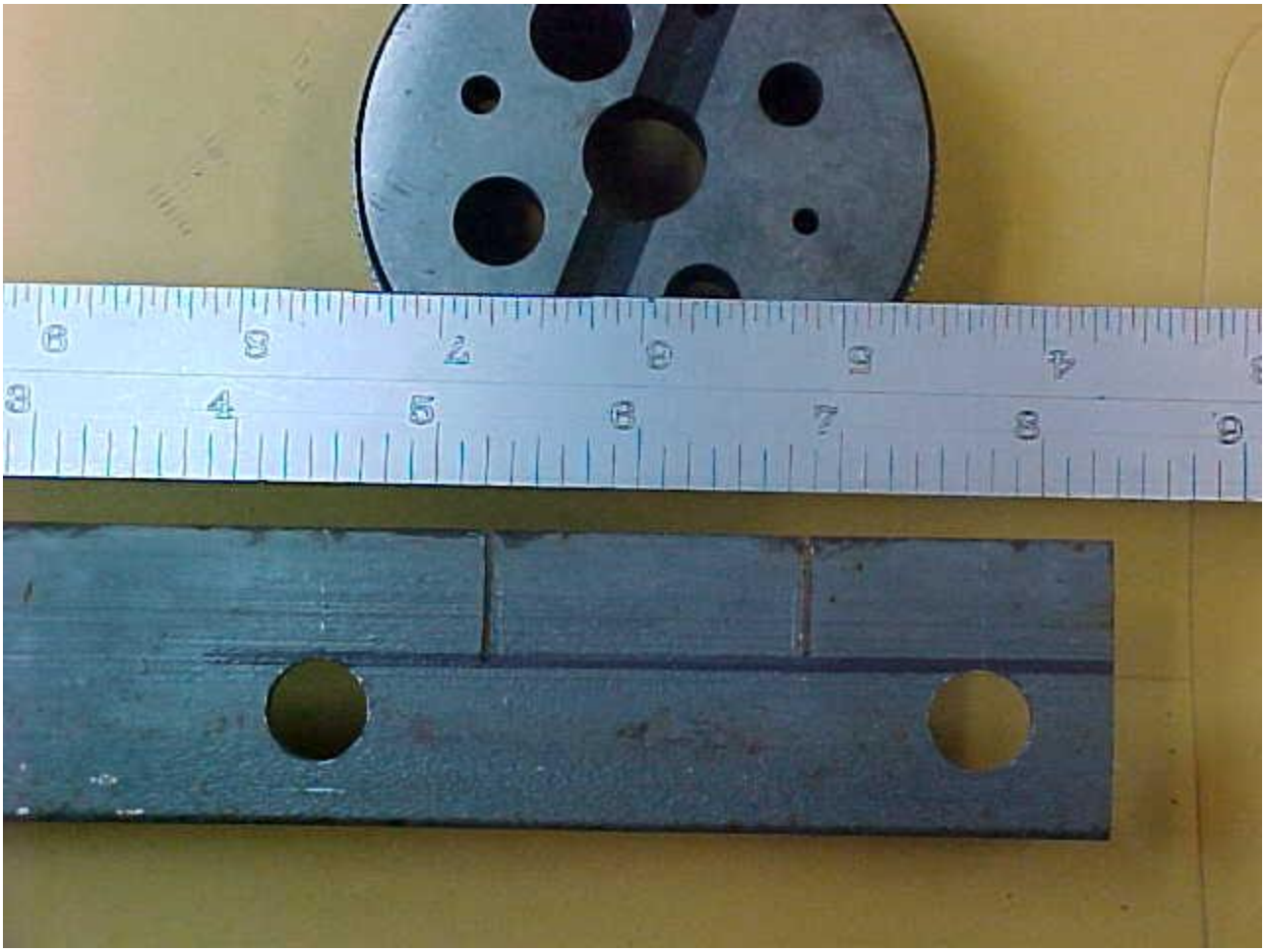
If making a head is not an option, because of insufficient machinery etc, then buy the Brownells head(s) and save $50 my making the handle, that's the easy part.



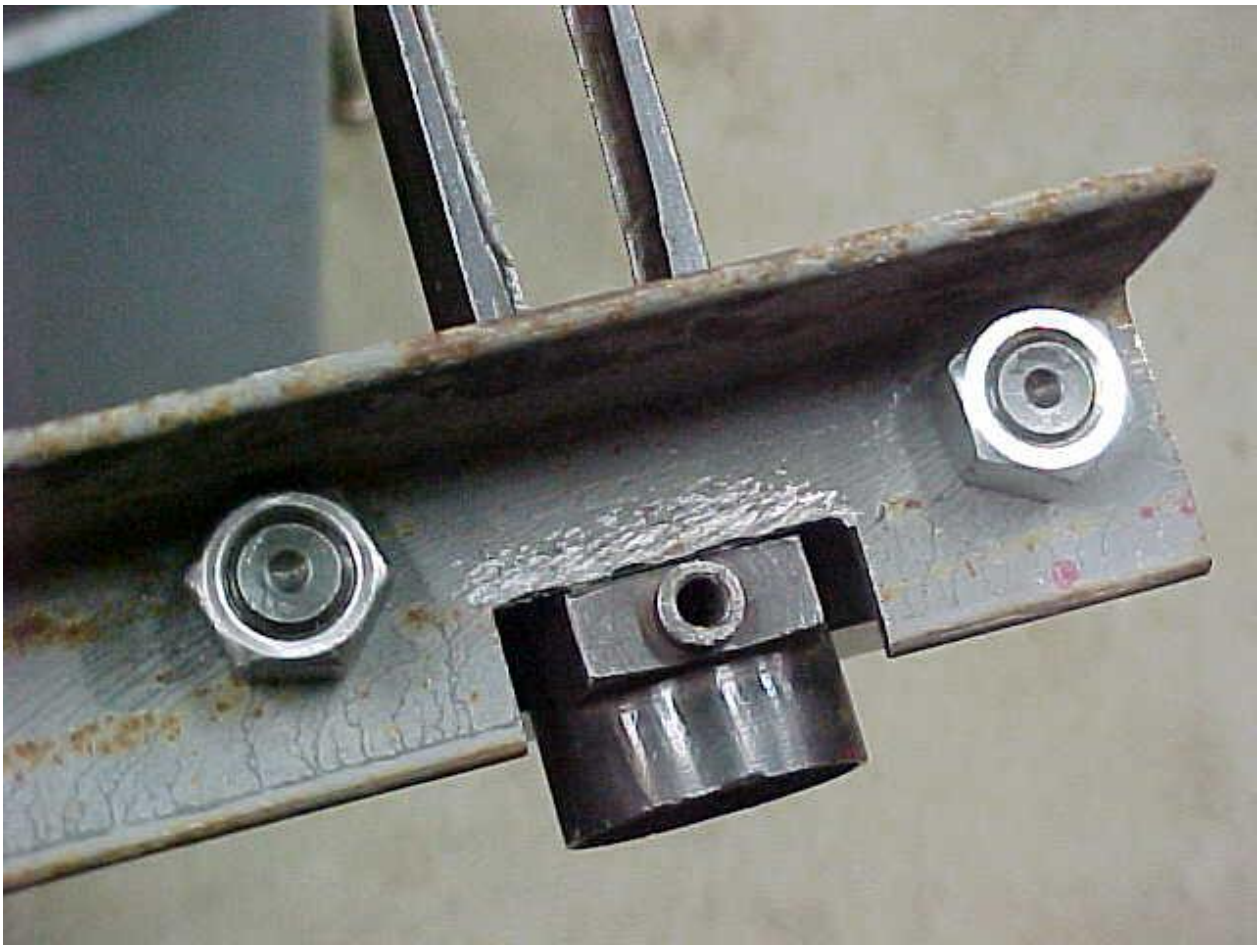
This shows the Brownells action wrench in action. If the action was blued, an aluminum shim could be wrapped around the top half of the action. But, take note of the cutout portion of the handle that allows for the recoil lug. If not for this cutout, the wrench could be made form a solid bar, with two holes, tapped or not, for the bolts.

