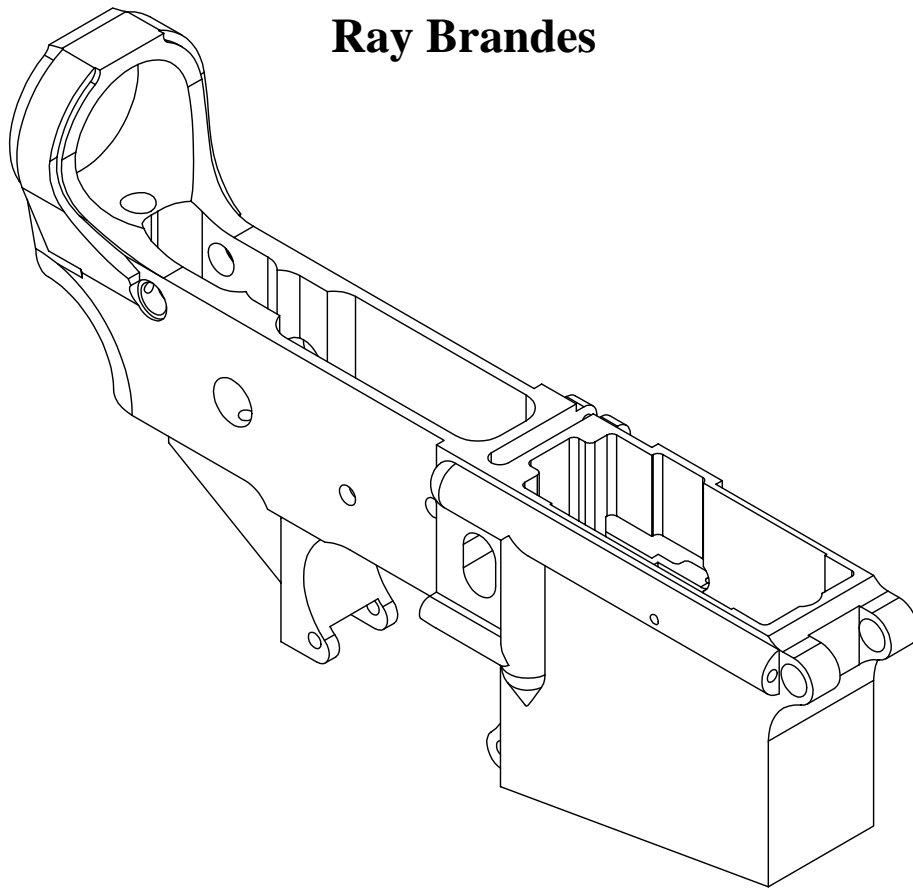


# **Machining the AR15 Lower Receiver Forging**

by

**Ray Brandes**





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First Edition

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This book is dedicated to my best friend and loving wife  
Vincentine “Ruby” Brandes

I would like to thank the following people for the help they provided in making this book possible:

Frank White - Compass Lake Engineering  
Bruce Funk  
and all the members of AR15.COM

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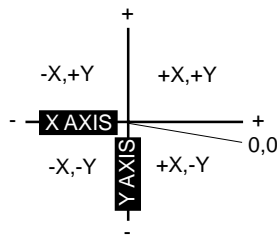
# Chapter 1

## What you need to know

In this book I will explain in simple terms just how I go about machining an AR15 lower receiver from a forging. When I first looked at the blue print for the Colt lower I was overwhelmed by the complexity of it all. Now, after successfully machining several, it is nothing more than the combination of many small, simple operations.

First of all cutting metal is the easy part of being a machinist. The difficult part is holding the work and locating the cutting tool relative to the work. These two things together are called the setup. We will use 10 setups to finish our lower.

I use a Bridgport style milling machine with a digital read-out (DRO). With the DRO it is very easy to work using Cartesian coordinates. If you don't have a DRO, you can still do it, but it will take you a little longer and you must guard against positioning errors. Each full turn of the handle is usually 0.200" and the usual method for moving to a position is to count turns. You won't make an error of a few thousands, it will be .200" or one full turn of the handle. Always touch off your drill and then check with your scale before putting in the hole. When setting your position always come to the mark by turning the handle clock wise to eliminate backlash errors.

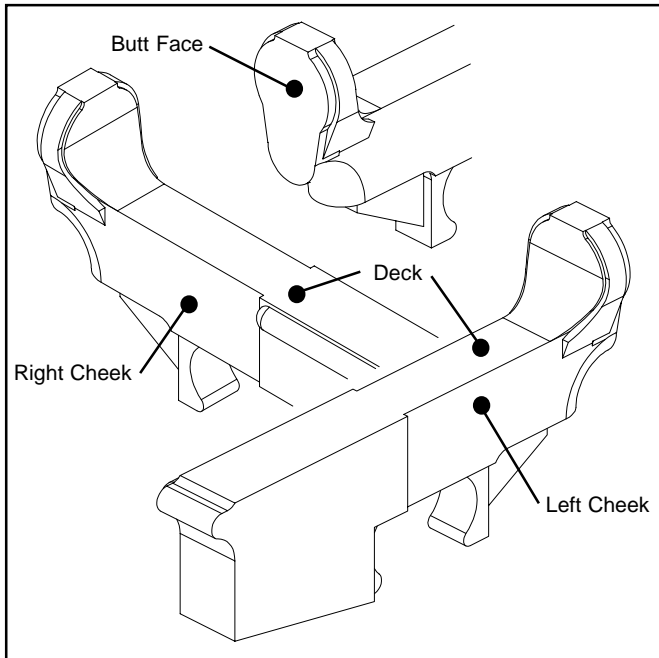


Throughout this book I will maintain certain conventions. When a position is noted it will always be the X axis first followed by the Y axis. The X axis runs left to right and is the long axis on your milling table. For example, if 0,0 is the pivot pin hole location, then the take-down pin hole will be at 6.375~-0.00.

There are some special tools you will need to follow my method of doing this project. A 1-3/16 x 16 tap for the buffer tube is a must. Also a long 3/32 drill and a long 1/8 drill. Also a long 1/4" center drill for spotting the buffer retainer hole.

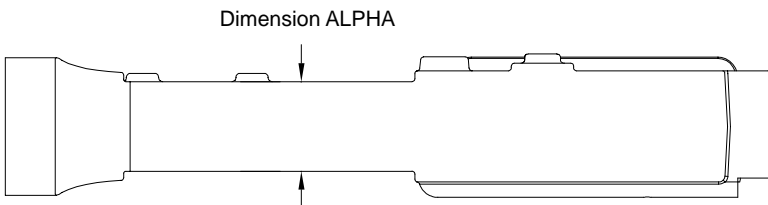
It is also recommended that you have all the parts for your lower on hand to check for fit and function as the project progresses.

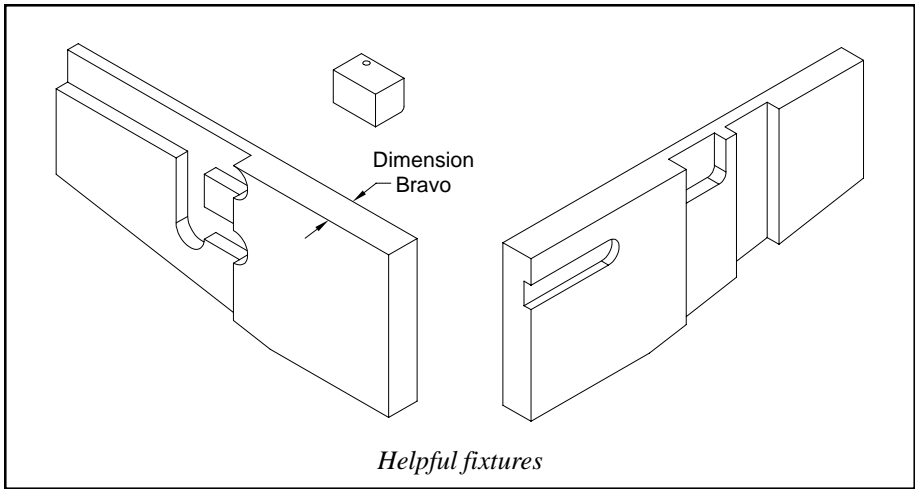
There are some key surfaces on the lower that will be called by



Named Faces

name because we will be referring to them often in the text. The deck is the main flat surface that mates with the upper. The butt face (don't laugh) is the face that the buttstock mates against. The left cheek is on the driver's side and is the face where the trigger & hammer pin holes will be. The right cheek is on the opposite side. All forgings are not the same. Measure across the cheeks and record this dimension. You may want to take several readings and use the average. I will refer to this as dimension Alpha.





Before you start cutting on your forging, there are a some fixtures you will need to make. One is a pair of clamping pads to support and hold the forging for several setups. The other is a little drill guide that takes the heart-burn out of putting in the bolt release pivot pin hole. Drawings for all of these items may be found in the back of the book, figures 1, 2 and 3. Take the time to make them now. You will regret it if you don't. After you finish the passenger side clamping pad, measure and record dimension Bravo.

Another thing to keep in mind is your serial number. If you are going to stamp the number in it is best done while the forging is solid rather than when it is all hollowed out for triggers and magazines. The BATF does not require a serial number, but they recommend you mark the receiver in such a way that it can be returned to you if lost or stolen. It is better to have a number on the receiver than to try to explain to the arresting officer that it is legal for you to have a weapon without a serial number! The alternative is to take your finished receiver to a trophy shop and have them engrave it to your specifications.

This book is offered for educational use only. It is the users responsibility to determine if finishing an AR-15 lower receiver is allowed by law in their state and municipality. The author and publisher assume no liability whatsoever.

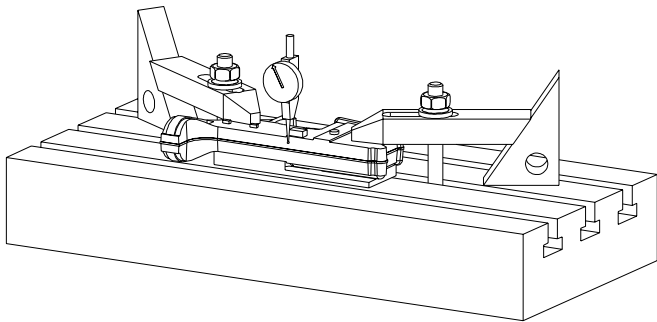
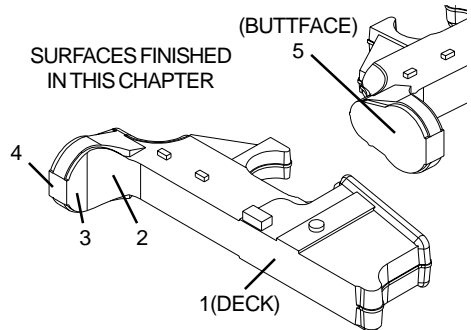


# Chapter 2

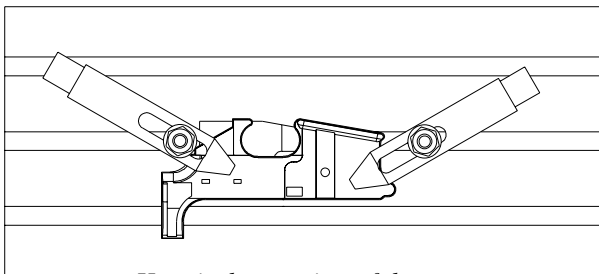
## The First Setup

With forgings (as well as castings and weldments) that require final precision machining, the big problem is where to start. If you cut too much off of one side, there may not be enough material on the other side to clean up and now you have one expensive piece of scrap. It is like cutting a diamond. You must make the first cut just exactly right in order for everything else to fall in place.

This chapter takes you through the first setup and the first, and most important, cuts. When you complete this chapter, you will have five finished surfaces on your forging.



Begin by clamping the forging to your milling machine table using the passenger side clamping pad. Then indicate the forging true to the x axis.

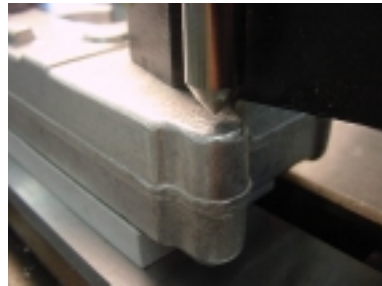
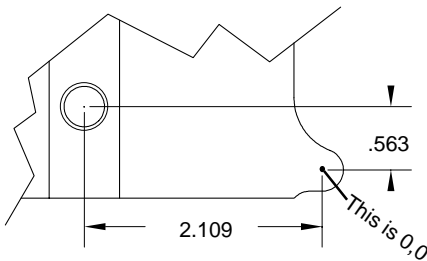


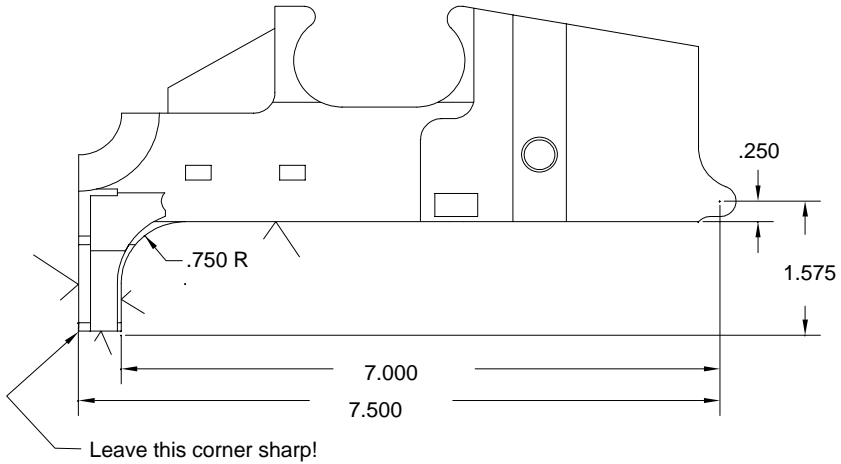
*Here is the top view of the setup.*

Now the forging is parallel and aligned to the table in the x axis. We will now cut the five surfaces. But, first we have to locate the piece in order for our machining to line up with the various features on the forging.



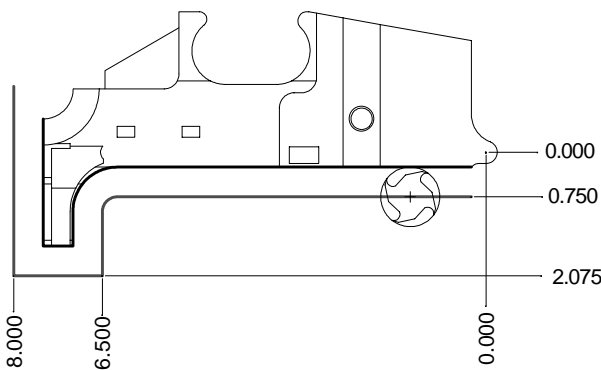
I like to pick up the round boss where the magazine catch will go. This is a good feature to locate on as it will give both x and y. Use a center and center it on the boss. You can easily get within .005" by eye. Zero you digital read out. For those without DRO's, it will take you longer and you will have to be more careful, but those are your only handicaps. Move the spindle to the pivot pin hole location and check the alignment with the forging. If it looks good make this position your absolute zero.





Above are the five surfaces to finish in the first set-up or hold. I use a 1" endmill because it makes for easy math. For the 3/4" radius I x-y it with the 1" endmill in 18 steps (5 degrees each) and it comes out very smooth.

Nothing more needs be said for experienced machinests. However, I will add somethings for the benifit of the beginners. Since you will be working close to the table, set your spindle stop to keep the cutter from hitting the table. Don't try to take off all the metal in one cut. Take rough cuts and leave about .010 for the final cut. A light final cut will deflect the cutter less and give you a better finish. When you think you are finished cutting, clean all the chips away and take a look at your work.



X	Y
-6.250	-0.750
-6.270	-0.750
-6.291	-0.753
-6.311	-0.757
-6.331	-0.763
-6.350	-0.771
-6.368	-0.780
-6.386	-0.790
-6.403	-0.802
-6.419	-0.816
-6.433	-0.830
-6.447	-0.846
-6.459	-0.863
-6.469	-0.881
-6.478	-0.899
-6.486	-0.918
-6.492	-0.938
-6.496	-0.958
-6.499	-0.979
-6.500	-1.000

Above is the tool path for a 1" dia cutter. On the right is the table of the 18 steps around the 3/4" radius. The first and last coordinates are the ends of the straight tool paths.

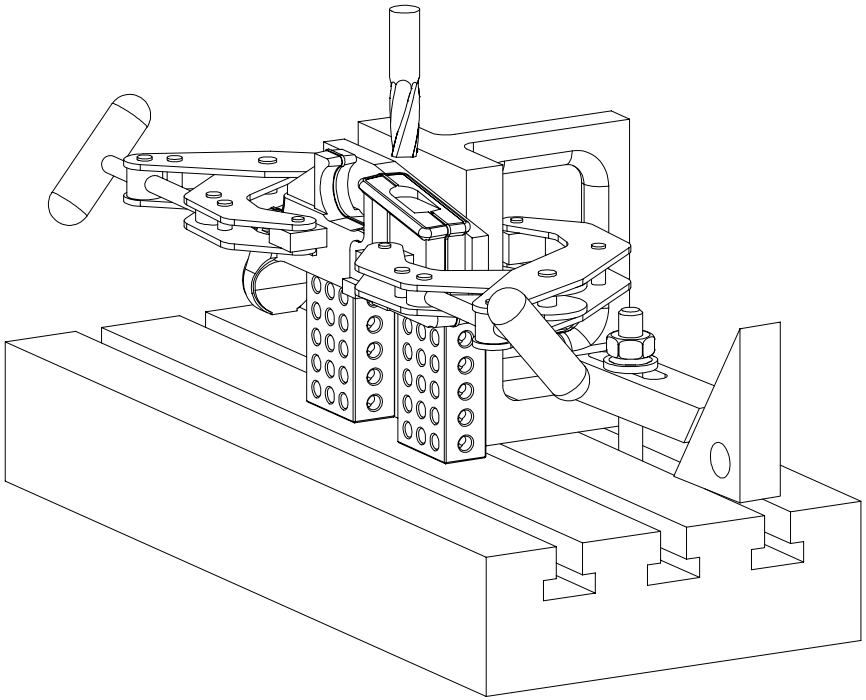


Make sure you have done all the cuts scheduled for this setup before you break it down.

