The Corvair Two Cylinder Engine Conversion Manual

Written By: Fletcher Burns

Manual Serial#_____

Purchased By_____

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Return of this document automatically enrolls the builder for manual revisions and additions. This also applies to technical advice to questions encountered during the conversion process. UltraVair Aviation LLC is committed to help individuals build their own engines. Making a profit or producing multiple parts from our information is in violation of this contract, and will not be tolerated. Anyone found to have breached the agreement will be prosecuted under the fullest extent of the law.

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Please fill out this form. Keep one copy for your records
and forward a copy to: S. Toor
395 Hannan Ranch Ln
Petaluma,CA 94952

RECOMMENDED BOOKS

Many books about Corvair engines and Corvair conversions for aircraft use have been published over the years and all are excellent reference material for building the UltraVair. Listed are a few recommended books.

- "**Converting Corvair Engines for Use in Experimental Aircraft" by William Wynne** Conversion Manual (written in 1996 and updated in 1999 and 2002). William Wynne's mission is to help as many people as possible LEARN, BUILD AND FLY through teaching, writing, flying and manufacturing.

- "The Classic Corvair" by Bob Helt An excellent technical and performance guide. Lots of engine information and comparison of the different corvair engines that were produced.

- "**How to Keep Your Corvair Alive" by Richard Finch** How to perform a 20-year overhaul on Corvair engines plus other Corvair info. A new section in the 8th edition also covers the conversion of Corvair engines for use in experimental aircraft.

CORVAIR AIRCRAFT ENGINE INFO

The UltraVair conversion utilizes many of the proven concepts used in the conversion of a full 6-cylinder corvair engine for experimental aircraft use. Much information about these conversions can be found online and in published books. Perhaps the most noted and respected "Authority" on aircraft conversions is William Wynne. His publications and website are a wealth of information and the UltraVair builder may benefit from one or both of these resources. We encourage the UltraVair builder to research and gain knowledge about aircraft conversions as this will further the builders understanding of safe engine construction and design. Listed below are several online sources of information about corvair aircraft conversions.

http://www.flycorvair.com/
Professional airplane builder William Wynne presents all aspects of using the Chevrolet Corvair motor as aircraft powerplant for homebuilders. Wynne is considered one of the country's foremost experts on Corvair aircraft conversions.

http://www.corvaircraft.com/
Promoting the use of the Corvair engine in Experimental Aircraft.

http://www.siinc-sources.com/Corvair/
Parts and info on the corvair engine conversion for aircraft use.

http://home.hiwaay.net/~langford/corvair/
Lots of excellent info and pictures for the corvair aircraft engine conversion

VENDERS AND SUPPLIERS INFO

Corvair Underground Inc

Est. 1974

www.corvairunderground.com

Corvair Underground
Box 339
Dundee, OR 97115
Phone: (503) 434-1648

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www.larryscorvair.com

Larry's Corvair
14919 South Crenshaw Blvd.
Gardena, CA 90249
Phone: (310) 970-9233

Site of the World's Largest Corvair® Parts Supplier Since 1973

www.corvair.com

Clark's Corvair Parts, Inc.
P.O.Box #NET 400 Mohawk Trail
Shelburne Falls, MA 01370
Phone: (413) 625-9776

GREAT PLAINS AIRCRAFT

www.greatplainsas.com

Great Plains Aircraft Supply Co., Inc.
P.O. Box 545
Boys Town, NE 68010
Phone: (402) 493-6507

AIRCRAFT SPRUCE & SPECIALTY CO. SINCE 1965

www.aircraftspruce.com

Aircraft Spruce & Specialty Co.
225 Airport Circle
Corona, CA 92880
Phone: (909) 372-9555

WICKS aircraft supply

www.wicksaircraft.com

Wicks Aircraft Supply
410 Pine Street
Highland, IL 62249
Phone: (618) 654-7447

CORVAIR CLUB INFO

Contact a local Corvair club and see if any engines or engine parts are for sale. By searching some of the websites below, local chapters of the national clubs can be located. Most have a “buy and sell” or classified ad section of their newsletters or websites and these are an excellent resource for locating engines and parts.