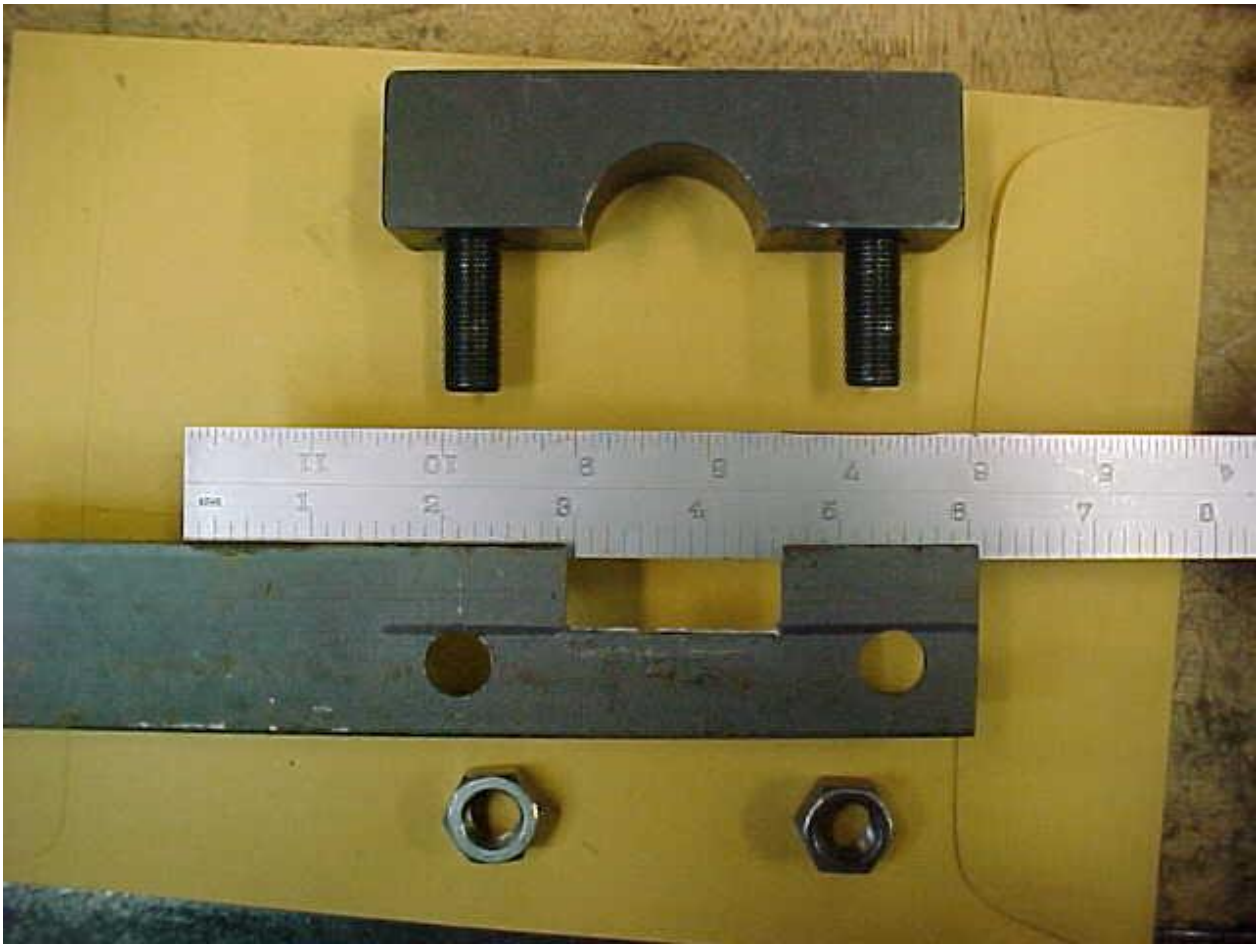


This shows the "economy" handle, just a piece of bedrail, with two holes and a notch. This one is about 3 feet long with the action at the end. If your bench/shop will stand the extra length, use a four foot piece and but the action in the middle. Then two of you can use it, one on each end.