Now that we have established our initial finished surfaces we can hold the forging for the placement of pin holes etc. But before we do, we need to cut a small flat in the bottom of the magazine well to aid in clamping.

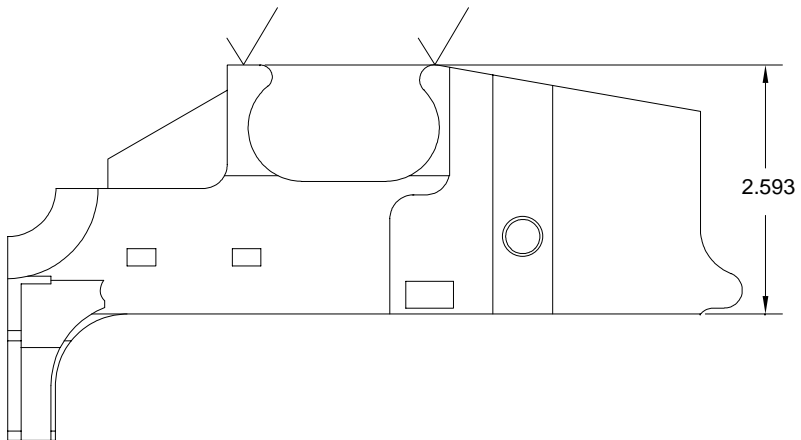


Put the lower on a couple of 1-2-3 blocks and clamp as show above. Using a 1/2" cutter make a flat in the middle of the magazine well, centered and about 3/4" long. Cut this flat in the material that will be removed when we cut the magazine well.



Here is an alternate method for cutting the clamp flat. Support the lower on a 1-2-3 blocks and using the passenger side clamp pad, clamp it to an angle plate. You can also hold the lower in a vise using the driver side and passenger side pads.

If you prefer to work in a vise, take the optional cut shown below across the bottom of the trigger guard bosses. When clamping on these bosses, be careful not to overtighten and crush your forging.

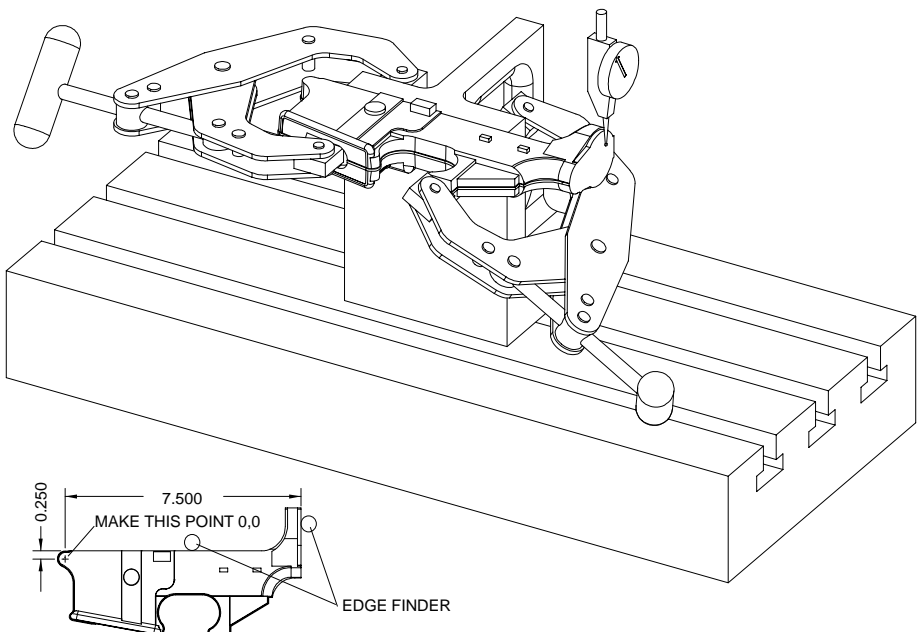


# Chapter 3

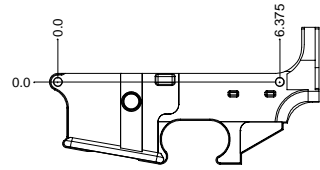
## Holes

In this setup you will be putting in the pivot pin hole, take-down pin hole, trigger and hammer holes, safety hole, magazine release hole, bolt release hole and rear trigger guard hole. Also, the safety stops will be milled along with the magazine release pocket, the bolt release pocket and one side of the pistol grip mount.

**Workholding:** Put a sturdy angle plate on the mill table and indicate it true to the x axis. To the plate you will clamp the forging for drilling pin holes etc. Make sure the surface with the two safety stop bumps is about 1/32 above the top of the angle plate. Using the quill, indicate the machined surface on the end of the forging as show below and clamp tightly.



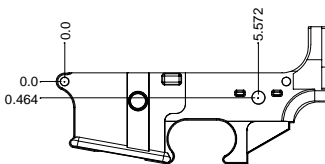
**Location:** Pick up the surface just indicated (butt face) with an edge finder and then the face of the forging that is against the angle plate (deck). Move to the location of the pivot pin (7.500X -.250Y) and zero your DRO. Refer to the drawing “DRIVER SIDE” in the appendix for dimensions for this setup.



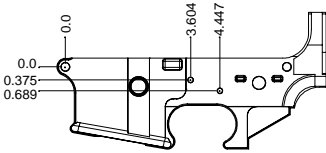
Drill and ream .251 dia. the pivot pin hole through at 0.000-0.000. Now do the same for the take-down pin hole at 6.375-0.000.



When doing this kind of work it is a wise move to just touch the work with the center drill and then lay your scale on it just to make sure you are in the right place.

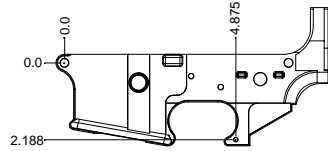


Next is the hole for the safety selector. Drill and ream 0.376 dia through at 5.572-0.464.

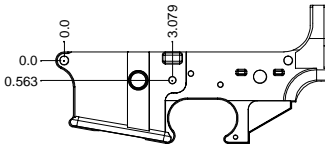


Drill and ream the trigger hole 5/32 (0.156) dia. through at 4.447-0.689. Do the same for the hammer hole at 3.604-0.375.

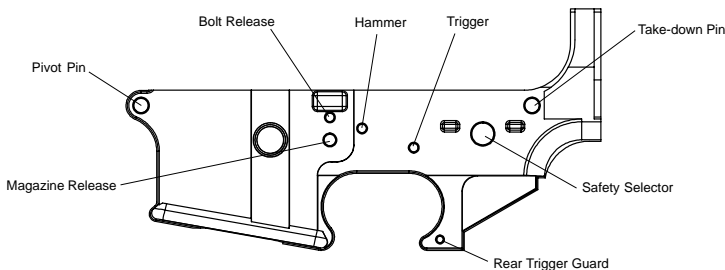
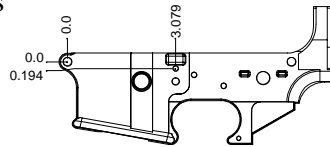
Next, drill the rear trigger guard hole. It is .125 dia. through at 4.875-2.188. Do not drill the forward trigger guard hole from this side. It is only on the other side.



Next is the magazine release hole. Move to 3.079-0.563. Drill through with a #5 drill (0.205" diameter).



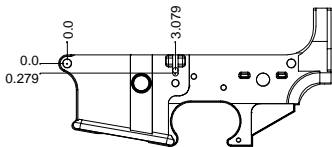
The next hole does not go through. It is for the spring that keeps the bolt release down. You will probably have to spot face here to get a flat spot for the drill to start. Drill 5/32 dia. at 3.079-0.194 to 1/32 past the centerline.



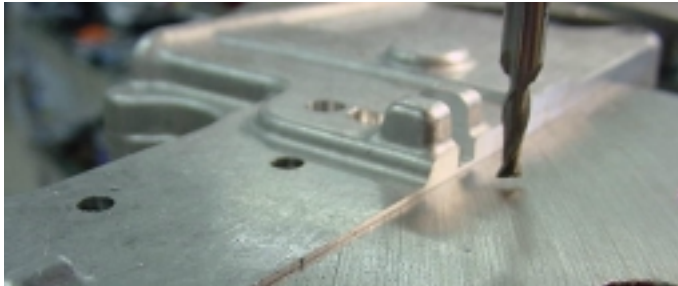
That concludes the drilling portion for this setup. Check your work against the drawing above and be sure you have all eight holes.



Now we will do a little milling. Since we are in the neighborhood of the bolt release we will mill the side portion of that groove first. Mount up a 5/32 end mill and set it to stop on the safety bump surface as show below. This is as far down as you need to cut the groove.

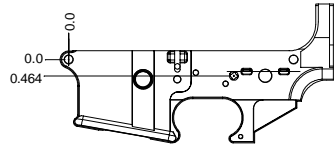


Crank the table down, locate the spindle at 3.079 and mill the bolt release groove to 0.279 to the depth set above.



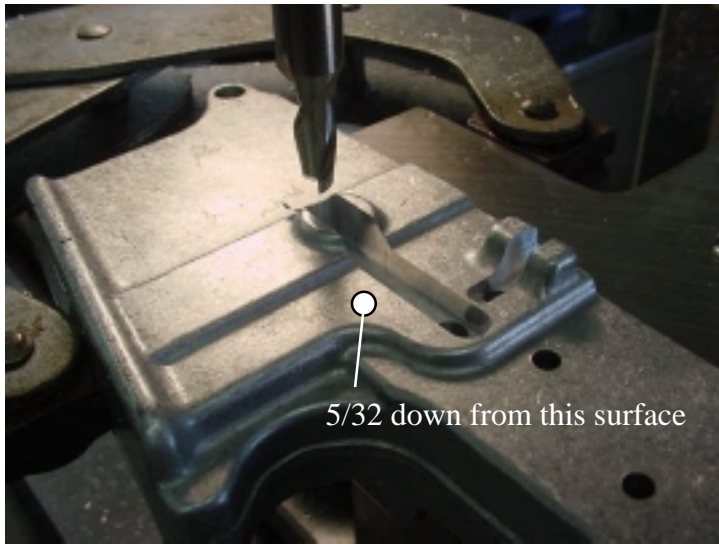
This is why that surface needs to be about 1/32 above the top of the angle plate.

Now we will do the safety stops. Chuck a 1/4 dia. cutter and put the spindle on the Y axis of the safety hole, 0.464. Using a piece of plain paper, about .004" thick, for feeler gauge, set the depth of your cutter to be 0.004" above the surface. On this setting mill off the lower half of the safety bumps.

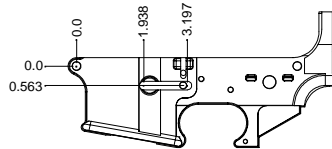


When you have this done, go ahead and drop the safety in and check the fit. You have two minutes to stop smiling and get on to the next step.

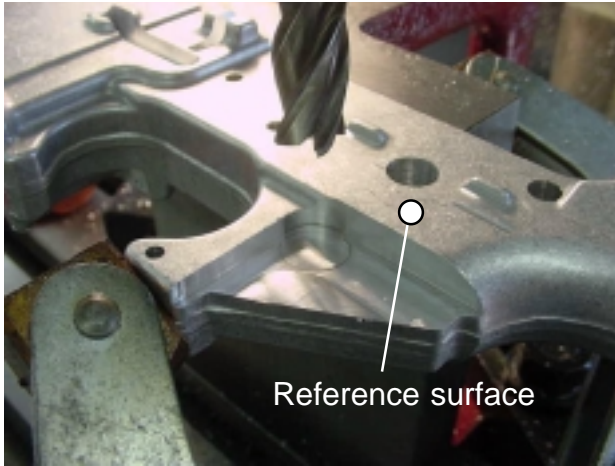




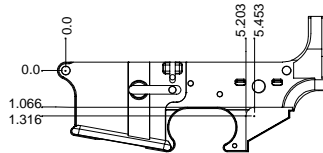
The magazine release lays in a slot you will mill using the same 1/4 inch cutter. The depth of this cut is 5/32 from the surface. The coordinates are 1.938-0.563 to 3.197-0.563.



Go ahead, drop the magazine release in place. It should be close to flush with the reference surface. When you stop smiling, we can get going with the pistol-grip pocket.



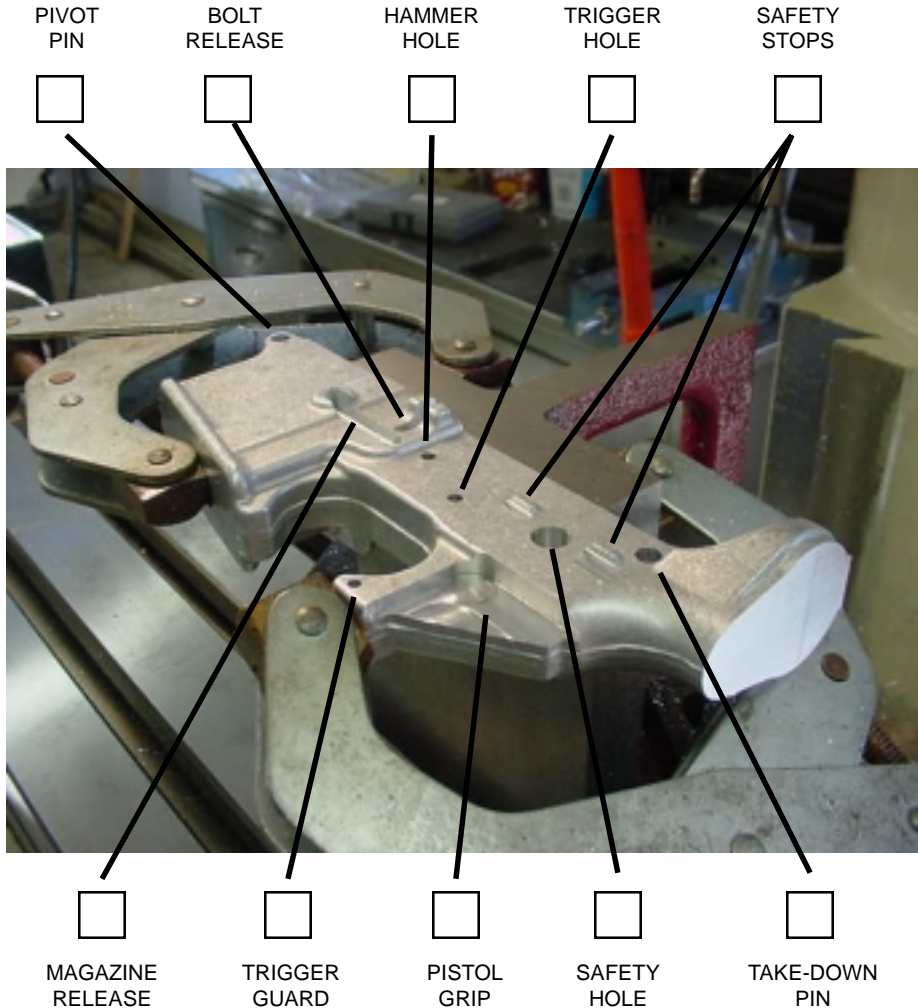
Chuck a 1/2" dia. cutter and touch off on the reference surface. My forging is 0.864 thick at this point so it will be 0.432 to the centerline. The face of the grip pad is 3/16 up from the centerline so we need to subtract .1875 from .432 which gives .244 inches down from the reference surface to the bottom of the cut. You will need to make your own calculations based on the thickness of your particular forging.



You can set your incremental zero at 5.453-1.316 which is the corner of the pocket. Stay away by five or ten thousandths as you rough down to within 0.005" of the finished depth. Then set your finished depth and mill the sides and bottom finished in one pass. Be careful not to run into your clamp!

# Check List

Before breaking the setup, double check that all the operations for this setup have been completed.

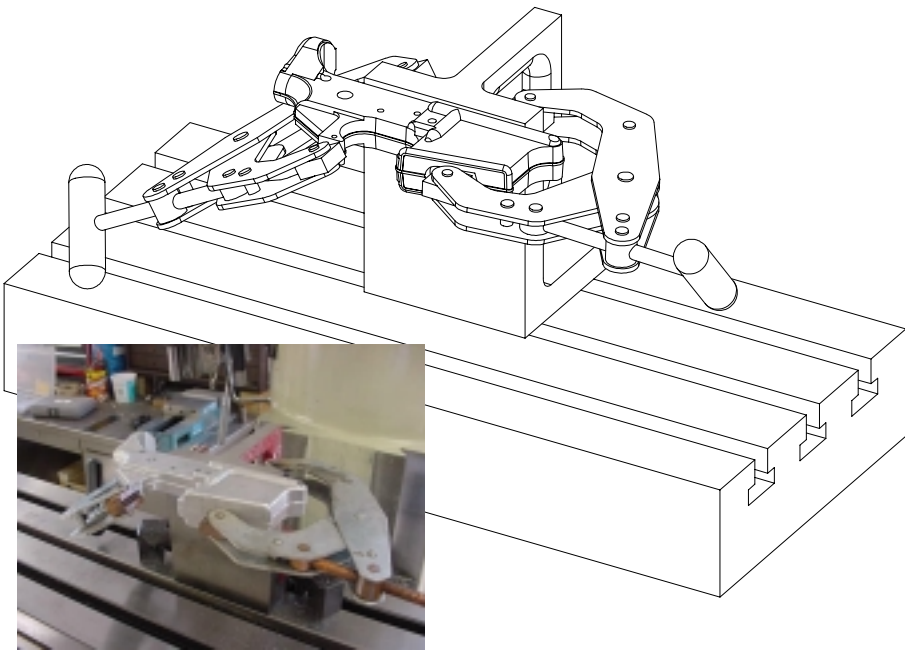


A good habit to get into is this. When you think you are finished, clean off the machine of chips and tools etc. instead of rushing to remove your work-piece. This gives you some time to think about it. Nothing is as frustrating as having to re-setup something because you missed a hole.