Corvair Society of America
P.O. Box 607, Lemont, IL 60439, 630/257-6530
Founded in 1969, it is the largest group of Corvair enthusiasts having several local chapters in every U.S. state including several in Europe. Contact CORSA or search their website for a local chapter and online classifieds. www.corvair.org

CORVAIR INFO ON THE INTERNET

Locate parts using the internet. Some of the websites below offer parts for sale as well as links to other Corvair enthusiasts web pages. Using a search engine to find Corvair engines and parts will reveal many other sites.

http://www.vairbid.com/
VairBid.com is an online auction site for nothing but Chevy corvairs and corvair related items. You can buy bid or sell your corvair parts, corvair engine, corvair accessories, corvair collectables and more.

http://www.corvaircentral.com/
Covering everything having to do with the Chevrolet Corvair. Looking to buy or sell a Corvair, looking for information on a Corvair or just looking, this is the site for you.

http://www.vv.corvair.org/
Virtual Vairs free Internet e-mail Corvair discussion group website.

http://www.corvair.de/
Corvairs in Switzerland and Germany as well as other European corvair web links.

INTRODUCTION

Thank you for purchasing the UltraVair Conversion Manual. We think you will gain a great deal of knowledge and satisfaction during the conversion and construction of your engine. You will also be better equipped to maintain your engine because you will have complete knowledge of all its components. When you are finished you will have a very rugged, simple and inexpensive four-cycle direct drive engine.

This engine was developed as an alternative to the two-cycle and ½ VW conversions currently available. Years of studying how to create a two-cylinder Corvair engine led to this engine. Many questions have been asked about why we settled on this configuration. We chose to use the flywheel end of the engine for many reasons. The engine was designed to transmit its power through this end of the engine. Six-cylinder aircraft engines produce three times the power and transmit it through this end of the engine, so we don't feel we are over-stressing anything. The timing gears are already in place with this end of the engine and the bell housing completes this end very elegantly. The only thing missing from the flywheel end is the oil pump and ignition system, this conversion solves these problems.

Weight was an important factor in every decision about this engine. The magneto used on this engine weighs much less than a distributor, coil and battery. To use the opposite end of the engine and make use of the existing oil pump meant using the Corvair back housing, oil pump and distributor. The UltraVair's back cover and oil pump weigh much less than the Corvair's back housing. The thrust bearing could have been retained in its original position, but the timing gears, camshaft bearing size difference, camshaft thrust bearing, and front engine cover complicated using this end of the engine. A VW type prop flange could have been used in place of the pulley, but this end wasn't designed to transmit power.

The choices we made were also based on what would require the least amount of machining and welding. The crankcase can be completed with no welding and the heads can be welded in about half an hour. It seems a shame to throw away the rest of the engine, so we are continuing to explore ways to use the other end.

We at UltraVair Aviation are committed to helping you through your conversion. We are a collection of aircraft mechanics, machinists and welders. Since this manual was written using knowledge gained from our backgrounds, you may find terms or concepts unfamiliar to you. We are counting on your feedback (e-mails, phone calls or letters) to continuously improve and clarify this manual. If you find something unclear to you, please let us know so we can revise this manual and help you and the next individual.

ABOUT THIS MANUAL

This manual is intended to guide you through the conversion of a General Motors Corvair engine into a 2 cylinder opposed engine. The methods and concepts in this manual are by no means the only way this can be accomplished. No guarantee is expressed or implied that in following this manual you will enjoy the same level of success we have. We have no control over your accuracy or judgement and make no claim that you can build an airworthy engine with this manual. If you choose to build an engine using our manual, you do so at your own risk. We at UltraVair Aviation assume no liability for your actions. You as the builder are responsible for determining the airworthiness of every aspect of your engine including whether the materials and methods in this manual are adequate for your use.

The steps necessary to convert your manual require straightforward machine shop and welding practices. At first glance this may seem to be a formidable project, but when taken a step at a time it becomes very manageable. This manual is not machine shop-101. It is assumed that you have the skills to do this conversion or that you can find someone who can accomplish the tasks beyond your capability.