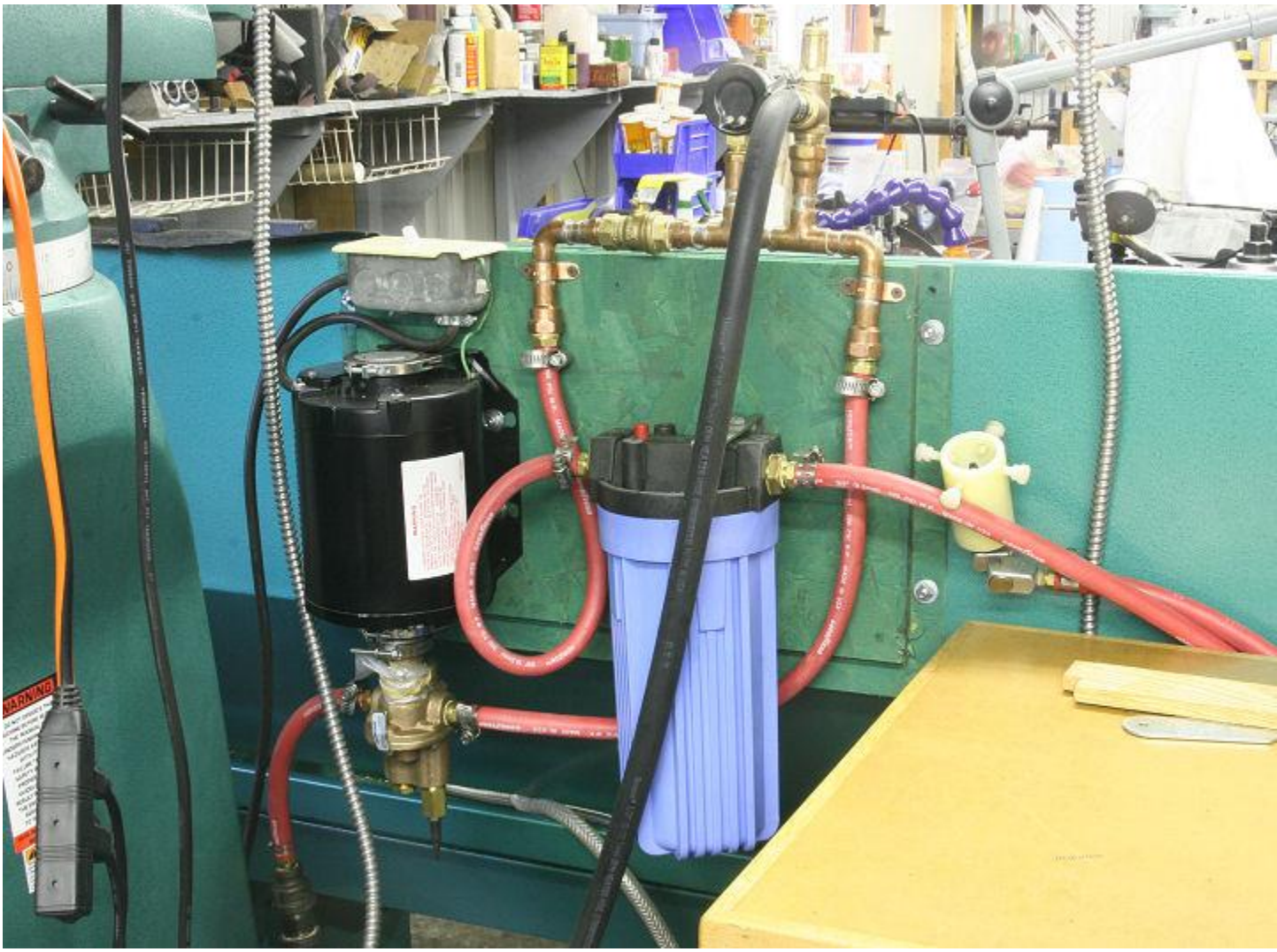
At the end (of the bedrail or light angle or maybe tubing?), or better, in the middle, drill two holes for the 1/2 inch bolts. Drill them as near to the "other" leg of the angle as possible (see below), while leaving room for the nuts-on the underside. Then draw a line so that it just touches the edges of the bolt holes, that's the long black line seen above. Then cut, with a hacksaw, in two places, from the edge of the angle to the line, the cuts being centered between the holes and 1 1/4 inch apart. These are the short lines seen above. Then use a chisel and notch the along the black line from cut-to-cut, grab the piece between the lines with a Crescent wrench and wiggle to-and-fro until it breaks.





These two pics show the underside of the homemade handle, and the pieces that comprise the wrench. You don't have to use socket head screws, and buy nuts to match whatever bolts you are using. Remember, I think the Brownells wrench is great, but don't pass up the opportunity to save money and buy some more Turks. A friend, Neil, gets nervous if I don't get a shipment every 2 weeks or so, says something about it being an addiction.

---------- muzzle flush data ----------



This is my shop made high-pressure coolant flush system used during chambering. The pump (MSC part number 09390774) is a 1/3 horse unit capable of pushing 4.4 GPM at 100PSI. A pressure relief valve (MSC part number 37011921) is used to regulate the delivered pressure and hence flow. The canister filter takes standard 2 inch by 9.75 inch spun filters - I use a 5 micron size. The hose is high quality air hose, and the final connection to the muzzle is made with a coupling unit from Gre-Tan rifles. This system is fed from the lathe coolant pump via a set of valves and a tee. It makes all the difference when chambering, allowing constant feed, without the need to pause and clear chips from the reamer.

I believe the picture will be self explainatory.

Tank is a 15 gallon barrel.

3/4 hp gear gear head pump with bypass.

Return line with ball valve

Line with ball valve to filter, gauge and rotary coupler.

Whole house water filter 2 micron.

125 psi gauge

18 inches of flexible hydrolic line with two swivel conectors.

1 Duff Norton Rotary Coupler.

4 hose clamps and a assortment of heater hose pieces.

WILLIAM AND OTHERS:

I bought 5 gallons of Rustlic 255R about 5 years ago. I have recycled the same coolant for the 5 years. My reservoir is a 15 gallon barrel. Over the years I have spilled a little hear and there. I still had about 15 gallons left in a 55 gallon drum to use to replinish my original reservoir. Yesterday, I topped off my reservoir with about 6 gallons on new coolant from the premix, I had. I could tell a difference in the lubricity both in the reaming and on my arms. After chambering two barrels my hands and arms felt sticky and greasy. Since reamer wear is a concern I may change out my coolant yearly from

here on. I chamber 300 barrels a year and make dies using my flush system. I may have been expecting too much from my coolant. Even though I have not had any problems. Yesterday, I chambered to barrels with a new PT&G piloted reamer. With 30 psi of coolant the reamer cut as fast as I could advance it with the hand wheel. For all but the last .100 I cut .100 and flushed, backing out .100 then reengaging. I had the reamer set .073 short with a Micrometer Adjustable Reamer Stop. When the reamer bottomed out. I reset the Micrometer Adjustable reamer Stop .074 and made 3 reams and flushes watching both the Micrometer Adjustable Reamer Stop and the dial on my handwheel. I stopped and blew out the chamber with air. Then inserted the Go gauge and screwed the action on the tenon. The bolt closed with just slight resistence. I removed the Go gauge and inserted the NoGo gauge. The bolt would not close. The whole process took about 10 minutes. It took me longer to setup and take down than to ream the chamber.