# Chapter 4

## The Passenger Side

This setup is basically the same as the previous one, except that we will be putting the passenger side of the receiver up. This chapter deals with spot facing the take down pin hole, milling off the front of the pivot pin detent channel, drilling the vent hole for the pivot pin detent, finishing the magazine release, drilling the front trigger guard hole and milling the other side of the pistol grip mount.

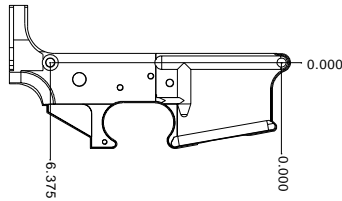


### The Setup

**Workholding:** As in chapter 3, clamp the forging to the angle plate (passenger side up) and indicate true the butt face using the quill.

**Location:** Edge find the buttface and the deck. Move 7.500-X and .250-Y (to the pivot pin location) and set this to zero-zero. Refer to drawing "PASSENGER SIDE" in the appendix for this setup.





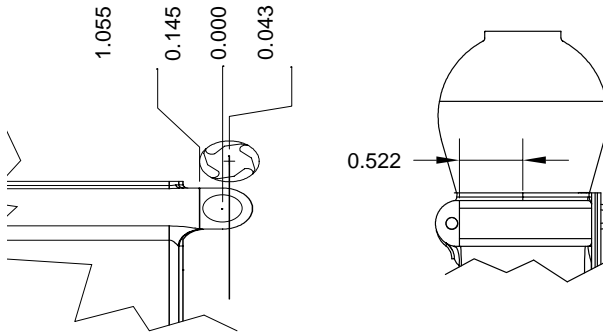
First operation is to spot face the take-down pin hole. Chuck a 7/16" dia. endmill and move over the right cheek. Set your elevation wheel at zero and bottom the cutter on the right cheek for the Z reference. Move to 6.375-0.000 and spot face to 0.411" from the centerline.

You can check the fit, but there isn't much to check for. Just see that the spot face is big enough for the pin head.

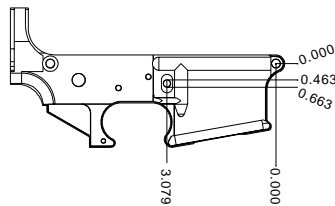




Now use a 3/8" cutter and move to 0.043 x (to the right of the pivot pin hole and mill off the face at a setting of 0.522 from the centerline. Check that the pivot pin fits nicely before moving on.







Chuck a 5/16 endmill and prepare to mill the pocket for the magazine release button. The drawing calls for this to be 0.318 wide by 0.515 long, centered on the hole at 3.079-0.563. You will mill from roughly 0.663-Y to 0.463-Y to a depth of 0.069 past the centerline. Before moving on, check the fit with the mag release button. You don't want this to be tight.

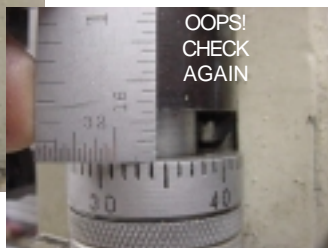
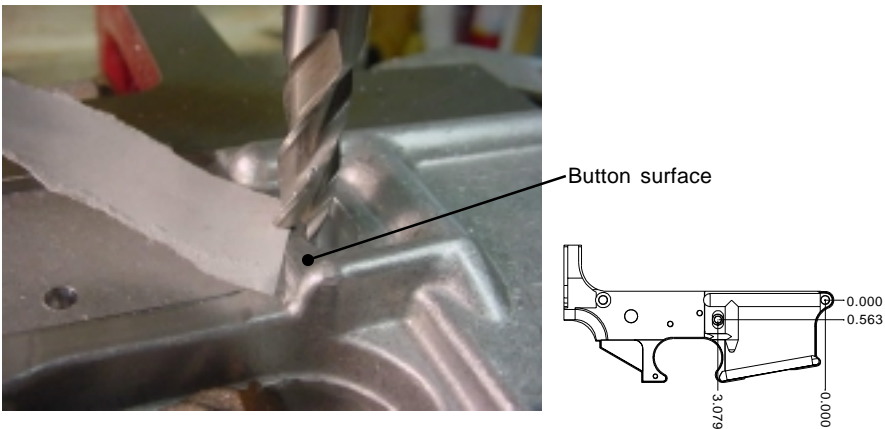


The magazine release hole needs to be relieved for the spring. You may be intimidated by cutting the mag well, but this operation is what scares me the most!

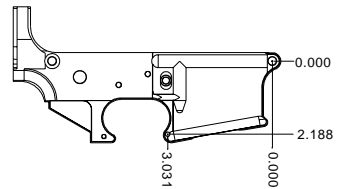
You have to cut to within 0.054" of the bar slot on the other side and here is how to do it.

Hold the mag release in the bar slot the wrong way around, measure down to it from the button surface and record your measurement. It should be close to 15/16" (0.937"). From this value subtract 0.054" and record the result.

Now chuck a 5/16" end mill and bring the quill down to the stop. Raise the table until the end mill touches off on the button surface. Set your elevation dial at zero. Raise the quill and then bring the table up by the result you recorded earlier. Position the spindle at 3.079-0.563 and with the spindle off, bring the cutter down until it bottoms on the metal to be cut. Check your quill stop, you should have about 1/4" to go. If you have more, recheck all your measurements!

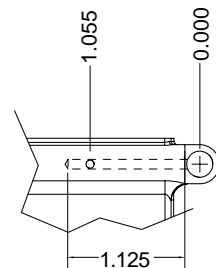


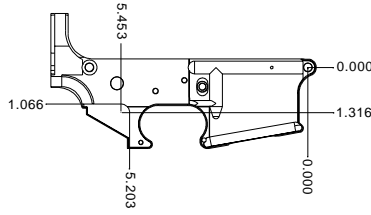
The next item in this setup is the forward trigger guard hole. Locate the spindle at 3.031 x 2.188 and drill a 1/8" hole about 1/4" deep. Don't drill it through.



Here is the lower being held by the alternate method in a vise. After you drill this hole, go back in with a #2 center drill and cut a nice chamfer on the edge.

One little hole that is easy to overlook is the breather for the take-down pin detent. Locate your spindle at 1.055-0.000 and drill a 5/64 (0.078) diameter hole about 1/8" deep. The hole it will be venting isn't there yet so don't go too deep.

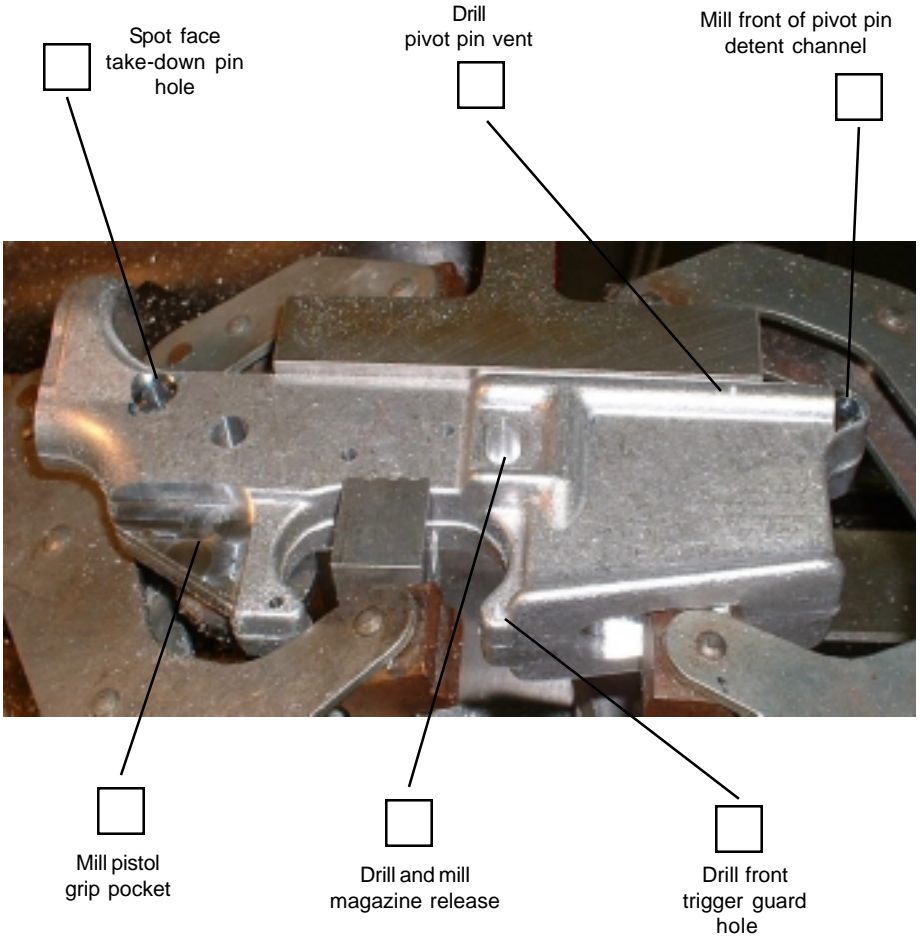




As in chapter three to cut the passenger side of the pistol grip mount chuck a 1/2" dia. cutter. No need to touch off, just take a light cut then measure the thickness and adjust from there for a finished size of 0.375".

You can set your incremental zero at 5.453-1.316 which is the corner of the pocket. Stay away by five or ten thousandths as you rough down to within 0.005" of the finished depth. Then set your finished depth and mill the sides and bottom finished in one pass. Be careful not to run into your clamp!

If you use the alternate holding method using a vise, be sure to leave the area to be milled clear of the jaws as shown above, not like on the opposite page.



Before you break your setup, check your work!

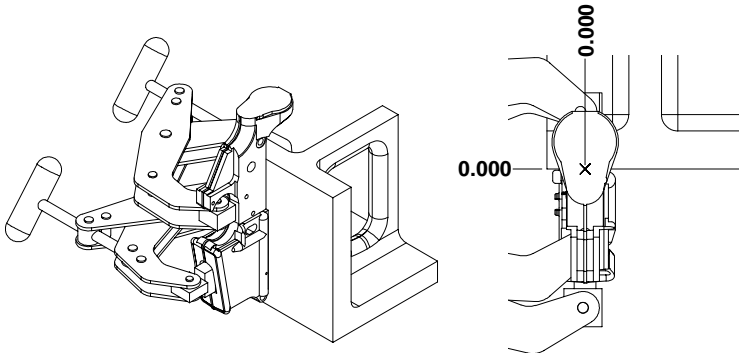
# Chapter 5

## The Buffer End

In this setup we will put in the hole for the bolt release pivot, take-down pin detent hole, the buttstock key hole and bore and thread the hole for the buffer tube. Also, two more surfaces on the pistol grip mount will get finished.

**Work Holding:** Once again, clamp the top face of the receiver to the angle plate in the orientation show at the right with the buffer end of the receiver up. Indicate it true and tighten the clamps.

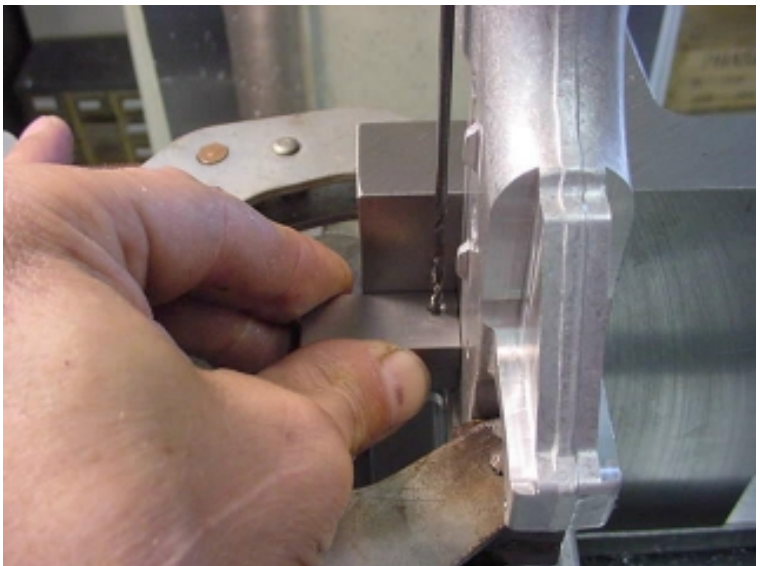
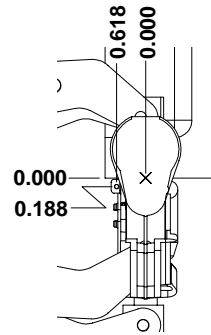
**Locating the spindle:** With you edge finder, locate the center of the .375 pistol grip mount. If you prefer, find the center using the left and right checks. This will be zero on the X axis. Edge find the face of the angle plate and make this surface zero. This will be your zero on the Y axis.

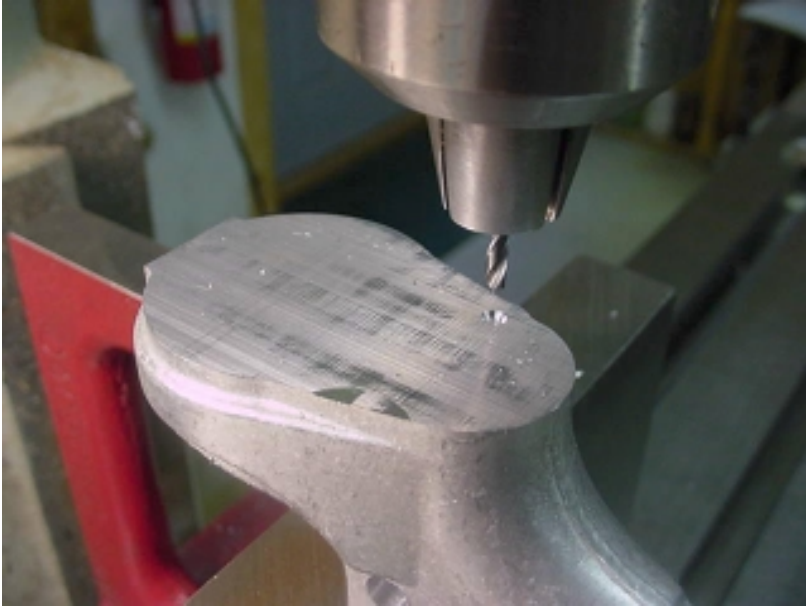






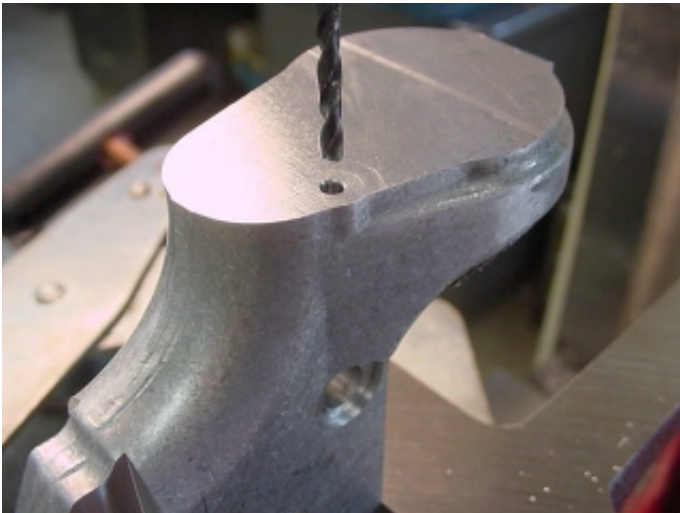
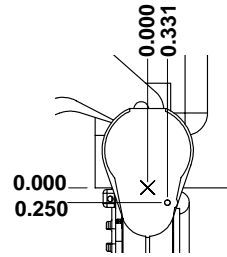
Locate the spindle at 0.618-.188 and chuck that long 3/32 drill. Here is where you will use that little block I told you to make in chapter one. Hold the block tightly against the angle plate and the forging. The drill should line up exactly with the hole in the block. Holding the block tightly, drill the hole through the lug on the forging. Drilling this hole any other way will drive you nuts!





Next is the hole for the take down pin detent. Locate your spindle at 0.331-0.250 and drill a 3/32" hole down to the take down pin hole.