This manual is not an overhaul manual for the Corvair engine. We have not included every tolerance, clearance and torque value. This information is readily available through many other sources. The only changes from standard Corvair engine rebuilding practices are in the head and crankcase bolt torque patterns. Simply use a criss-cross pattern using the values in the Corvair shop manual.

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Please do not copy any part of this manual. If you are building the UltraVair engine, you need your own set of plans. Years of research went into the development of this engine and writing this manual. The price you paid for this manual is miniscule when you think of the thousands of hours of research you are getting. Remember copying copyrighted material is illegal. Please also bear in mind that the purchase of this manual authorizes you to build the components for one engine. It does not license you to build parts or engines for profit. If you want to build engines or components for profit contact UltraVair for a licensing agreement.

ENGINE SELECTION

This manual's intended use is for the conversion of 1964 through 1969 164 cubic inch Corvair engines. Earlier engines had a displacement of only 145 cubic inches and would probably not produce sufficient power. There are several different models of the 164 cubic inch engines. The correct engines are the 95 and 110 hp engines, they are identified by having one carburetor on each cylinder head and one of the following last two letters in their identification number:

For 1964, 164 cubic inch engines the identification number will end in,
YC, YL, Z, ZH, or ZD, for 95hp engines
YN, YM, ZF, or ZG, for 110hp engines

For 1965 through 1969, 164 cubic engines the identification number will end in,
RA, RE, RG, RJ, RS, RU, RV, RW, AC, or AD for 95hp and 110hp smog legal engines
RD, RF, RH, RK or RX for 110hp engines.

The engine identification number is located on the top of the crankcase centerline at the rear of the engine just behind the top cover.

If you find parts of engines or partial engines look for the numbers 8409 on the crankshaft.

Selecting the proper cylinder heads is essential to building an engine that will last. There are several different combustion chamber designs but not all are suitable for your engine. Study the photos showing the combustion chamber. You need heads having the flat "squish" area in the bottom half of the chamber. Borrowing from William Wynne's extensive research into detonation, we feel that these are the only heads you should be flying. The open chamber-head without this "squish" area are more prone to destructive detonation, so they should be avoided. Look for one of the following numbers on the end of the rocker area

For 1964 engines look for head numbers 3819876, 3886256, 3856631, 3886257, or 3856632. 1964 engines had a slightly smaller cylinder opening in the heads and slightly thinner wall thickness at the top of the cylinders. So if you use 1964 heads, you must uses 1964 cylinders. You also must know what cylinders and heads you are using when you buy your head gaskets. Don't make the mistake of putting 1964 cylinders inside of 1965 through 1969 heads. They will physically go in the holes, but they will be very loose and won't work.

For 1965 through 1969 engines look for head numbers 3856743, 3856759, 3878561, 3778562, 3878566, 3883863, 3856743, or 3878569.

We encourage you to purchase William Wynne's manual or visit his website at www.flycorvair.com. He has a lot of good information on parts selection, specifically, which heads to use and not to use.

There are other 164 cubic inch engines with two carburetors on each cylinder heads but they are not good candidates for conversion into ultralight engines. They have the same crankshafts and crankcases but they have much larger valves intended for power at much higher rpm's than we will see. You could use the bottom end of these engines and sell or trade the heads for the ones you need. There are several good sources for determining the correct engine. The Corvair Underground sells a parts manual which lists the location and meaning of the engine codes on the engine block and cylinder heads. The Corvair Underground parts manual also lists all of the parts needed to properly rebuild your engine.

When searching for your engine, keep in mind that you don't need a complete engine. Partial engines are usually less expensive than complete engines. You don't need the carburetors, alternator, cooling fan and shrouds, exhaust manifolds, or distributor. You only need one cylinder head, so if the top end is missing off of one side you still have enough parts. You will need to keep a left side connecting rod on the left side of the engine and a right side rod on the right side of the engine. You will need both valve covers. You can also use an engine that has a bad crankshaft or block in the rear half of the engine because you will be cutting it off anyway. We have had engines given to us for free because of a spun bearing or other problem making the engine junk for six-cylinder use. Once you find an engine you'll probably find the person who has it knows where a lot more are.