As for the post about pluming the filter before the pump. If your filter gets stopped up then the pump can run dry and burn up. I have magnets in my catch pan. I have a screen to filter out any larger particles. My intake pipe is off the bottom of my barrel by a foot. My 2. micron whole house water filter is clear and I can see a chips building up on the filter. With five years of chambering there is about two inches of chips built up in the filter. I think I will change my filter next week.

Another design change is that I am going to put another T with a ball valve and a air hose quick connect in the output line. This is so when I cut off the lathe, and withdraw the reamer I can blow out the coolant in line.

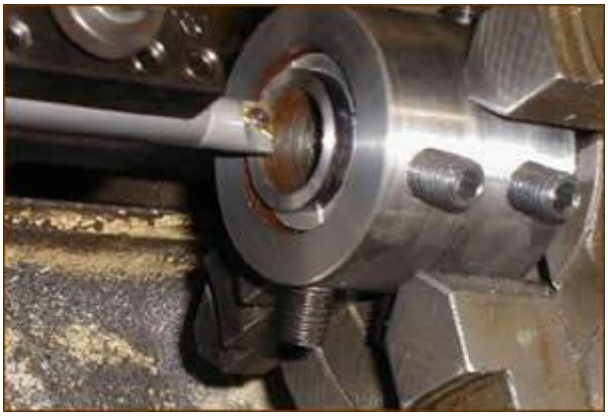
Just thought I would share that with you.

I read on another post somewhere about putting the magnets on the outside of the catch pan. Then when you clean the catch pan just remove the magnets and the chips will be easily cleaned up. Currently I have been wearing gloves and removing the chips from the magnet directly. This is a timely process and often I get chips in my fingers. Thanks to who ever made that post.

This shows the collet that is placed around the receiver to keep from marring the finish of the receiver.

Indicating the receiver bore for minimum run-out. A tight fitting mandrel is a necessity.

Facing the front of the receiver. The receiver is held in the indicating collar.



Set-up to face the receiver locking lugs.

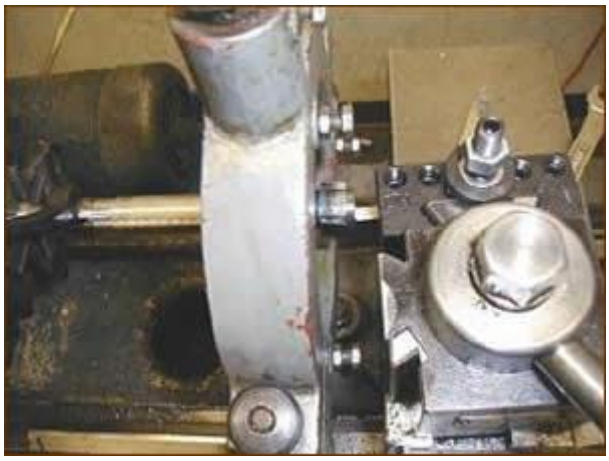
Single point re-cutting the receiver threads.

Drilling receiver to pin Holland recoil lug.

Indicating in bolt body. The bolt is held with threaded ball similar to a construction ball.

Truing the bolt locking lugs.

Adjusting steady rest to true bolt face. The dial indicator is to check that the bolt body doesn't move when steady rest points are adjusted.



Truing bolt face.

The end result of precision machining. Full contact of both locking lugs without lapping on this receiver. If lapping, is required after truing, it will take a very minimal lapping to

make full contact with both lugs.

The threaded ball mentioned in the bolt faceing picture above looks about like a trailer hitch ball except threaded to fit in the rear of the bolt. The normal way of doing this was to thread a rod and screw it into the bolt threads. Then chuck the bolt body up in the lathe and turn the threaded rod down concentric with the bolt body. Then turn the bolt around and chuck it back up on what you just turned down. Every bolt is different and you wind up having to make another one after you have turned the rod down for concentricity several times. The threaded ball lets the bolt pivot and then you can move the back of the bolt back and forth to get the bolt body running true in the lathe. Not very often is the fixture on the other end of the bolt necessary. As long as the bolt body is within a thousandth or so front and back, you'll be fine when you face off the lugs and bolt face. The bolt bodies are not perfectly round especially on actions that have been shot a lot, so you have to use some judgement as to just how close to perfect you can get the bolt indicated. The main thing on the threaded ball is that it ends having to re-make the piece to hold the back of the bolt.

As to a rod to indicate in the center of the action, I like using bushings with the Gretan reamer. One bushing at the rear of the action, one just behind the locking lug area of the receiver. You can make your own bushings in various sizes from .700 to .706 by turning the outside in the lathe and then drilling out the inside hole and finishing it with a boring bar on the same setup. The inside hole needs to fit as tightly as you can get it. The Gretan bushings are 1/2" inside diameter. A 1/2" drill rod would work for the indicating rod.

---------- Another way of truing an action

One method of truing 700 actions

Posted Today at 10:43 AM by Dennis Sorensen

I am posting this to show one method of truing actions to a certain point. Mike Bryant on his website has excellent pictures and descriptions of another method.

A while ago different methods of "truing" a Remington 700 action were discussed. I mentioned I had purchased some tooling and would be testing it shortly… I bought the tooling from Dave Kiff at Pacific Tool and Die in Oregon.

Previously I had been truing 700 actions in the lathe with considerable time involved. This tooling allows me to do the job much quicker and at a savings to the customer.

The test I did was to machine threads on a barrel stub in the lathe and then screw an unaltered 700 action on to this stub.

I inserted tight fitting straight bushings in the front and rear of the action in the bolt race way. The front of the action required a bushing of .7015"; the rear was .7025". I then inserted a ground tool (a long piloted tap) made for those bushings and measured the run out just behind the action as I turned the lathe chuck by hand. It was running out .026".

I then unscrewed the action and using the piloted tap re threaded the action. It removed threads more on one side than the other. Then I used a piloted cutter that removed a slight amount of the tops of the threads and re-cut the face of the action and the locking lug recesses. I had inspected the recess and the lugs were bearing well but a bit harder on the bottom lug and not particularly smooth.

After this threading and facing operation I screwed the action back on the threaded stub in the lathe with the same bushings in the bolt race way. I inserted the piloted tool (same as before) and when rotating the lathe chuck by hand found the run out was now less than .003".
I then set the bolt itself up in the lathe and faced less than .002" of the rear of the bolt lugs. They were quite true. Then I took the bare action and screwed a bolt-facing guide into the action threads. I slipped the carbide bolt-facing tool behind the extractor. It is held there like a shell and I inserted the bolt and the tool into the action and the guide closing the bolt. It is held closed while the bolt facing-tool is pushed against the bolt and slowly turned. This is removed, inspected and redone until the bolt face just cleans up evenly. This assures the bolt face is not crooked to the bore.