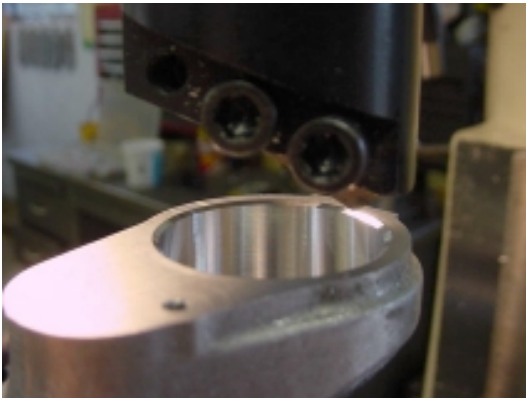
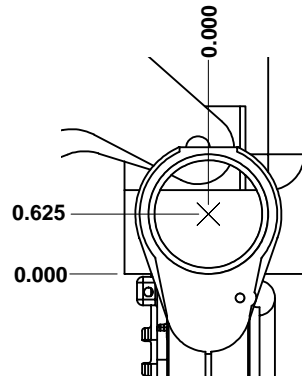
When drilling deep holes, a poor start will get the drill walking off right away. Start the hole with the drill choked up close in the chuck. Once the hole is started, chuck the bit normally and finish the hole.







Now for the buffer tube hole.  
Locate your spindle at 0.000-0.625 and  
bore a 1.125" hole through the tang.



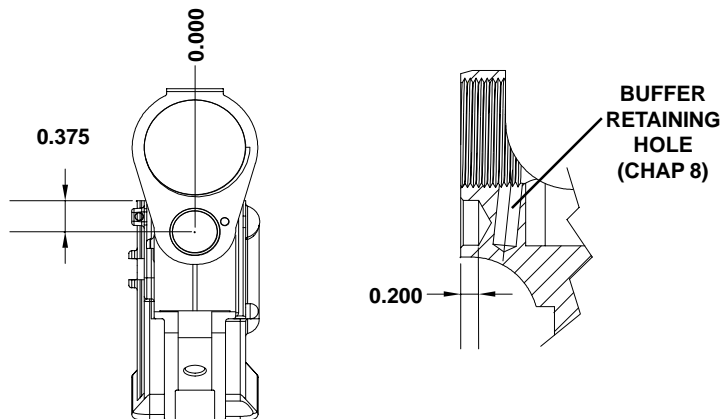
You can put a tool in your boring  
head or flycutter to put a nice 45 degree  
chamfer on the corner.



If you have the 1-3/16 - 16 tap go ahead and tap the hole. Put a center in the spindle to keep the tap aligned and with a light pressure on the down handle turn the tap with a wrench. If you don't have a tap, you can single-point the thread in a lathe, see the appendix.



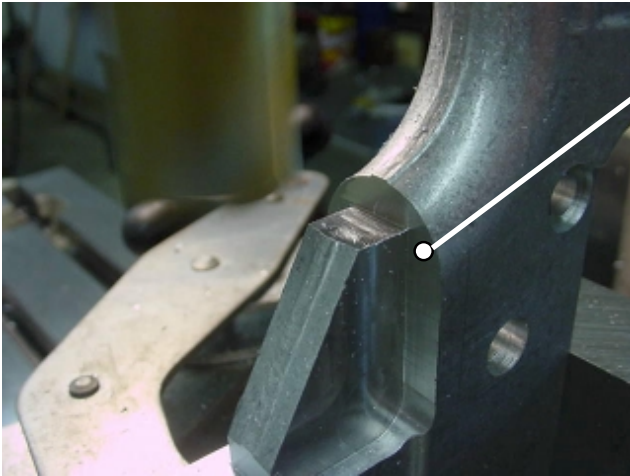
At 0.000-0.375 spot and bore the buttstock anti-rotation hole. The size of this hole is 0.499 plus .004 minus nothing. If you drill a pilot hole first, your 1/2" drill should not cut oversize. It is important not to drill this hole too deep since the buffer retainer hole will go just on the other side. I like to drill a 1/4" hole 1/4" deep and then go in with a 0.500" diameter end mill about .225".





Chuck up a cutter and touch off on the butt face. I use printer paper that is 0.004" thick and set my dial that amount before the zero.

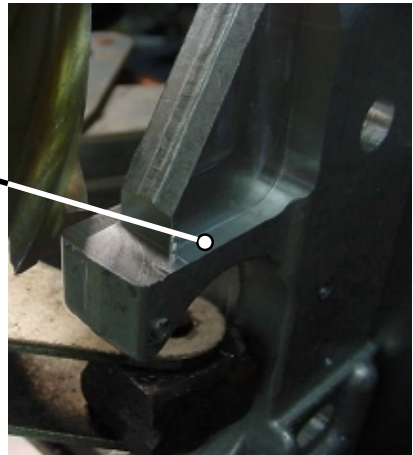




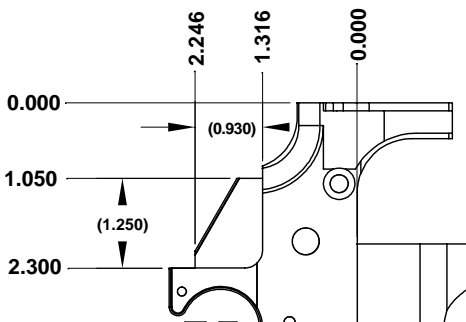
Mill flush with this surface

The first surface to mill is 1.050" down from the butt face. Mill until you are flush with the side faces of the pistol grip mount.

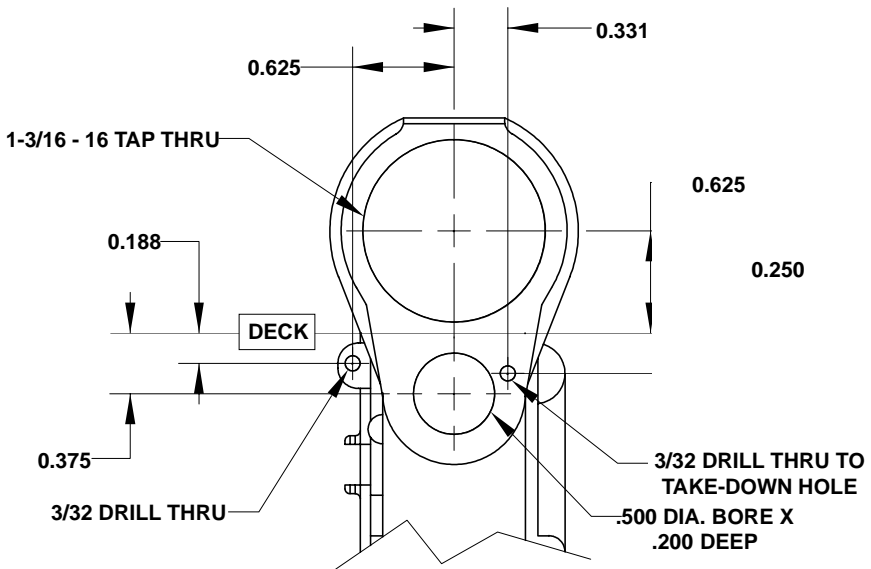
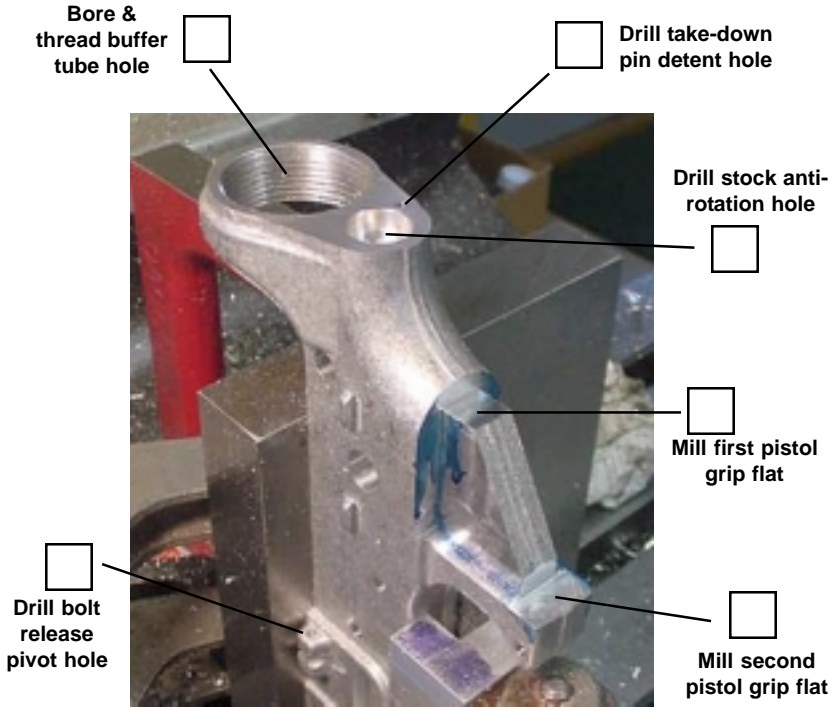
The next surface should be 1.250" further down and 0.930 away from the surface just milled. Move to your depth slowly and make your cut flush with the existing surfaces.



Mill flush to this surface



Once again, before moving on, check that all operations are complete before breaking this setup.





# Chapter 6

## Pivot Pin Details

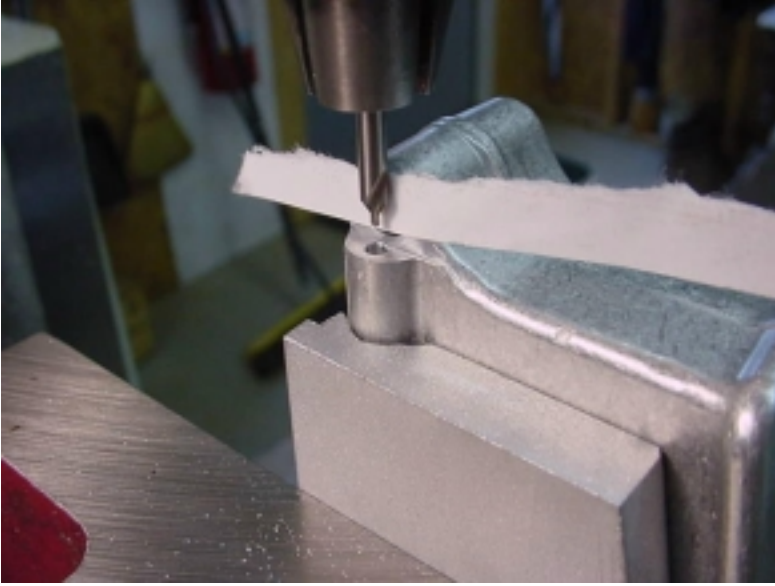
In this chapter we will put in the pivot pin detent hole and mill out the pivot pin boss where the upper receiver goes in.

Once again we will use our passenger side plate to hold the work. You need to know the exact thickness of the side plate where it contacts the cheek of the receiver so if you haven't miked it yet, do it now and write the dimension down on the passenger side plate drawing.

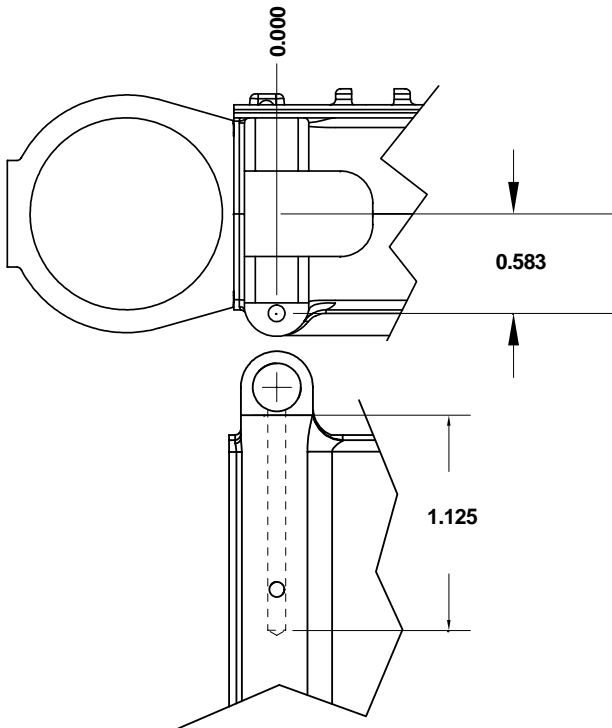


**Workholding:** Clamp the forging to the angle plate using the passenger side plate. Put the butt face against the table. Indicate the deck true to the quill.

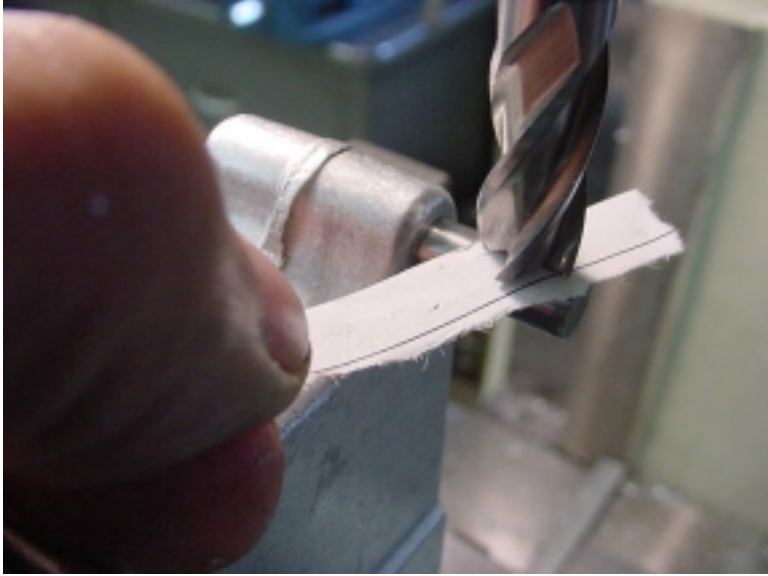
**Location:** Edge find the deck and move in 0.250 and set X zero. Edge find the face of the angle plate and move out the thickness of the side plate (that you just recorded) plus half the width of your forging ( $\text{dim. } \alpha / 2$ ) and set Y zero.



First in will be the pivot pin detent hole. Position your spindle at 0.000-0.583 and center drill with a #0 center drill. Choke a 3/32 drill and start the hole. Chuck the bit normally and finish the hole to 1.125" deep from the surface.



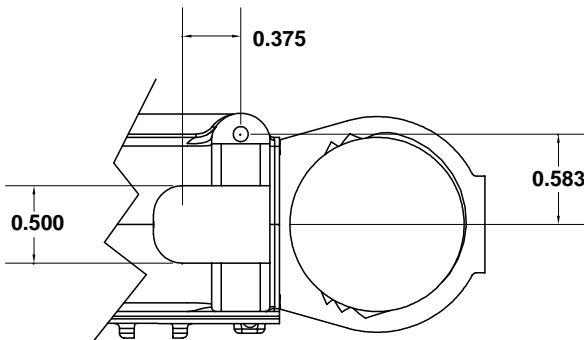




For the slot where the upper and lower meet, chuck a 3/8" end mill. Put a pin in the take-down hole and touch off on the top of the pin. From here you will go down 0.385" to the finished surface.

Mill down along the center-line 3/8" past the pin hole until you are within 0.010" of the finished depth. Then widen the slot equally on both sides to 0.500 +.004 -.000.

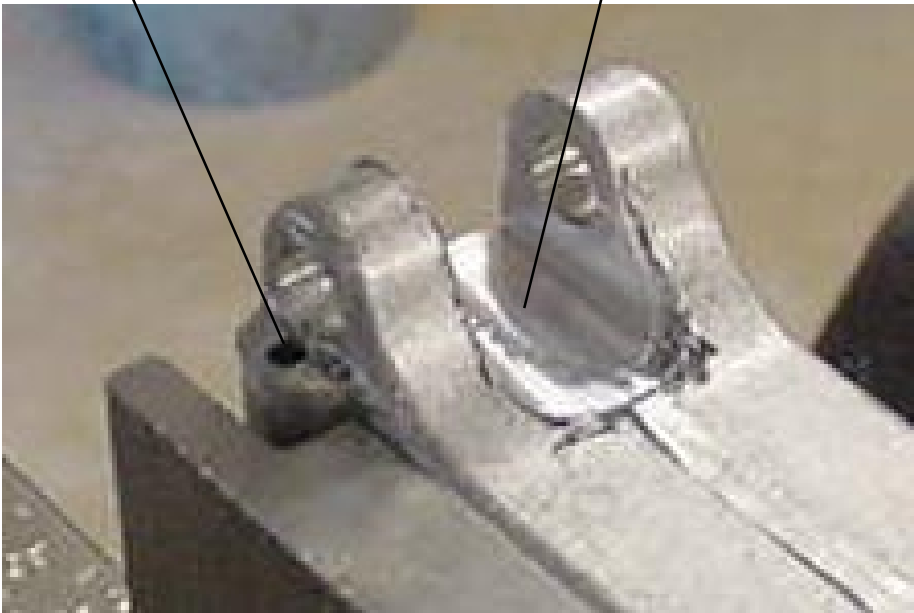
To check if you are deep enough, put the pivot pin in the hole and see that a 1/8" dowel pin fits freely between the pivot-pin and the receiver. An even better check is to see if your upper fits.



Chapter 6 check list. Check that all operations are complete before moving on.

Drill pivot-pin detent hole

Mill pivot recess



# Chapter 7

## Finishing the Pistol Grip Mount

We will now finish up the pistol grip mount. First we will mill the 30 degree face and then drill and tap 1/4-28 for the pistol grip screw.

**Workholding:** This is an easy setup (if your milling machine is level!). Set your combination protractor to 60 degrees and using the nest plate, clamp the forging to the angle plate with the butt face at 60 degrees. Tap until the bubble is centered and then add a second clamp. Re-check the angle after tightening the second clamp.



**Location:** Find the center line as usual and then put a .250 pin in the take down hole. Edge find the pin then move to its center and set zero. Chuck a 1/2" endmill and set the spindle stop and bring the spindle down and lock it against the stop. Raise the table until the cutter touches the pin and zero the elevation dial.