GETTING STARTED

Take your engine to the car wash and get it as clean as you can, they are usually filthy The gaskets and seals used in the 1960's weren't as good as today's materials. This is a good thing though because these old engines are usually well preserved inside and out with oil. You will need a good Corvair engine overhaul manual to determine wear limits, tolerances and torque values. Your local library usually has a manual that you can copy the needed information from.

Disassemble your engine and clean and inspect everything. Using the information from the overhaul manual, determine the condition of all of your parts. You may need to have your crank reground, if so have it done before you cut it because you will be cutting off the rear of the crankshaft needed to center it in the grinder. Tell your crank grinder that only the front 2 main bearings and rod bearings need to be ground. If your crank measures within limits you can just get new bearings. Corvair crankshafts are very tough and it's entirely possible that it won't need to be reground. Check your cylinders for wear and taper. On the prototype engine we picked the best two of the six we had and honed and re-ringed them using the stock pistons and new rings. The best way to go here is to send two of you cylinders to one of the Corvair shops, let them re-bore them and use forged pistons. Make sure to only use pistons with the wrist pins offset the way GM intended them to be. We have found that some Keith Black pistons don't have this wrist pin offset.

We are aware that big-bore VW cylinders and pistons are being used to increase power in six-cylinder Corvair engines. We haven't test this concept on the UltraVair engine.

CRANKCASE

One very nice feature of the Corvair engine is that it has flat milled surfaces making set-up simple for all the steps required for this conversion. We will be referring to the engine as if it were in the tractor configuration, that is, the prop flange is at the front of the engine and the magneto is at the back. Left and right on the engine will be from the pilot's perspective sitting behind the engine.

The first step in converting the crankcase is to add a dowel tube in the crankcase through bolt-hole as seen in the following photos. This dowel tube is needed because there are two dowel pins in the crankcase to maintain proper alignment of the two halves, but one of them is in the part of the crankcase you will be cutting away. Enlarge the crankcase through bolt hole in the lower left side of the case (the hole that will be in the back of the engine after cutting) with a ½ inch drill bit as shown on a good drill press. Bolt the cases back together leaving out the one bolt in the hole you just enlarged and drill from the left side again and at least ½ inch past the centerline of the crankcase into the right side. This time you can use a hand electric drill guiding through the hole you drilled in the drill press. Make the dowel tube out of ½ inch x .035 4130 steel tubing 3.375 inches long and press it into the ½ inch hole using red Loctite until it is flush with the outer surface of the bolt hole on the left side of the engine. You will probably have to run a 7/16 bit through the tube after the Loctite dries, then the bolt can be installed and the crankcase can be cut as shown in the photo.