Factory 700 barrels can still be used with this method although they require head spacing.

This does not make a 700 into a bench rest action, however it makes it much more accurate with a quality barrel. I feel the end result is as good as setting up and single point cutting in a lathe.

Here are two pictures of the run out, before and after…


Rapid Tap

This is a picture showing although the front and one lug recess are faced true it still needs more facing as the other lug recess is untouched…

Here is one picture of the action with the front bushing still in after re threading and facing.

Here is a different action after very lightly lapping the lugs with 600 grit to confirm the fit. Both lugs have good contact. The only reason the front of the lugs and the nose of the bolt are machined is for a more accurate measurement when fitting the barrel.

Truing and Timing a Savage..

There are about 5 areas to be checked for correctness on any Savage action.

1. The bolt race relationship to: a. action lug abuttments
b. tenon threads
c. action face (90 degrees to bolt face)
d. true up barrel nut
e. bolt diameter (factory bolt.696 aftermarket .700)

2. The bolt body: a. cocking ramp needs to be recut
b. cocking piece pin needs to be fixed
solid with .250 X 28tpi set screw
c. cocking piece and cocking piece
sleeve need to be polished
d. shouldered cap needs to be made
for back of cocking piece sleeve
e. main bolt screw needs to be shortened
then drilled and tapped .250 X 28tpi
then insert a .250 X 28tpi cone point
set screw.
f. firing pin needs to be polished and
adjusted to reduce over cocking
g. use the correct length and weight
firing pin screw

3. The bolt head: a. needs to be hand lapped
(at least 80% bilateral engagement)
b. leading edges need to be radiused
c. firing pin hole should be bushed
d. bolt face trued after the lapping

4. The bolt handle: a. Longer bolt handle for more leverage
b. primary extraction angle checked and
adjusted

5. The sear/trigger hanger: a. shorten sear/trigger pin for excessive
length.
b. deburr inside and outside holes
c. polish contact surfaces

There are more or less things that can be done to a Savage action dependent on the need.

There are about a 100 or more gunsmiths who work on Savages and there are about a dozen who know what they are doing and just as with Remingtons there have and are continuing changes going on all the time.

The new Savage Target Actions are much better than the earlier models but they are not in the class of custom actions. The can shoot just as good at a much lower cost. The number of aftermarket parts

is growing daily.

Rustystud

Savage Bolt Head Change Procedure

INTRODUCTION:

The use of a barrel locknut to set headspace by Savage makes the replacement of barrels by the hobbyist or mechanically inclined shooter simple. The Savage 110 family of rifles (110, 111, 112, 116, 10, 11, etc) can be rebarreled without the use of a lathe, or chamber reamers. It is possible to even change calibers as long as the case head sizes are the same. For example, if you have a 30/06 rifle you can easily rebarrel to a host of calibers from 22/250 to .35 Whelen, although some tweaking of the magazine may be required.

However, if you wish to change to a caliber with a different case head size, the easiest way to accomplish this is to change the bolt head to one of the correct case head size. The accompanying photographs show the change of a Magnum bolt head for a .223 Rem bolt head. (Note there are two types of push feed bolt heads - check here for more info.)

STEP 1: REMOVE STRIKER ASSEMBLY

The bolt shown above has an Allen (Hex) type bolt assembly screw. Older models are provided with a simple slot. Unsrew it all the way out. You may want to mark the bolt handled and body to simplify reassembly.

The cocking peice sleeve which retains the cocking peice pin can now either be removed (older models) or moved back so that the cocking peice pin can be removed from the striker assembly as shown below...

With the pin removed, the striker assembly can now just slide out.

Here is the striker removed. The pin and sleeve have been put back on the striker so the parts don't get lost.....

STEP 2: REMOVE BOLT HEAD PIN

Mark the position of the pin in the bolt by drawing a line with a permanent marker on the bolt throug the pin.

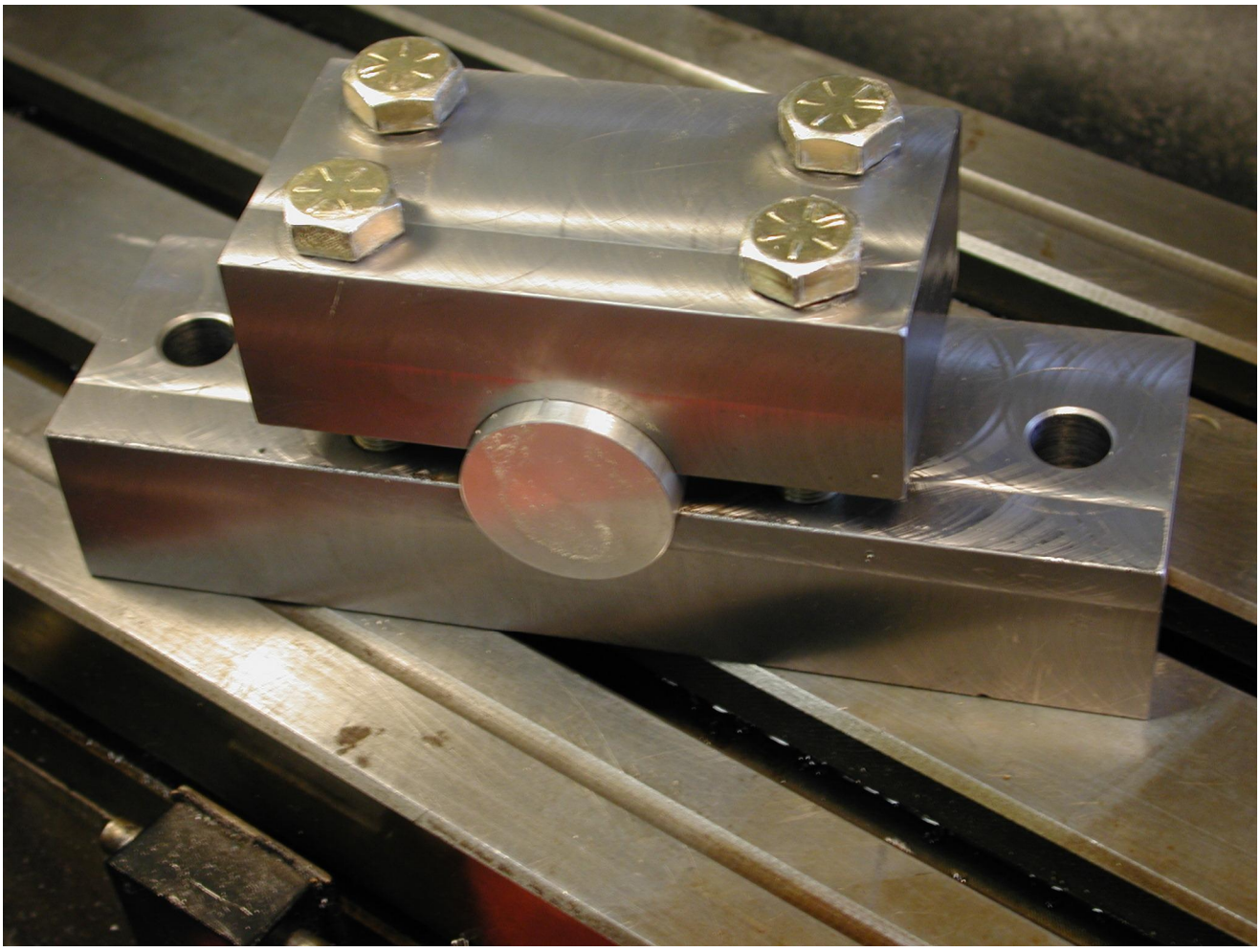
By pushing the bolt head in towards the bolt it should be possible to push the pin out of the bolt.