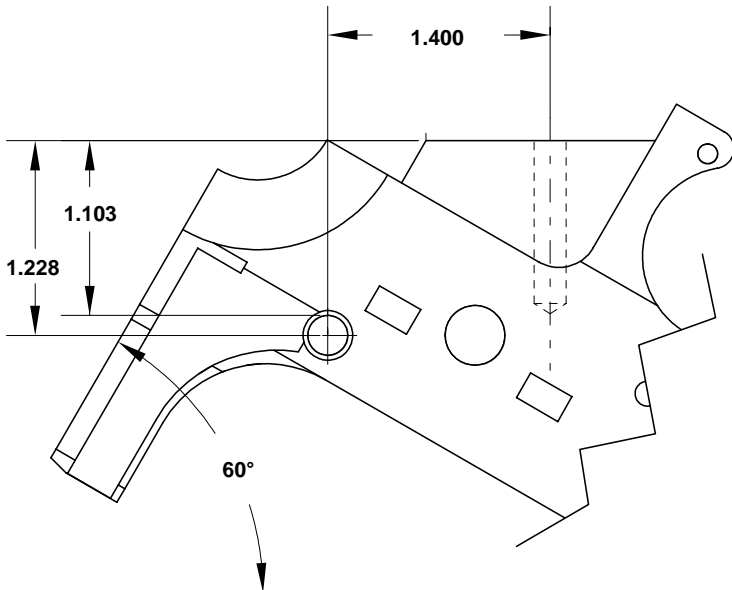
From the pin center-line to the surface to be milled is 1.228". Since we touched off on the top of the pin we will subtract the radius, .125" from the 1.400" giving us 1.103". Lower the table by this amount and mill the angle face of the pistol grip mount.

Locate the spindle at 1.400-0.000. Then drill with a #3 drill about 1-1/4" deep. Counter sink to 5/16" diameter (this helps getting the screw started) and then tap 1/4-28. That's it for this setup. Clean the machine and then go to the checklist on the next page before breaking down.



Chapter 7 check list. Check that all the features are completed before breaking your set-up.

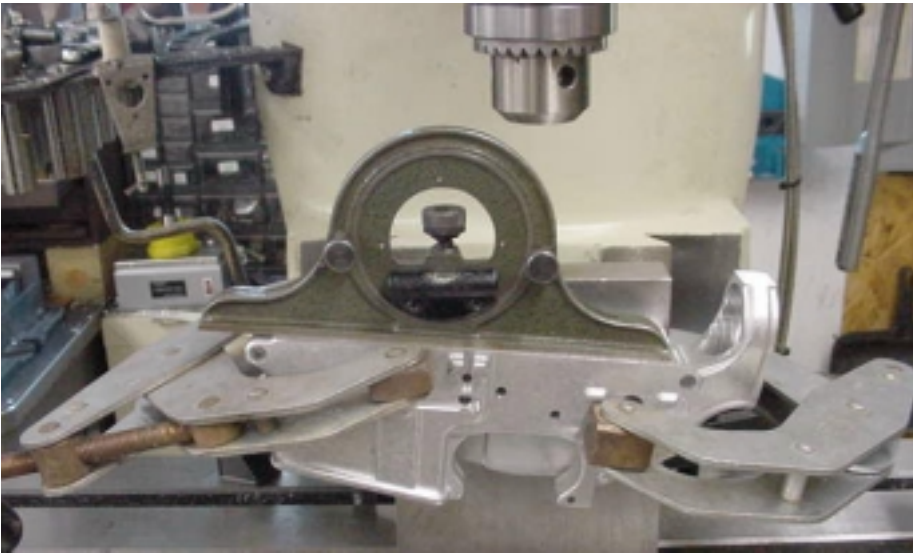
Mill pistol grip bottom face  Drill and tap 1/4-28 pistol grip mounting hole



## Chapter 8

# Buffer Retainer Hole

In this chapter we will drill the buffer tube retainer hole and in a similar and closely related setup put a small chamfer on the back of the receiver. The buffer retainer needs to be in just the right spot. The buffer tube itself keeps the retainer in place, but must allow the tip of the retainer to extend up to stop the buffer. Thanks again to modern computer graphics for helping us locate this hole easily.



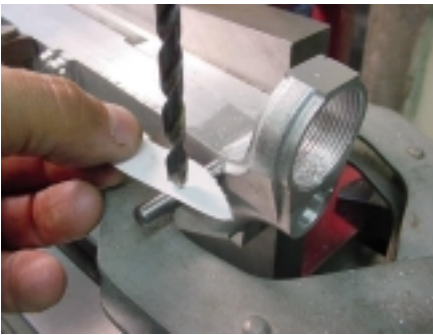
**Workholding:** Set your protractor for 6 degrees and clamp the forging against the angle plate using the clamping pad. Tap the forging until the bubble is level and add a second clamp. Re-check the angle after tightening the second clamp.

**Locating:** Edgelfind the corner at the top of the buttface. Alternatly, you can pick up the center of the take-down pin, but since the detent hold is relative to the buffer tube, it is best to pick up from the surface the buffer tube shoulders against.





Since you will be drilling into the buffer tube threads, the investment in a long #3 center drill is well worth it. Move to the location and spot the hole to the full diameter (.250) of the center drill.



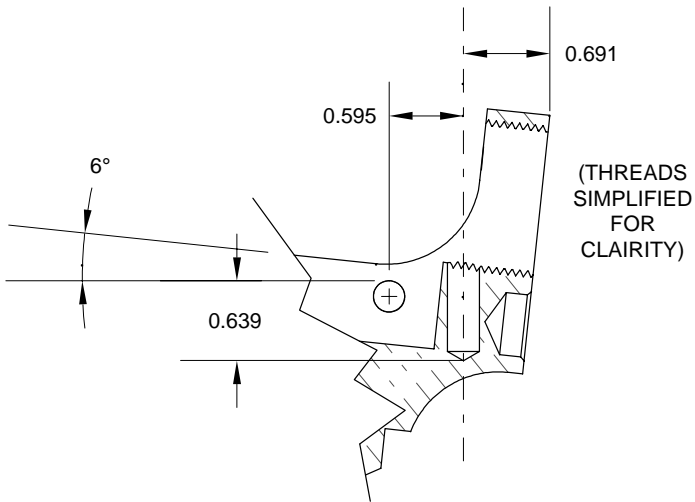
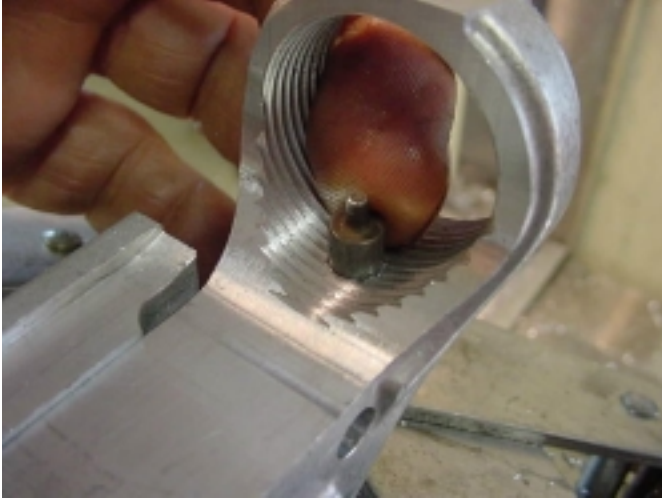
Put a 0.250 dowel pin in the take down hole and move the spindle over it with your drill in place. Bring the quill down to the stop and then bring the table up until the drill touches the pin. A paper shim is always handy and makes a good feeler. Set your elevation dial to zero and then come up 0.639”.



You don't want to make a mistake here by drilling through by accident. Double check your depth setting by moving to X-zero and bring the drill down to the stop and look in to see; first-that the drill tip will not break out of the forging at the bottom and second-that your drill chuck will not run into the top of the buffer tube ring.



Always check for fit with the part before breaking the setup. I had a 1/4" drill that drilled just a half thousandth small and the plunger wouldn't go in. This is the best time to find out if the hole is tight. I opened it up with a .251" reamer and the fit was perfect!





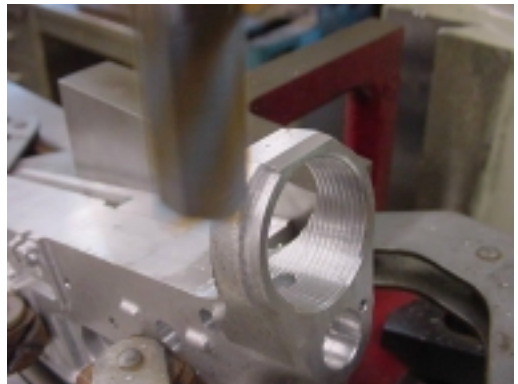
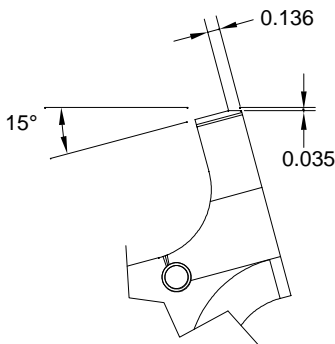
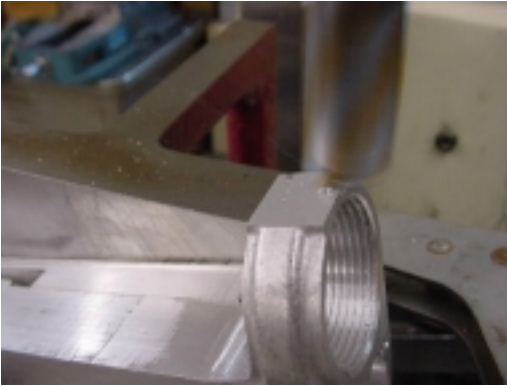
## Chapter 8-1/2

# Charging Handle Relief

This was originally another chapter, but I combined it here because the setup is so similar and the location and cut are simple.

**Workholding:** Clamp the lower at 15 degrees. Use your protractor and clamp it up and tap until the bubble is centered. Then add a second clamp.

**Location:** No location required for this setup. Just come down with your cutter until you touch the corner and then come down another .035". If you scheduled your work right, it might be a good time to go have a beer!



Clean your machine and then check your work!



Buffer Retainer Hole

Charging Handle Relief

# Chapter 9

## The Magazine Well

This chapter deals exclusively with the magazine well. I have done some very minor re-design of the profile here to make it easier to machine in the home shop. This profile works just fine and saves time and heartburn as well! Don't let cutting the mag well frighten you, it is easier than you think! The process is only five steps:

One: Drill 1/8" diameter holes in all the corners. These will create the corner fillets.

Two: Then we will drill rough holes to remove most of the stock that is coming out.

Three: Rough out with a 3/4" end mill.

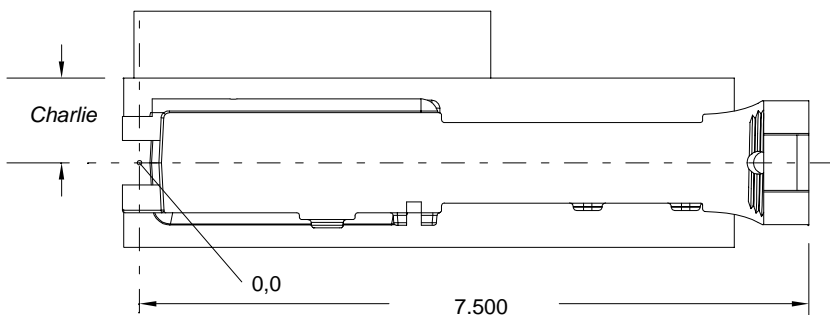
Four: Finish with a 3/8" end mill.

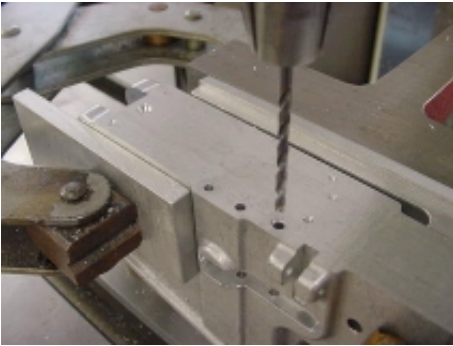
Five: Clean out the corners.

If you plan to stoke out the corners out using a special tool than you will not drill the 1/8" holes, but spot face with a 1/8" endmill instead.

**Workholding:** Use both clamp plates and clamp the passenger side against the angle plate and indicate the deck true.

**Location:** Pick-up the butt face, move 7.500" and set your X axis zero directly above the pivot pin hole. The Y axis zero is the forging centerline. Pick up the angle plate surface and move out distance *Charley*. This will be Y zero.

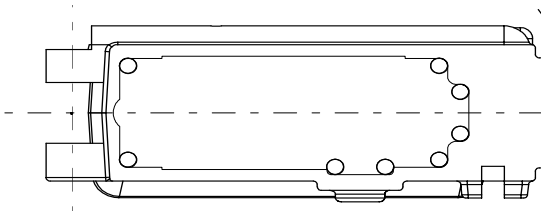
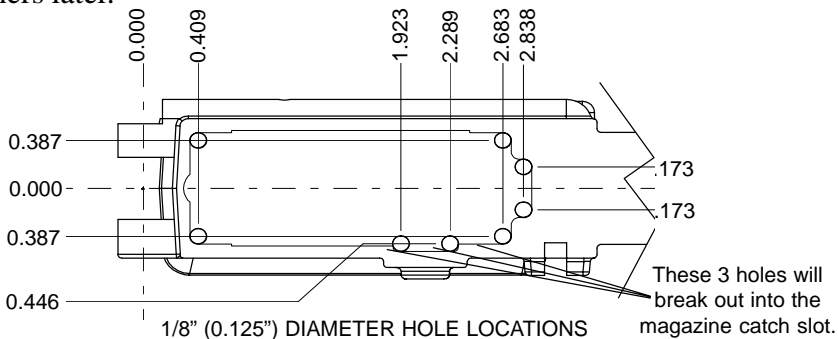




This step creates finished surfaces so drill slowly and carefully. Use cutting fluid and clear the chips often.

For each 1/8" hole: Move the spindle to the location and lock the table. With a small center drill spot the hole. Put a jobber length drill in the chuck and choke it up close so only about 1/2" is protruding. Start you hole with the choked up drill and drill slowly for about 1/4". Now chuck a 1/8" parabolic drill and drill the hole through. Check that you are actually through with a mirror. Move to the next location and repeat the process for all eight 1/8" holes.

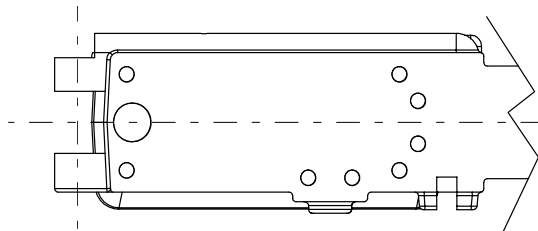
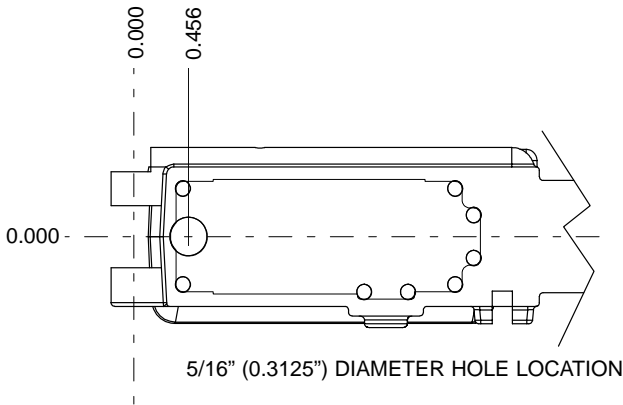
If you plan on stroking out the corners, just put a 1/8" dia. spot face by 0.005 deep on these locations as a lay-out for cutting the corners later.



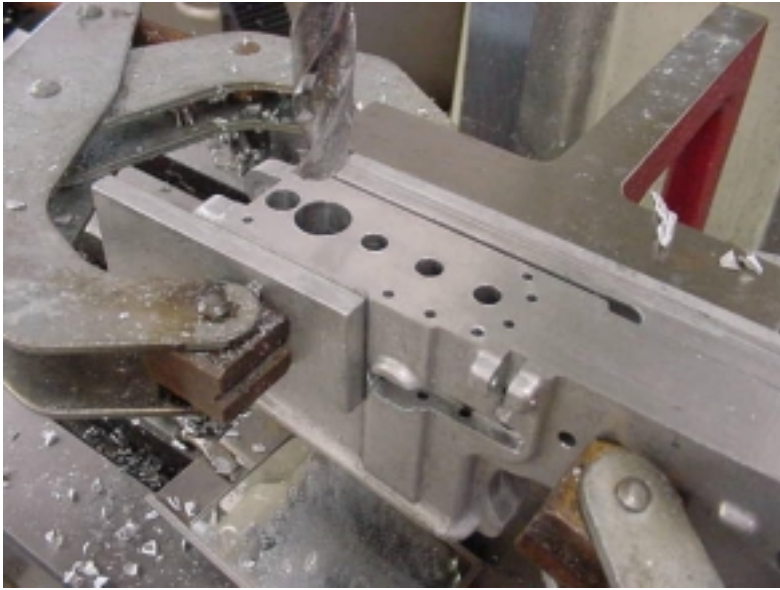
*The forging will look like this after the 1/8" holes are drilled.*



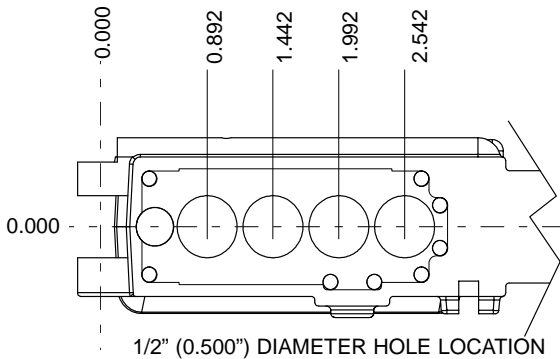
Next, put the 5/16" diameter hole through at the location shown below. This hole creates the little arc in the front of the mag well for clearance for the magazine rivits. This cut will leave a finished surface so feed lightly, use cutting fluid and clear the chips often. If you have a 5/16" reamer, then finish the hole with it.