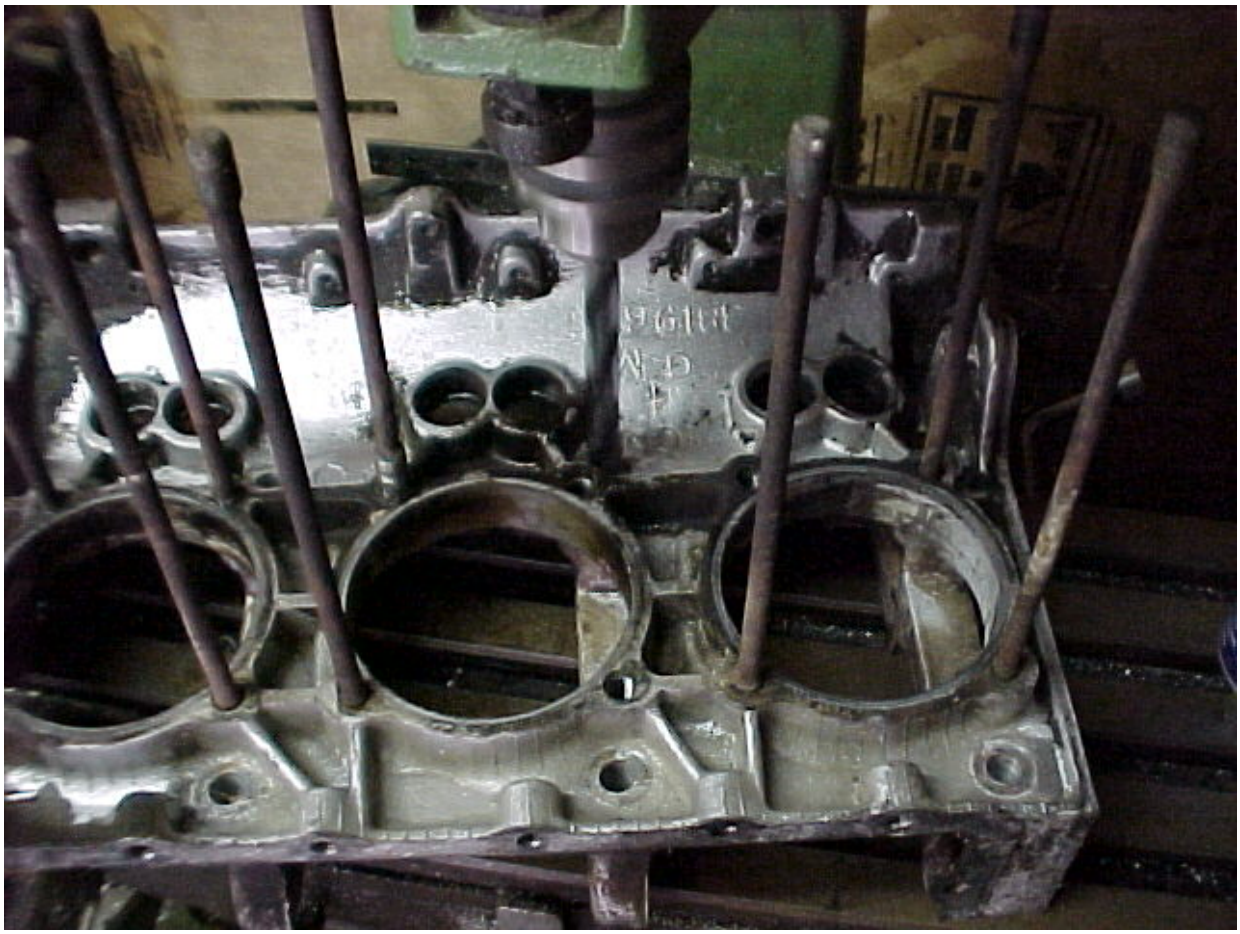
Remove the two cylinder studs on the left side in the front of the unused cylinder hole. Also remove the top front stud on the second cylinder from the front on the right side. You will be cutting right through this stud hole. Study the photos carefully and you will notice that you need to cut the case just behind the threaded bosses for the top cover and oil pan bolts. You will also be cutting right between the two lifter holes on the left side. The case will be milled off to 7.250 inches from the front gasket surface, so measure carefully and cut the crankcase longer if anything, it can be milled off easily. One unused lifter hole on the left side will need to be welded, or plugged before milling, see photo. Welding the hole is cleaner, but if you want to you can make a plug out of the .375 inch thick aluminum you are making the back plate out of. Cut a circle of the aluminum with a 3/16 inch hole in the center that fits snuggly in the lifter hole. Coat the lifter hole and the plug liberally with JB weld and bolt the plug in with a larger washer inside the case. Bolt the plug up tight against the shoulder of the lifter hole with a AN-3 bolt and nut, then let the JB weld dry before milling the back surface of the crankcase. The unused remainder of the cylinder hole on the left side will become the oil fill tube. You will need the case milled flat on the backside to the 7.250 inch dimension as shown in the photo. You will also need to cut off the protruding lifter bore and cam tunnel in the center of the engine as shown. We cut this off with the band saw but you can also use a saws-all.

The crankshaft thrust bearing is moved from the rear main bearing web to the new rear of the engine. This web must be faced off to the dimensions shown in the photo to fit the