Here are the parts layed out along withthe new bolt head. Note the spring washer between the baffle and the bolt body. It provides spring tension on the bolt head to retain the bolt head pin when the striker assembly is removed.

To reassemble replace with the new bolt head, push the bolt head towards the bolt body and insert the pin. It may be necessary to tap the pin in lightly. **Make sure the pin lines up with the line you drew before so that the firing pin does not bind on the pin!!** Before reassembling the bolt screw and handle (but with striker pin inserted) , check the firing pin protrusion (with the srtiker all the way down) with a caliper or micrometer. Protrusion should be ,052-.060 inch. Protrusion can be easily adjsted but requires dissambly of the striker assembly.

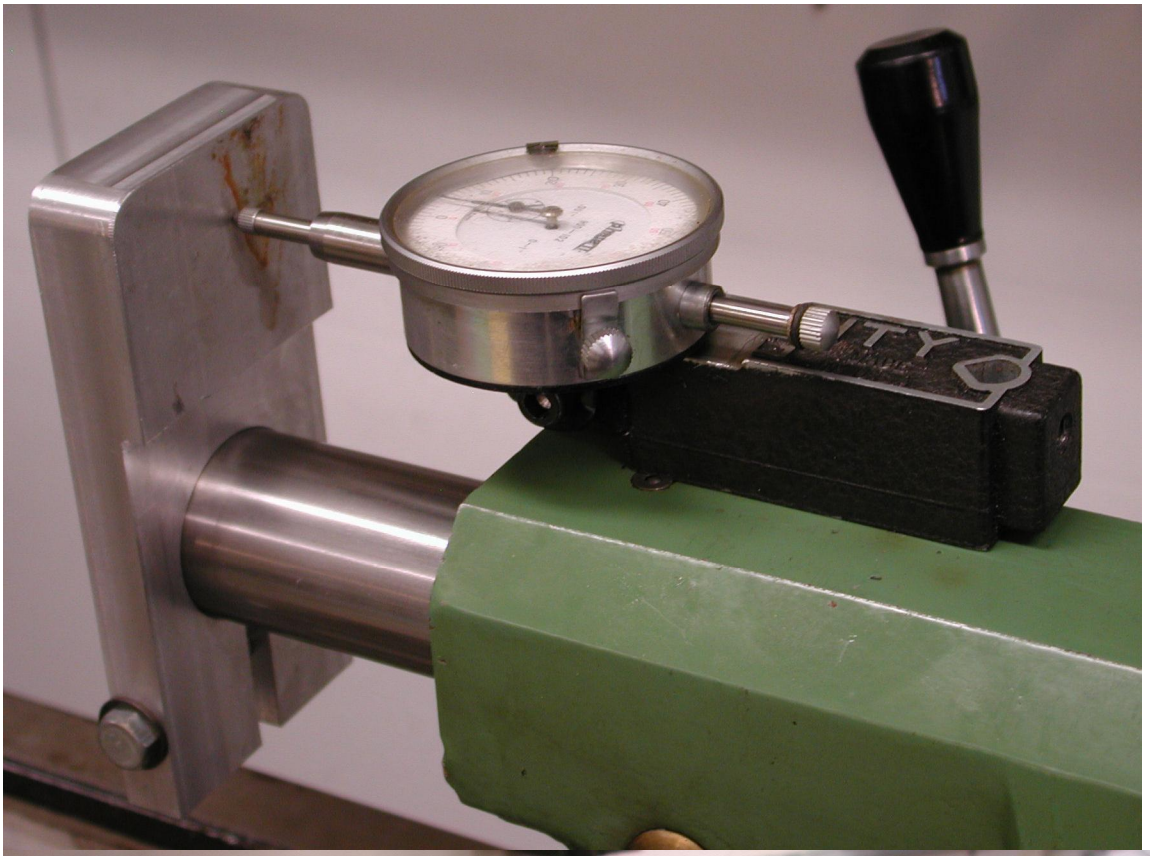
The tooling I have made so far based on studying the material above, reading John L. Hinnant's book "The Complete Illustrated Guide to Precision Rifle Barrel Fitting, and watching Richard Franklin's video on "Metal Working for a Rifle Smith".