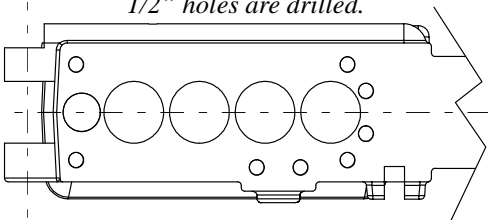
*The forging will look like this after the 5/16" hole is drilled.*



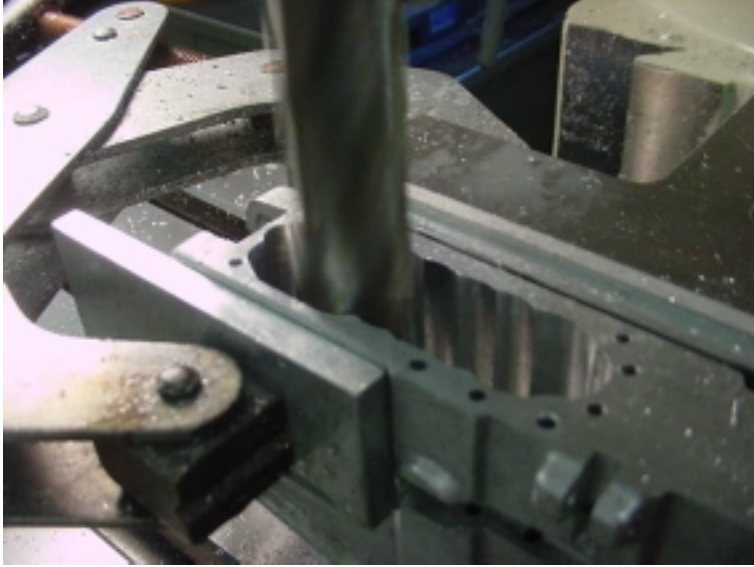
Spot and drill the four roughing holes through with a 5/16" or 3/8" drill. Next, drill through 1/2" diameter at the same locations.



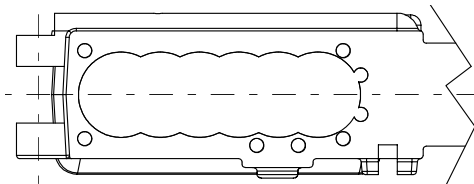
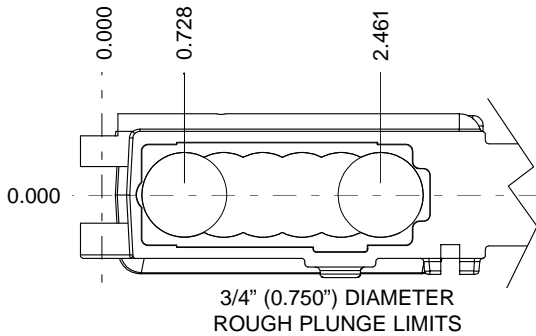
*The forging will look like this after the 1/2" holes are drilled.*



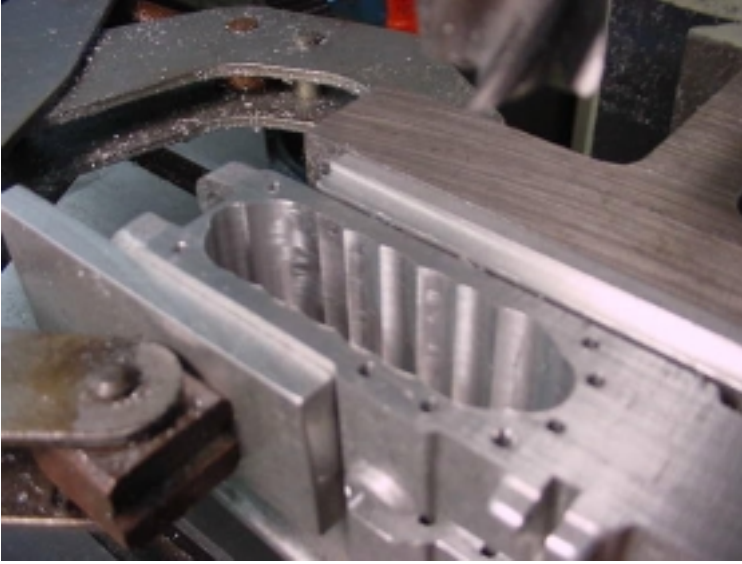
*Don't forget to inspect before moving on to the next operation.*



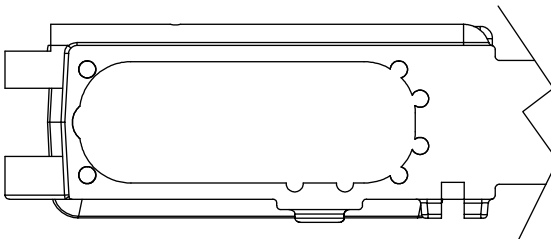
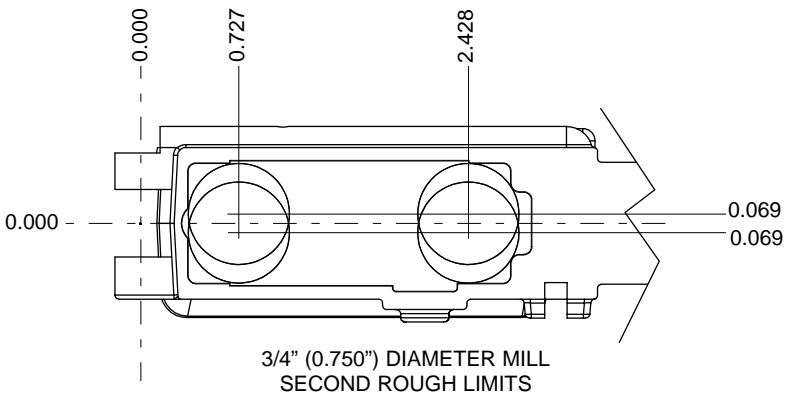
Now with a 3/4" diameter end mill (3" long) rough plunge out the material along the centerline. It is best to take out as much as possible with a heavy end mill so the smaller one will be under less stress. The dimensions shown below are the limits for this operation. The plunge positions inbetween are not critical. Take the first plunge on center of one of the inner 1/2" holes. Then move approximately .3" for each successive plunge, but be careful not to exceed the limits.



*Here is how the forging will look after the 3/4" rough mill.*



Using the same 0.750" diameter mill, follow the limits below for a second roughing pass. The numbers are calculated to leave 0.005" for final clean-up.

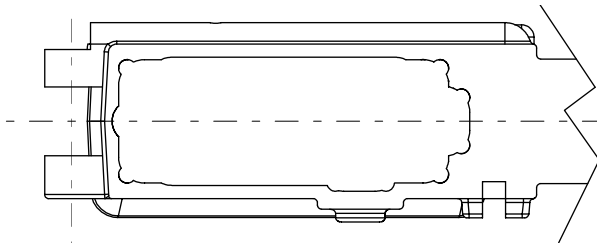
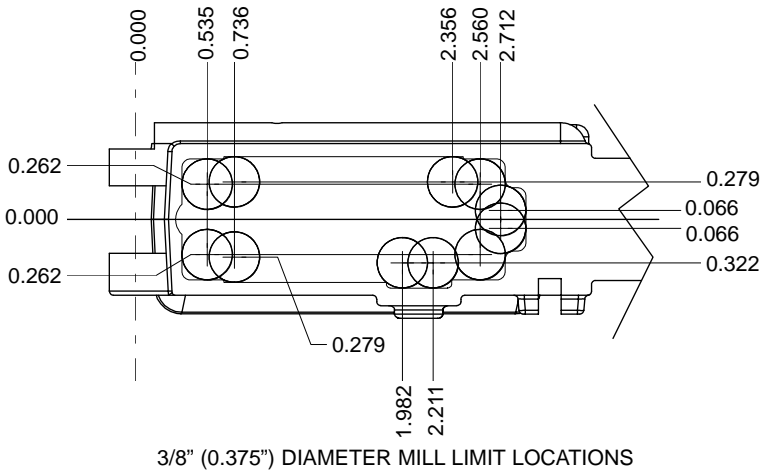


*Your roughed out magazine well should look like this at this point.*



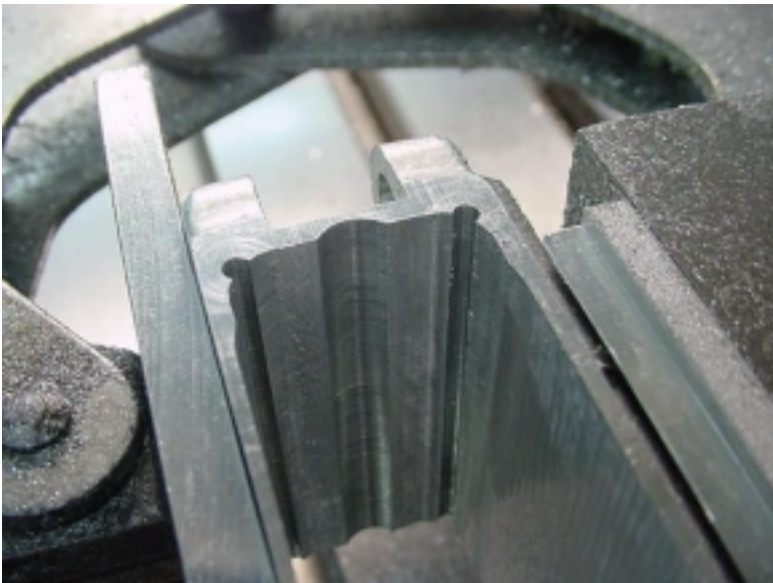
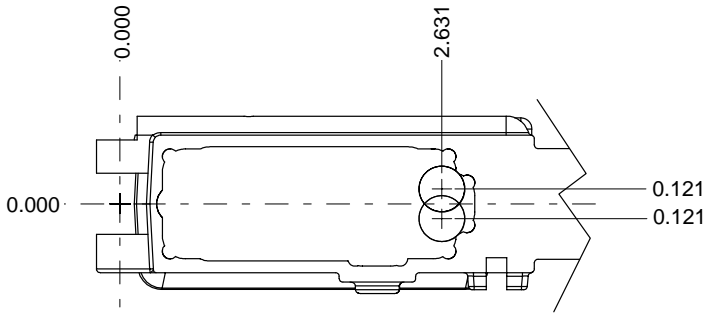
Once you have removed as much stock as possible with the 3/4 end mill switch to a 3/8 end mill. I use a short one and take out the corners as far down as I can and then I put in a 2-1/2" long 3/8 mill and plunge out well to full depth.

Initially, you may want to stay a few thousandths away from the finishe size then take a second pass with the full length endmill to the finished dimensions shown below.



*Milled out, the magazine well should look like this.*

One last little cut we will make knocks off the corners at the rear of the well. Plunge your 3/8" diameter cutter at the co-ordinates shown. While it won't leave the radius that the drawing calls for, it will provide the clearance needed and is quick and easy to do.



When you have removed all you can with the 3/8 mill there will only be some small cusps in the corners that remain to be eliminated. You can do this with a file or if you make a tool you can 'stroke' it out using your milling machine spindle as a verticle shaper.

If you plan to stroke it out, then do not break your setup and turn to page 58.



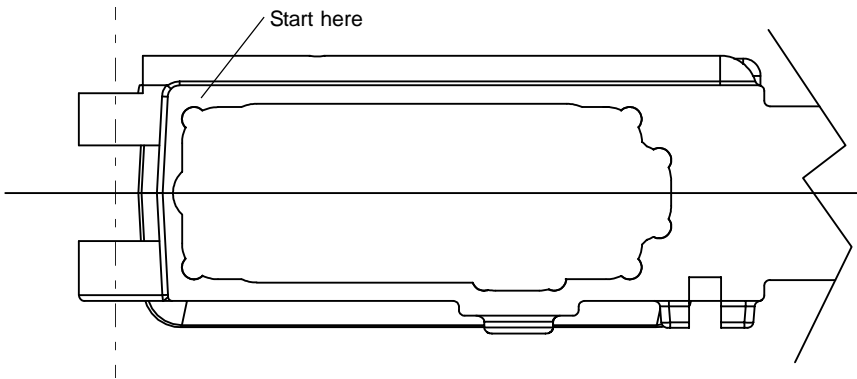
The reason we have left the trigger/hammer cavity solid until now is because we need to grab there with the vise, quite securely, while we file out corners of the magazine well.

Use a sharp file. If you don't have one, go buy one! Take long slow deliberate strokes. Check your progress often using the 1/8" holes for guides. File until you can get a magazine started. With the mag in the well you can look through and see where the tight spots are. What generally happens is that the mag fits at the top and the bottom, but is tight in the middle of the well. This is because we apply more file pressure near the edges. With a straight edge on your file, find which side is the belly (convex). That is the side to use when filing the high spots in the middle.



Once you have a mag that goes through, try all your magazines and choose the tightest one. Now make that one fit easily and you are done.

## Stroking out the Corners



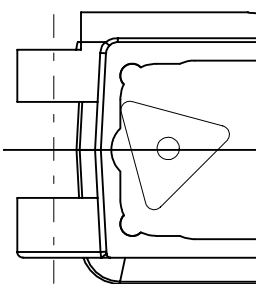
The drawing above shows the magazine well after all milling has been completed. The 1/8" spot faces will help you to clear out the corners. If you happen to have a Bridgeport with the slotter attachment (vertical shaper) then you know what to do. For those who aren't as lucky, we can use the quill to move a tool up and down and carve out the corners for a real good looking job.

You should make a tool holder as illustrated in fig. 4. Buy, beg or borrow a triangular carbide insert with 0.046" corner radius and mount it on the tool holder.

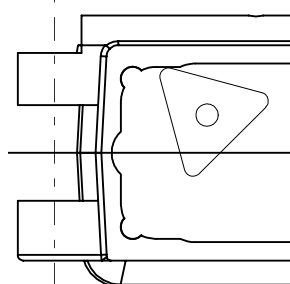
Chuck the tool holder in a collet and put your machine in the lowest speed and gear you have. Because of play in the spindle spline, you will want to use a spring or elastic to pull the radial play out of the tool. Rotate the belts by hand to get the initial orientation of the tool.

Start with the corner shown above since it is the easiest to see.

Touch your tool off on the left flat surface and set X zero.



Touch your tool off on the top flat surface and set Y zero.



While stroking the quill up and down, move the tool towards the corner with the table locked at Y zero. Once you see the tool is taking a chip you only want to advance the table when the tool is up and out, and then advance no more than 0.005” per stroke. Keep going until you reach X 0.017.

Now move to the area where you set X zero and locking the table at X zero, repeat the operation while moving along the Y axis until you reach Y 0.017.

One last little stroke at X 0.005, Y0.005 and you are finished with that corner. The opposite front corner is cleaned out in the same fashion after re-positioning the tool.

For the four corners at the other end, you will only be able to get a zero for one axis. Move out from that zero 0.017” and then procede towards the corner along the zeroed axis. Stop when you just cut tangent in the 1/8” spot face and set this point zero for the other axis. Then complete the corner as you did with the first two.

Finally, for the two corners near the magazine catch, just do these by eye using the 1/8” spotface as a guide.



Check your magazines for fit. They should be slightly loose. If they won't fall free then things are too tight somewhere. Look for the tight spot and see if you have a bent mag before cutting any more on your lower forging.

# Chapter 10

## Hammer & Trigger Cavity

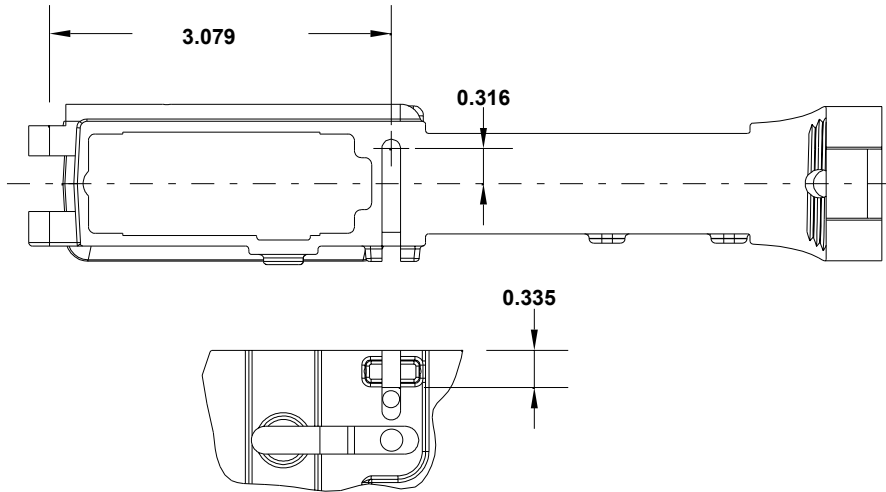
In this chapter we will finish the bolt release pocket and finish the hammer/trigger cavity.



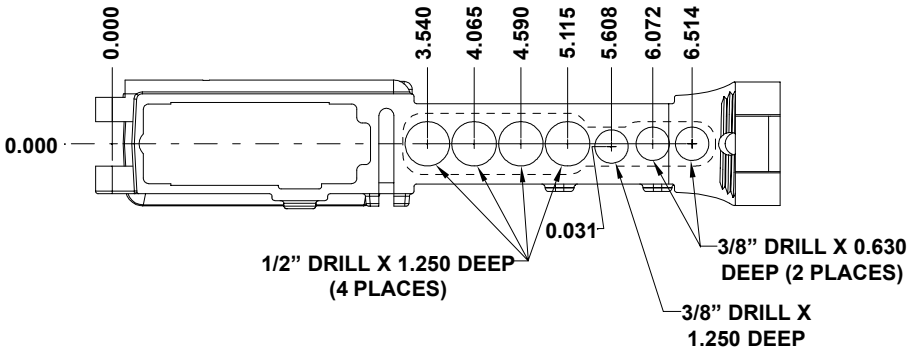
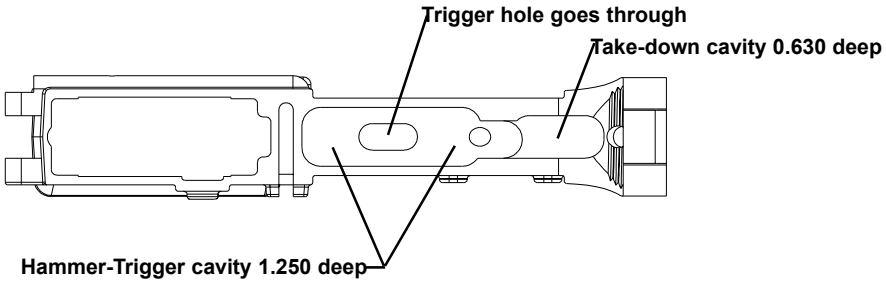
**Workholding:** Clamp up the forging and indicate it as in chapter nine. Position one clamp just behind and below the safety hole and the other clamp with a plate to protect the work just on top of the magazine release hole. Shown above is an alternate method using a machine vise. Clamp lightly and indicate the deck true then tighten the vise.

**Location:** Pickup the butt face with your edge finder and move 7.5" to the pivot pin and set your X axis zero. The Y axis zero is the forging center line.

It is easy to forget to finish the bolt release slot so we will do that first and get it out of the way. Put a 1/8" or 5/32" diameter end mill in the spindle and move to 3.079 X. Set your endmill to stop on the deck. You will be cutting a total depth of 0.335" to 0.316" past the center line. Match the sides of your slot with the already milled surfaces from chapter three.



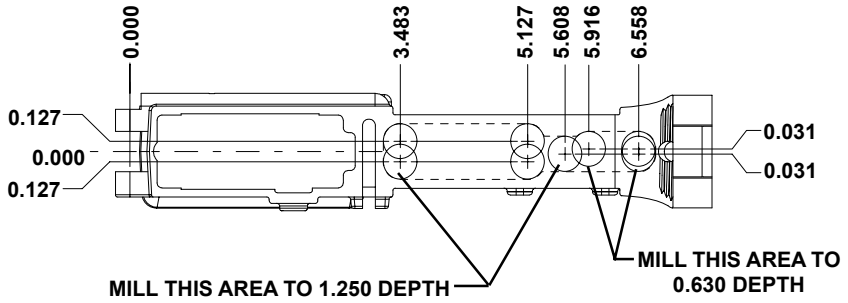




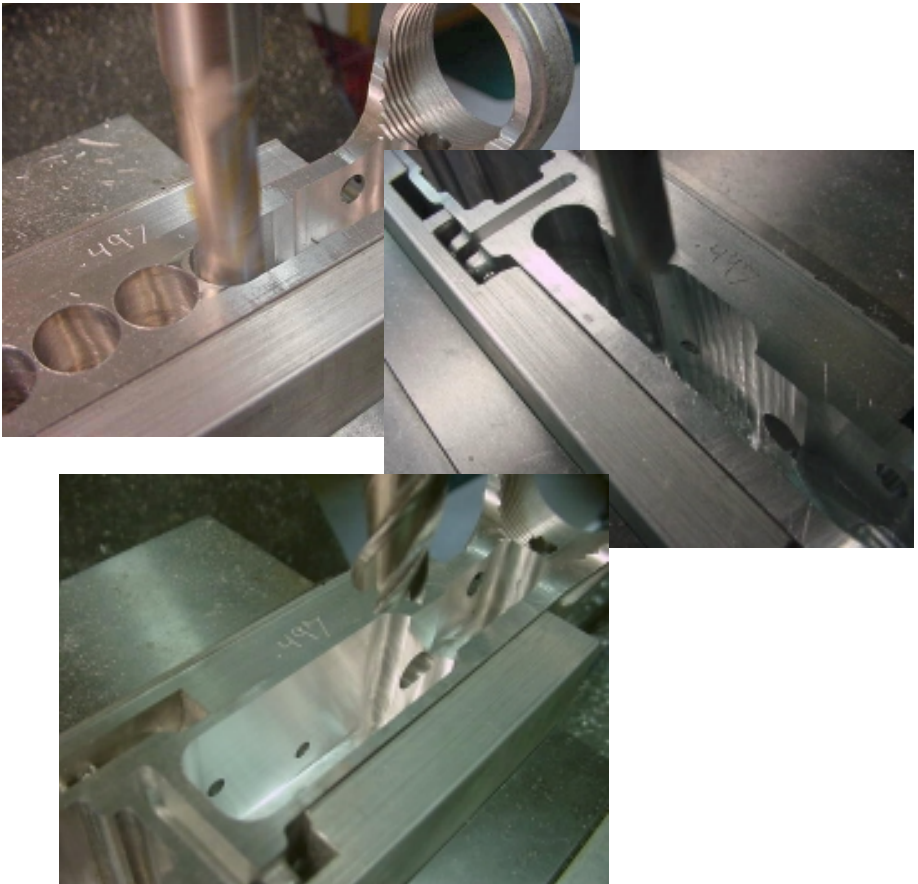
Once again we need to remove a lot of metal and the best way to do it is with drills. Drills are inexpensive and rugged. With some planning we can take out lots of stock before we have to put our end mills to work. Once the hole locations are spotted with a center drill, chuck up a 1/2" drill. Touch off on the deck surface and set for a depth of cut of 1.240" to leave some metal on the bottom for clean-up. Drill The four 1/2" holes and the one 3/8" hole in the trigger/hammer pocket. Then set the depth of cut to 0.615" and drill the rear two 3/8" holes in the take down pin area.



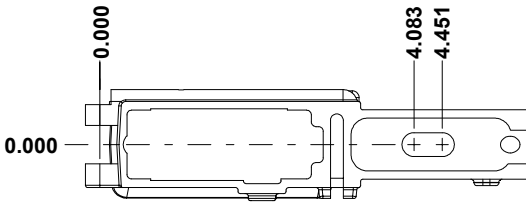




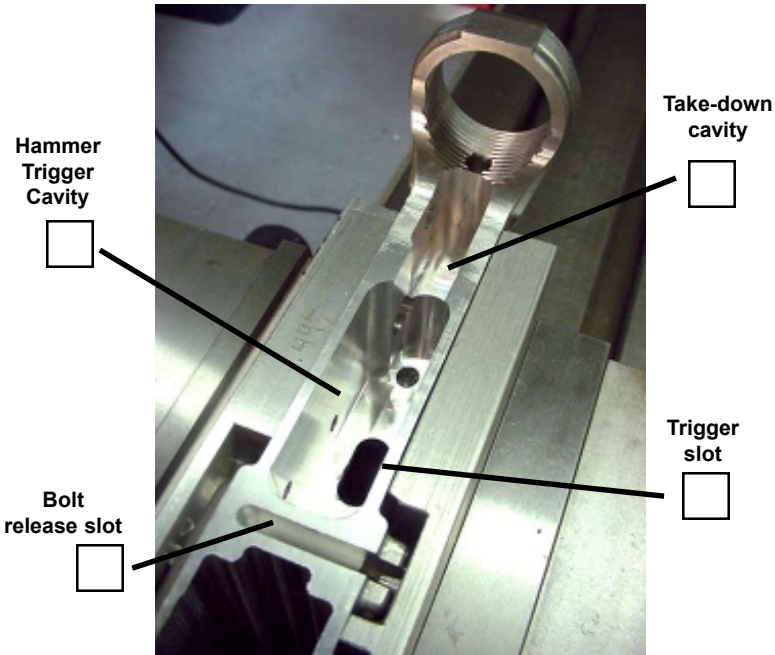
The cavity will be milled out using a 7/16" (0.4375") end mill. This will leave the proper radii in the corners. Refer to the diagram above for the travel limits. It is best to rough it out first leaving about 0.005" per side and on the bottom for finishing. Plunging works well for roughing. Blow the chips out often to avoid binding the cutter.



The last operation will be cutting the slot for the trigger. Drill two 1/4" holes through as shown. Then chuck a 5/16 end mill and mill the slot through using the same center locations.



Clean your machine and then check your work before breaking the setup.



# Chapter 11

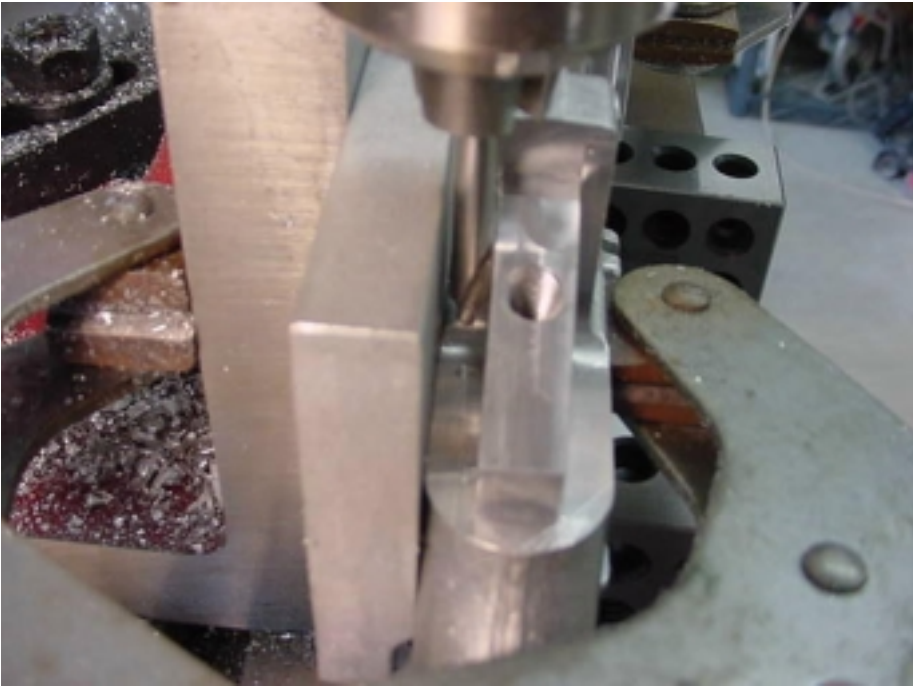
## Safety Detent & Trigger Guard

This is the next to last setup. Be careful now not to rush and make a mistake. Errors are very common near the end of the trail when one begins thinking about the next phase instead of focusing on the task at hand.

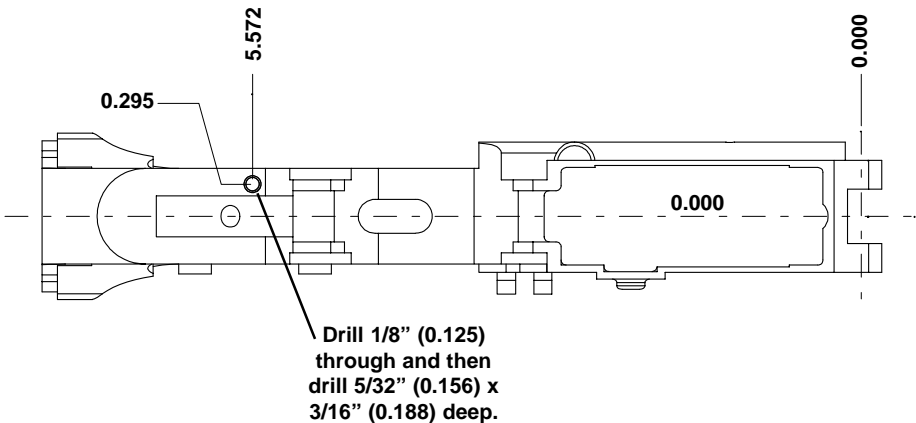
**Workholding:** Support your lower (it is more than 80% complete now so it is no longer a 'forging') on a couple of 1-2-3 blocks and clamp against the angle plate with one clamp at the magazine end. Use something between the clamp and the lower to help distribute the pressure.



**Location:** Edge find the butt face and then add a second clamp once you have your spindle located. Move 7.500" and set your X axis zero over the pivot pin hole. Y axis zero should be the same as the last setup.

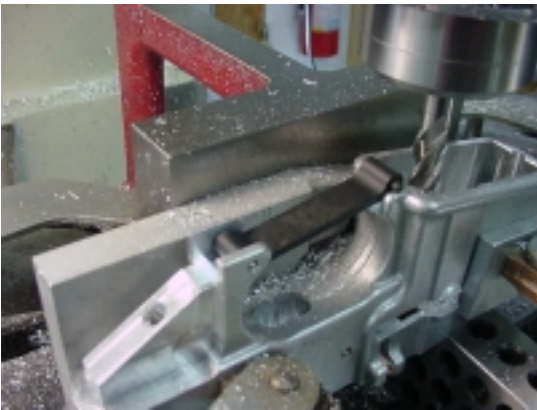


The first thing to do in this setup is the is the safety detent hole. Move back to 5.572" and off the center line by 0.295" and spot the location with a 3/16 center drill. Eyeball it with the safety hole as a double check before you drill 1/8" through. This detent is the headed variety and you must now drill a larger diameter for the head. Use a 5/32 drill, but be careful to only go 0.188" deep or you will be in bad shape.





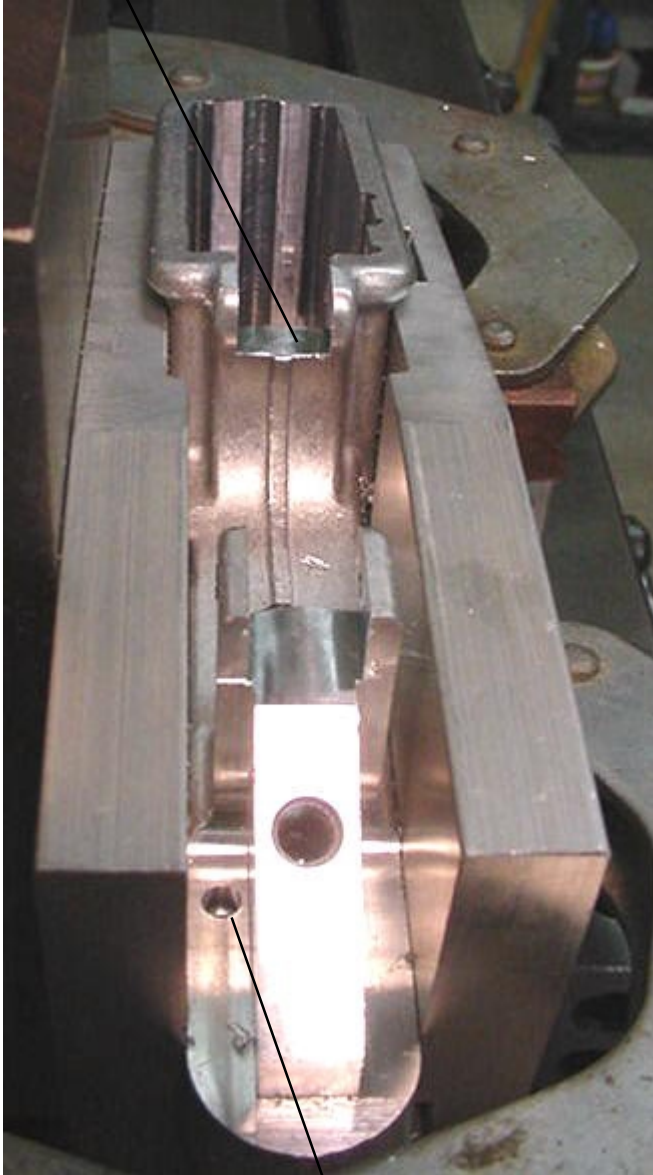
The trigger guard slots are  $7/16$ " wide, but I like to use a  $3/8$ " cutter. While on the centerline, cut down until you are flush with the flat surface of the pistol grip mount and stop there. Now take passes evenly on each side until you have the  $7/16$ " wide slot.



Always check your parts with the feature that is to receive them. I don't have to tell you it is a lot easier now to widen a tight slot than to find out later after you have anodized your work and the trigger guard won't fit!



Trigger Guard



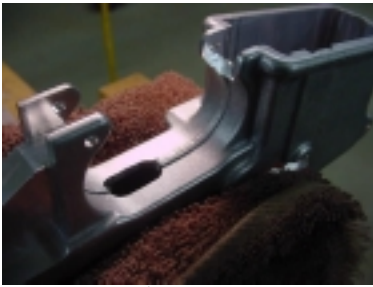
Safety Detent

# Chapter 12

## Finishing Up

Now that you have a working lower receiver, you will want to do some final finishing. Removing forging seams and smoothing sharp edges will take your lower from “home-job” to “nice job!”

You will want to file and sand smooth the forging seams inside the trigger area, front of the mag well and on the curve between the pistol grip and the buttstock.



*Rough trigger area*

Hold your lower in a bench vise using a rag to prevent the vise jaws from marring the surfaces. Be careful not to overtighten!