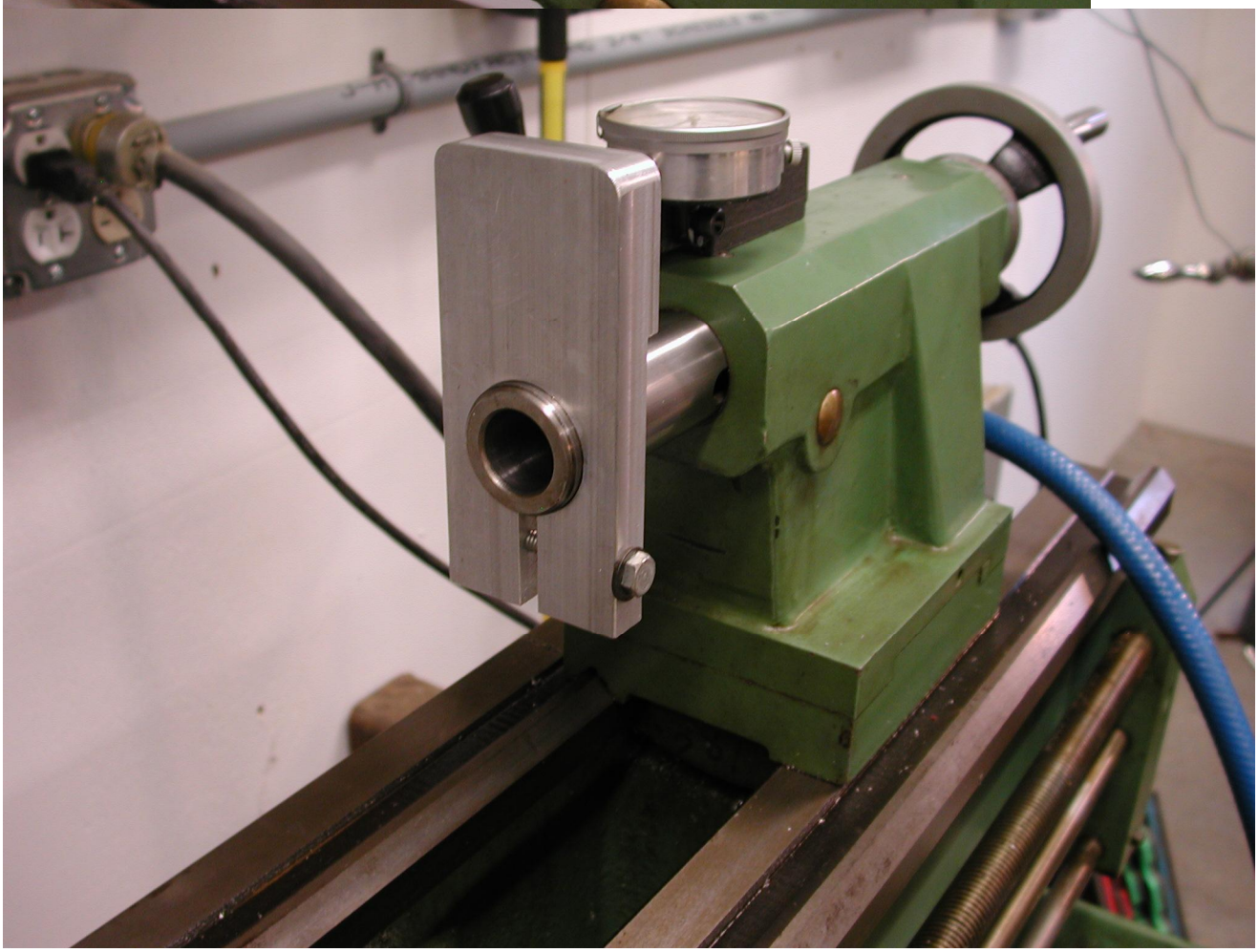
The Barrel vise. This is made from 1-1/2" x 2-1/2" bar stock that I picked up off the drop rack at the local welding shop. The bolts are 1.2"-20 Gr-8 and can be torque to 90 ft-lbs lubed which puts a total of 40,000 pounds of crush on the barrel. The center hole was machined to be 1-1/2" in diameter when the parts were separated 3/8". I plan to machine custom inserts to fit each barrel, then slit then in half.



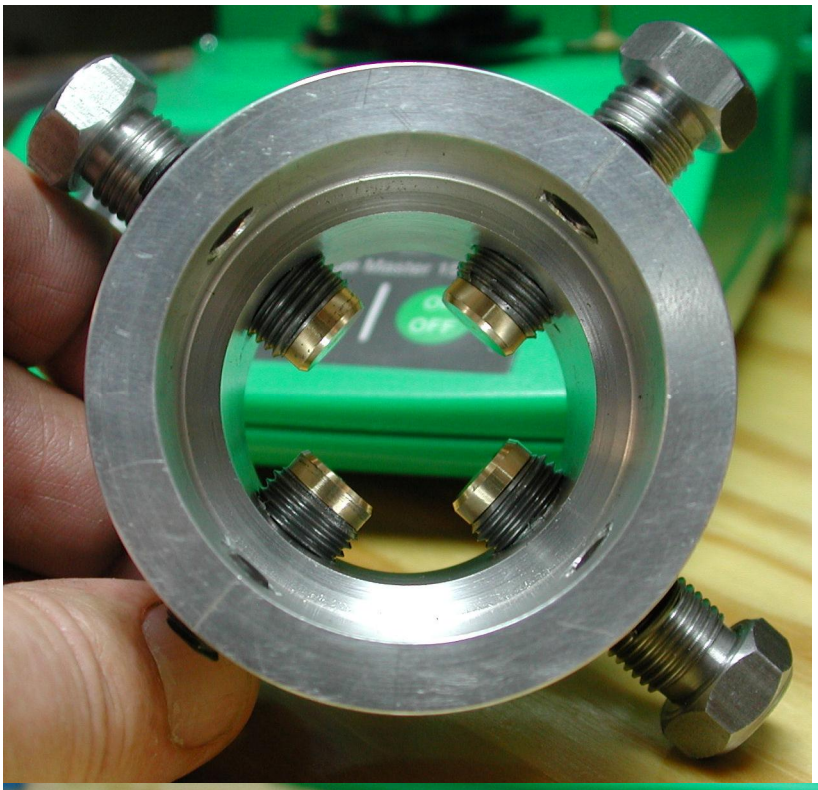
The mounting holes were drilled 9/32" to use ½" mounting bolts. The base piece is 8" long.