*Trigger area filed*

A half-round bastard file works well for taking down the forging seams.



*Trigger area polished*

Finish with 240 grit emory paper on the file to take out scratches and file marks.



*Rough*



*Finished*



*Rough*



*Finished*



*Rough*



*Finished*

A carbide burr in a hand grinder is very useful for putting a lead-in on the bottom of the magazine well. The lead-in makes it easier to get the magazine into the rifle. When using power hand tools, grind carefully to avoid cutting too deep. Smooth and finish with a file and sand paper.





*Pick a number, any number!*

Although it is not required by law, it is strongly suggested you put some kind of 'serial' number on the lower. The BATF recommends some kind of identification so the weapon can be returned to you in case it is lost or stolen. I use my old NRA number with a dash one, dash two etc. If you don't number your lower you may spend a night in jail because someone is not all that familiar with the laws and wonders why you have an un-serilaized weapon...

I am blessed with a loving wife who lets me buy just about any machine if I ding-dong long enough. I use a panto-mill to engrave my markings on the lower. If you are using stamps you should have stamped the forging before you did any machining as I mentioned in chapter one. Another option is to take it to your nearest trophy shop and have them laser or diamond engrave it. Have this done after the lower is anodized.

# Anodizing is Easy!

You need a battery charger, lye, battery acid and distilled water, baking soda and dye.

I was pleasantly surprised by how easy it was to get a great anodizing job at home. It is a four step process and if you succeeded in machining a lower, anodizing will be a walk in the park. The four anodizing steps are: clean, anodize, dye, seal.

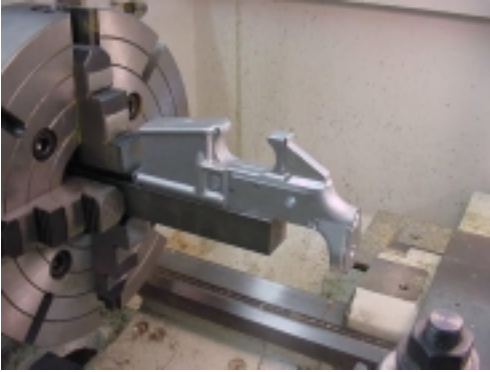
I am not going to detail the anodizing process in this book. You can learn all you need to know from this web-site:

*<http://www.focuser.com/atm/anodize/anodize99.html>*

# Appendix

Tools the author used (in addition to machine clamps and standard number, fraction and letter drills) in order of appearance:

test indicator  
1" end mill  
1-2-3 blocks  
1/2" end mill  
4 x 6 angle plate  
6" Kant Twist clamps  
edge finder  
0.251" reamer  
0.376" reamer  
5/32 reamer  
5/32 end mill  
1/4 end mill  
3/8 end mill  
5/16 end mill  
long 3/32 drill  
boring head  
1-3/16 x 16 tap  
1/4-28 tap  
long #3 center drill  
long 1/8 drill  
3/4 end mill x 3" long  
3/8 end mill x 3" long  
7/16 end mill x 1-1/4"



If you don't want to spring for the 1-3/16 x 16 tap for the buffer tube you can use the alternate method of cutting the thread by single pointing it in a lathe.

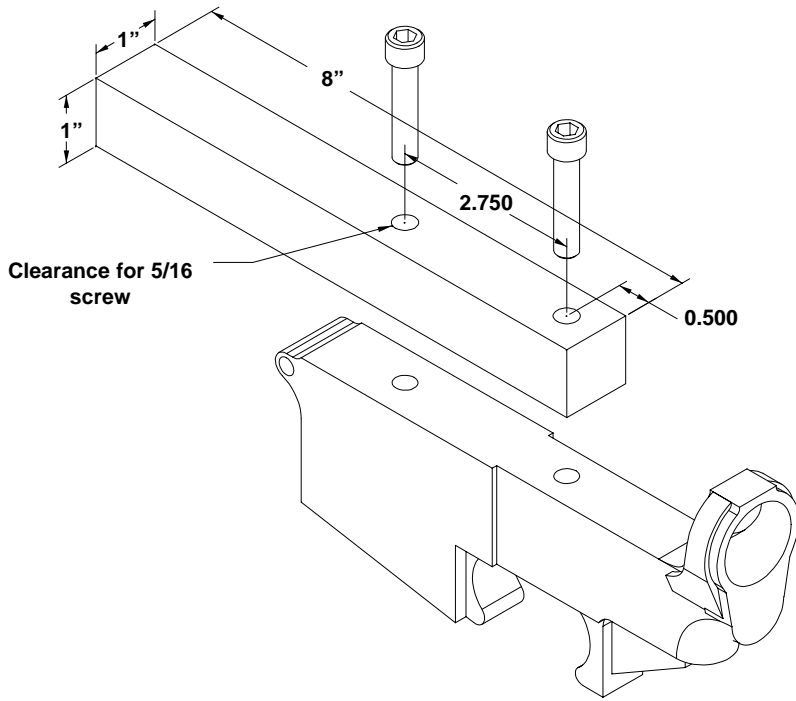
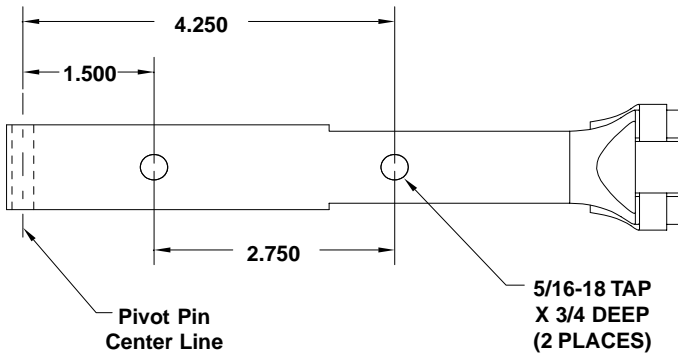
I recommend you bore the 1.125 hole in the mill per page 32 in chapter 5. If you don't have a boring head, drill and ream a hole on location. This hole will be used to locate the lower true to the lathe spindle axis.

If your lathe isn't big enough to swing stout clamps, you may want to drill and tap two mounting holes in the mag well and trigger well areas. Use these holes to screw the lower to your lathe bar.

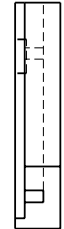
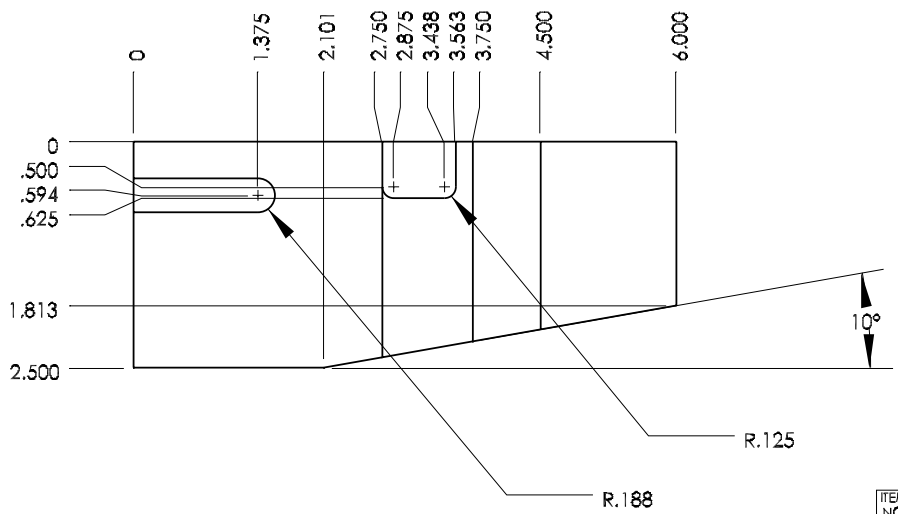
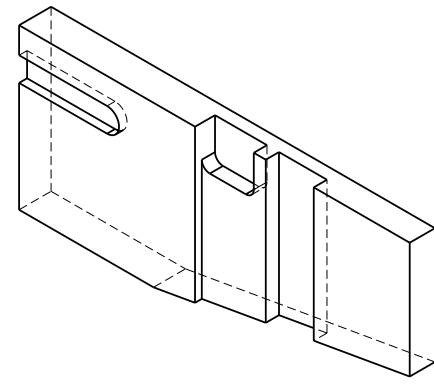
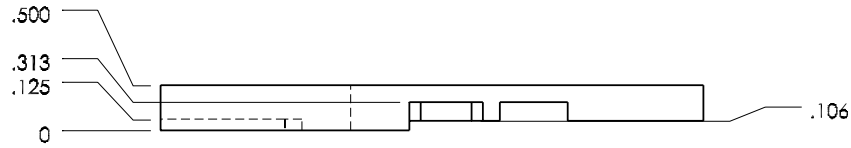
Get a sturdy bar, at least 1" square or better and chuck it in a 4-jaw chuck. Then clamp or screw the deck to one side of the bar. Next, turn the chuck so the forging is horizontal and indicate a cheek to get it parallel to the spindle. Finally, adjust the chuck jaws so your pilot hole is running true.

Now finish boring to 1.125" diameter and single point the internal thread. Use your buffer tube as a gauge.





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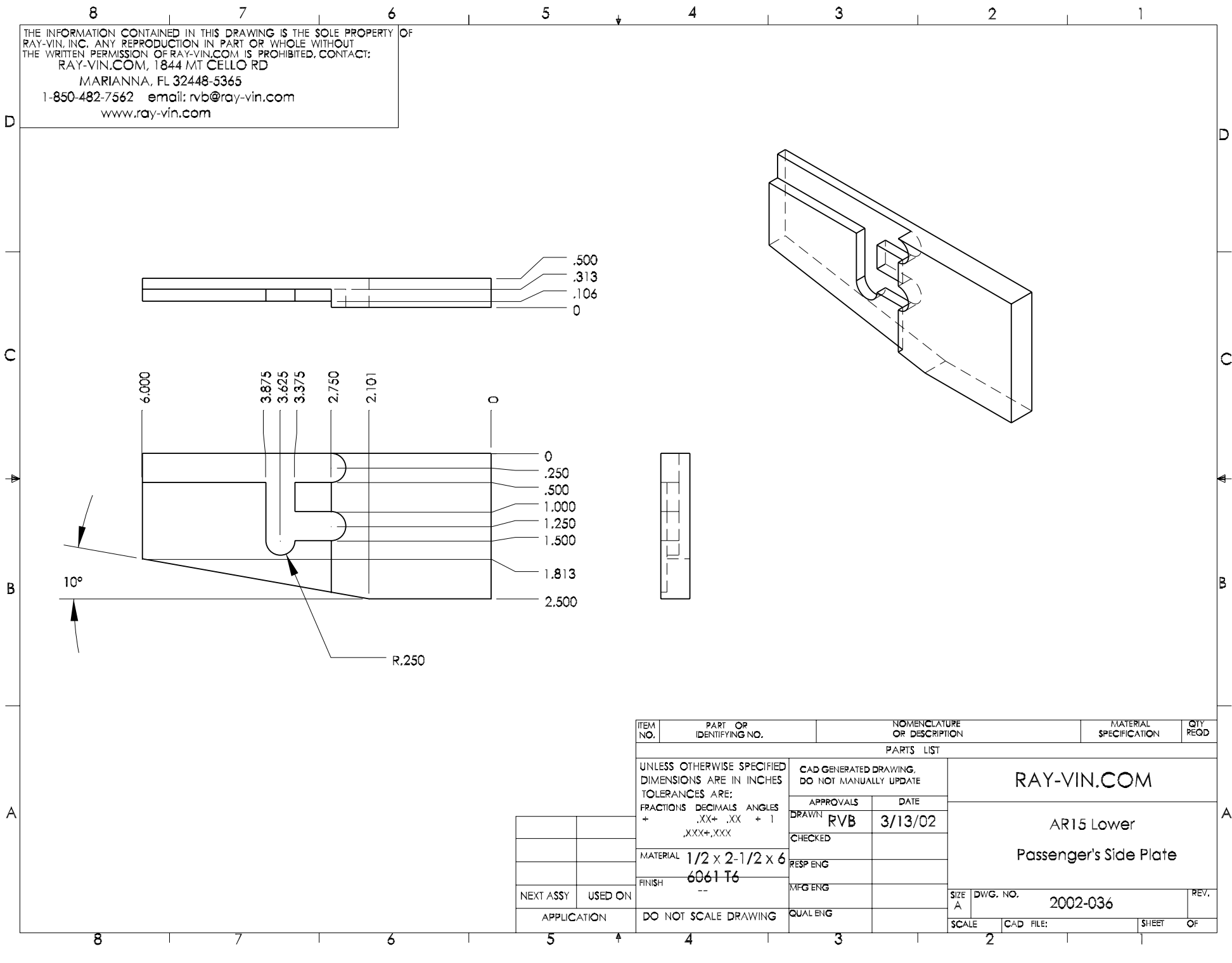
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		MFG ENG		
		QUAL ENG		
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RAY-VIN.COM  
AR15 Lower  
Driver's Side Plate

SIZE A DWG. NO. 2002-035 REV.  
SCALE CAD FILE: SHEET OF

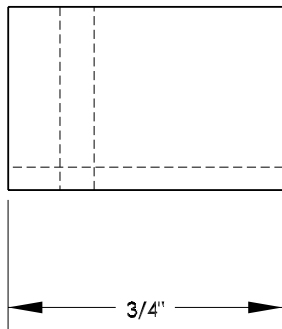
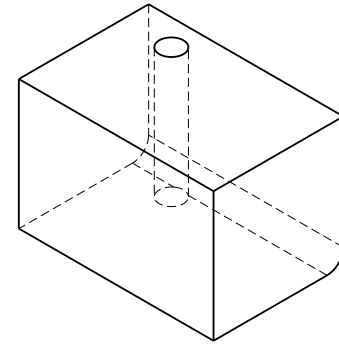
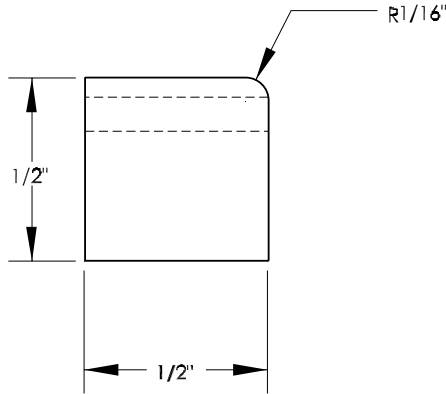
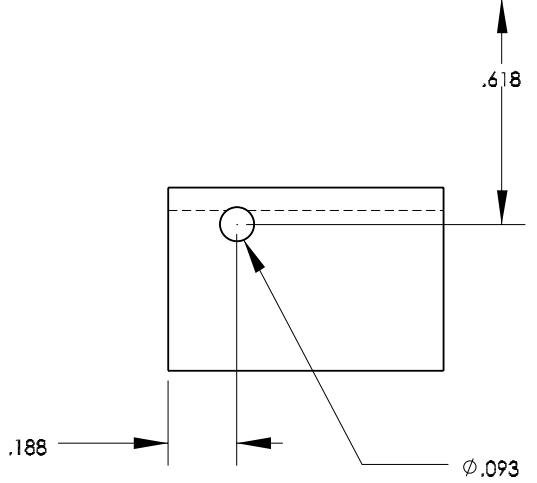
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FORGING CENTER-LINE



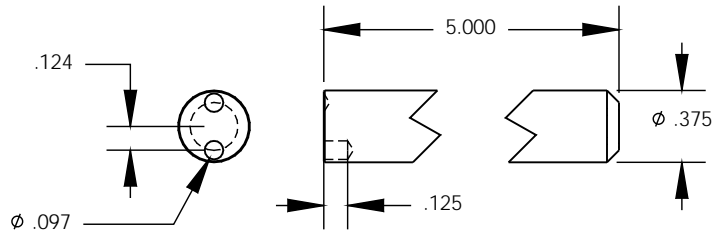
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AR15 Lower  
DRILL GUIDE

REV.  
2002-037



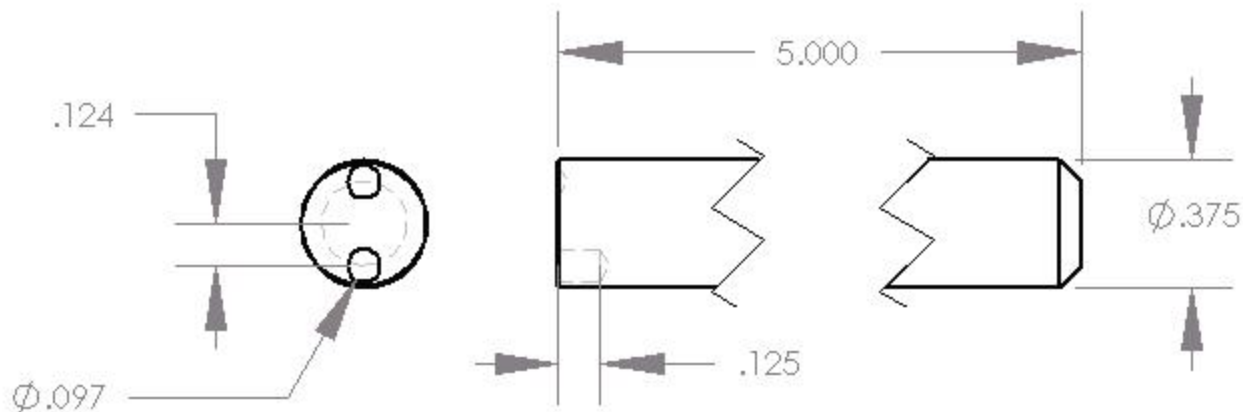
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AR15 Bolt Catch Pin Driver







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