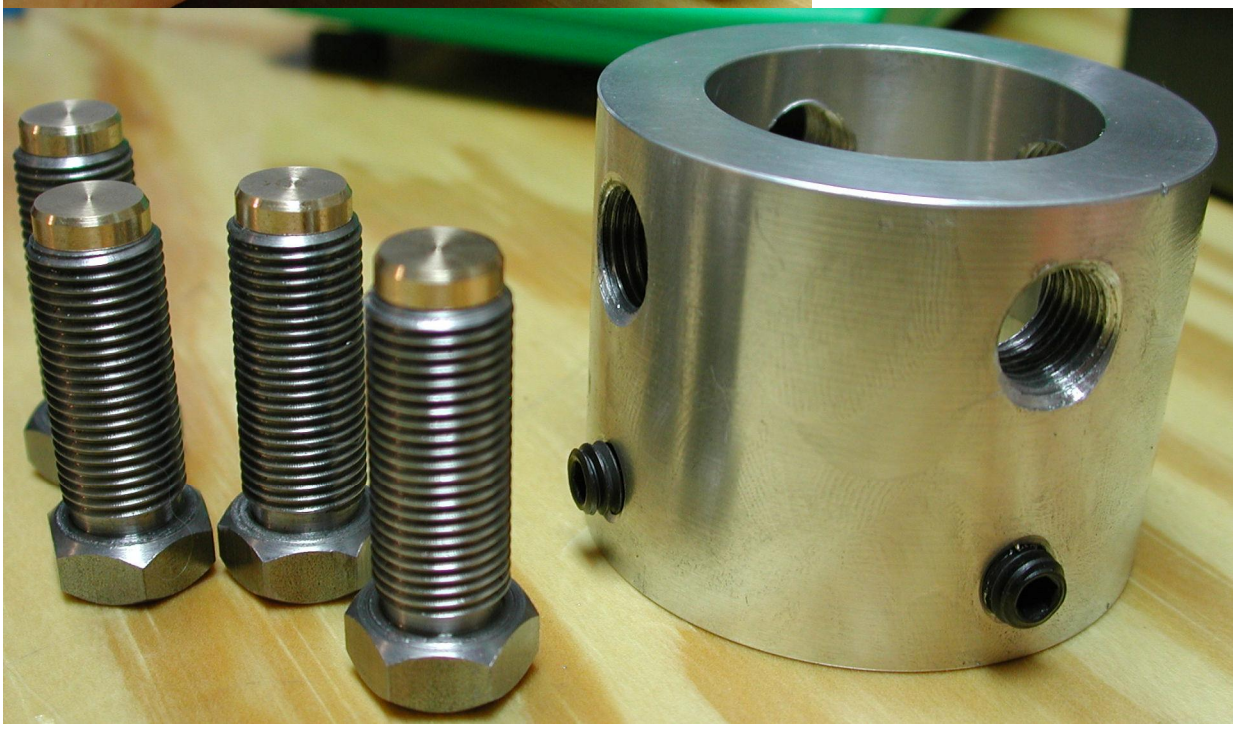
This is the bracket I made to go on the tailstock ram so that I could use the dial indicator to measure ram travel. I had to machine the magnetic holder to clear the back of the dial indicator.



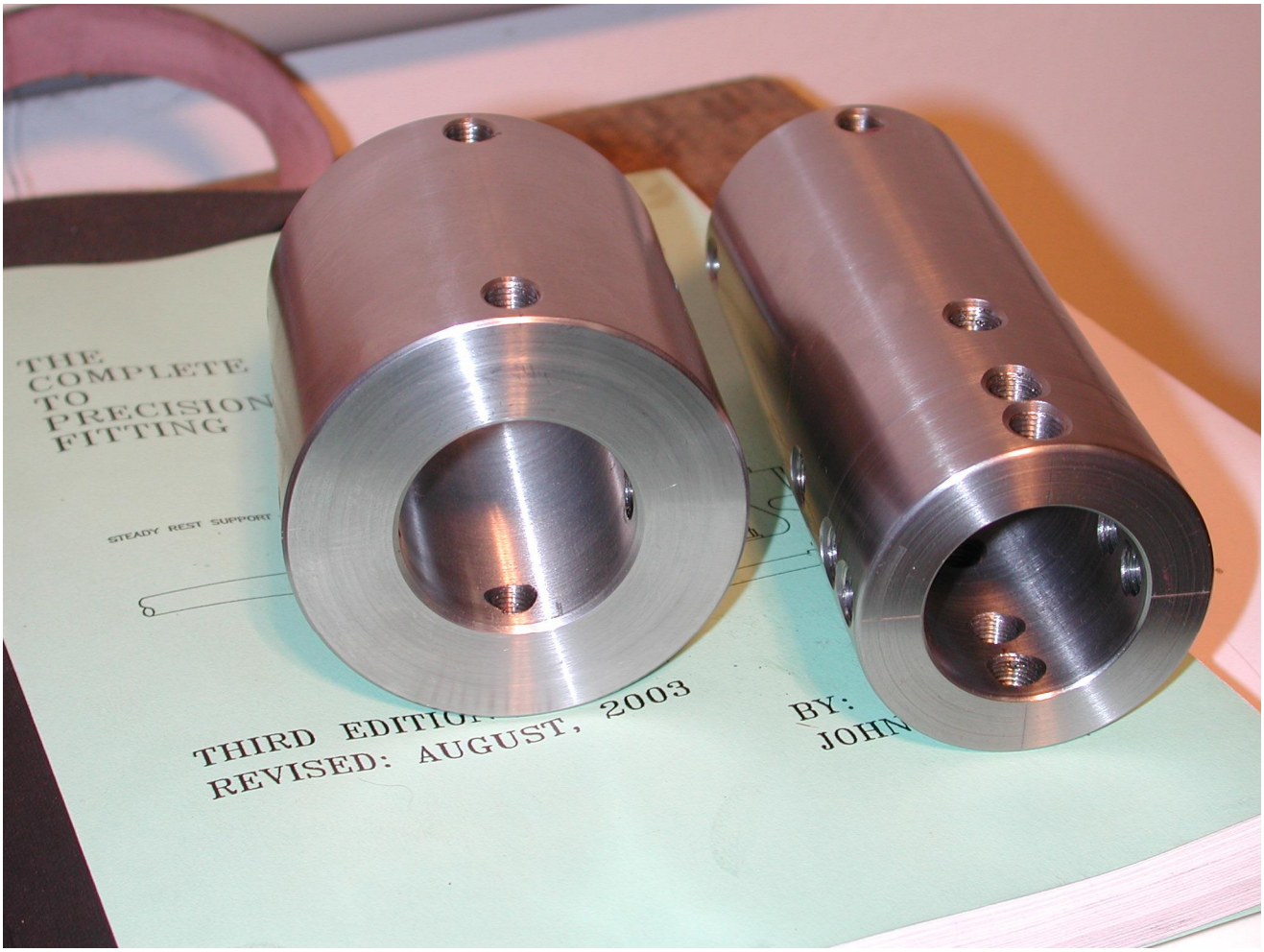


This is the “Cat Head” or Spider I made to go on the back end of the spindle.





These are the sleeves I made for truing actions.



This is the Spider chuck I made that bolts onto my 4J backplate. It is easy enough to swap the Spider Chuck and the 4J chuck, it doesn't happen very often, so I didn't spend the money to buy a separate backplate. The chuck body is 2 cleanup cuts less than 1-1/8" thick, a cleanup cut less than 6" OD. The center hole was bored 2" in diameter. The mounting bolts had to match the original chuck so they are M10x1.5-50mm long. The Spider bolts are 3/8"-24 x 2" Socket Head Cap Screws. I machined a dog point on them so that they wouldn't expand and capture themselves in the chuck. I may later add a brass tip to a second set of screws. The holes for the Spider bolts were counter bored to to leave ½" of threads. This permits the screws to clamp on something 1/5" in diameter or screw in till they touch in the middle and still never protrude outside the OD of the chuck body. Safety first!