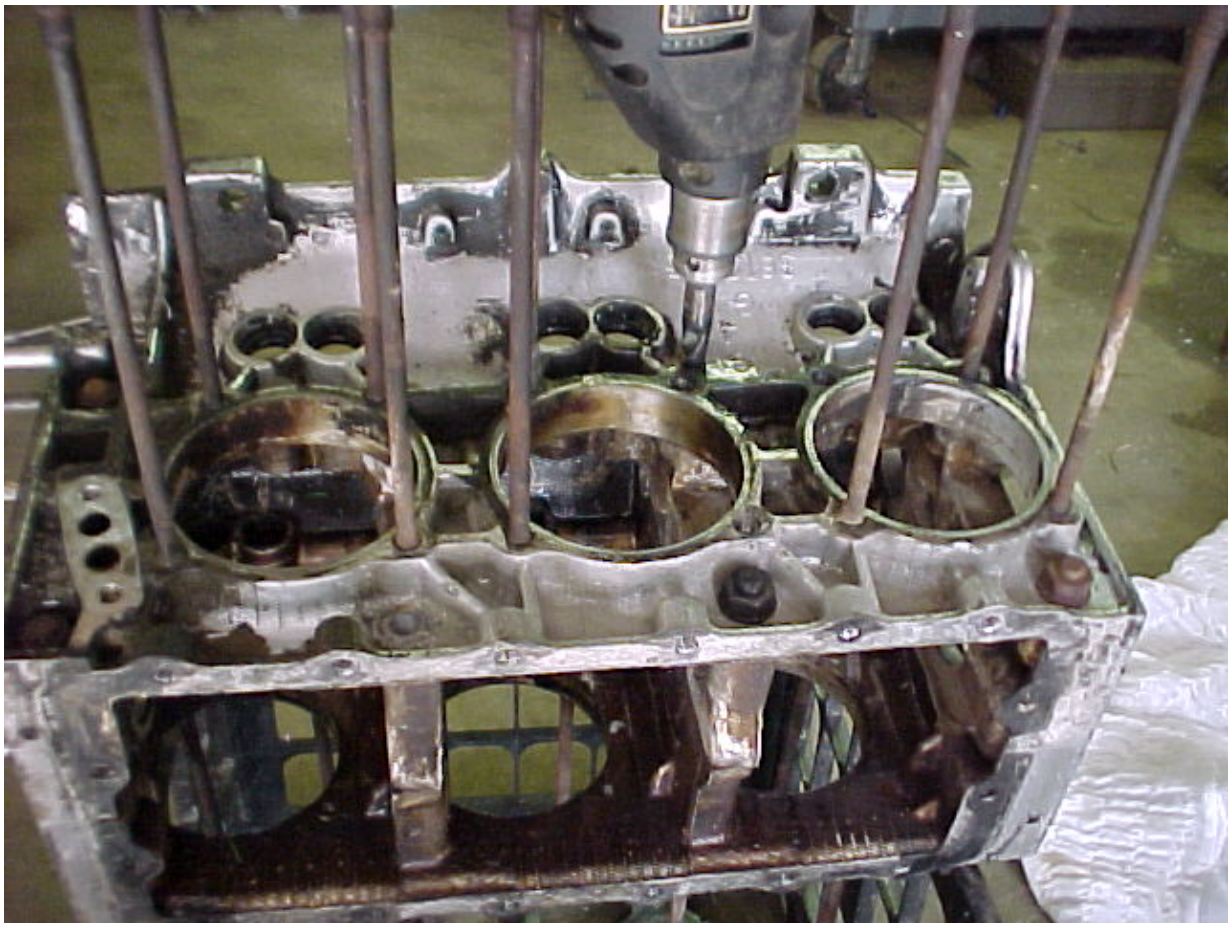
thrust bearing shells. Basically you are machining the main bearing web to match the way GM did it in the back of the engine so study the existing main bearing web. Please note that the front of the new rear main web is machined just until it cleans up all the way around. The rear of the rear main web is then machined to .810 inch to fit the thrust bearing shells. These steps place the crankshaft as close as possible to being centered in the cylinder holes. The main bearing tang notches in the block may have to be filed to match the tangs on the bearing shells.

Keep a set of your old main bearings for clearancing the inside of the crankcase to clear the counterweights added to the crankshaft. Place the crankshaft in one half of the block using your old main bearings and mark anywhere the counterweights touch the inside of the block. Remove the aluminum slowly with a rotary file or four inch angle grinder. Repeat for the other side. Don't take off any more than you have to paying careful attention to the oil galley protrusions for the main bearings. You need .030 clearance between the counterweights and the inside of the block.

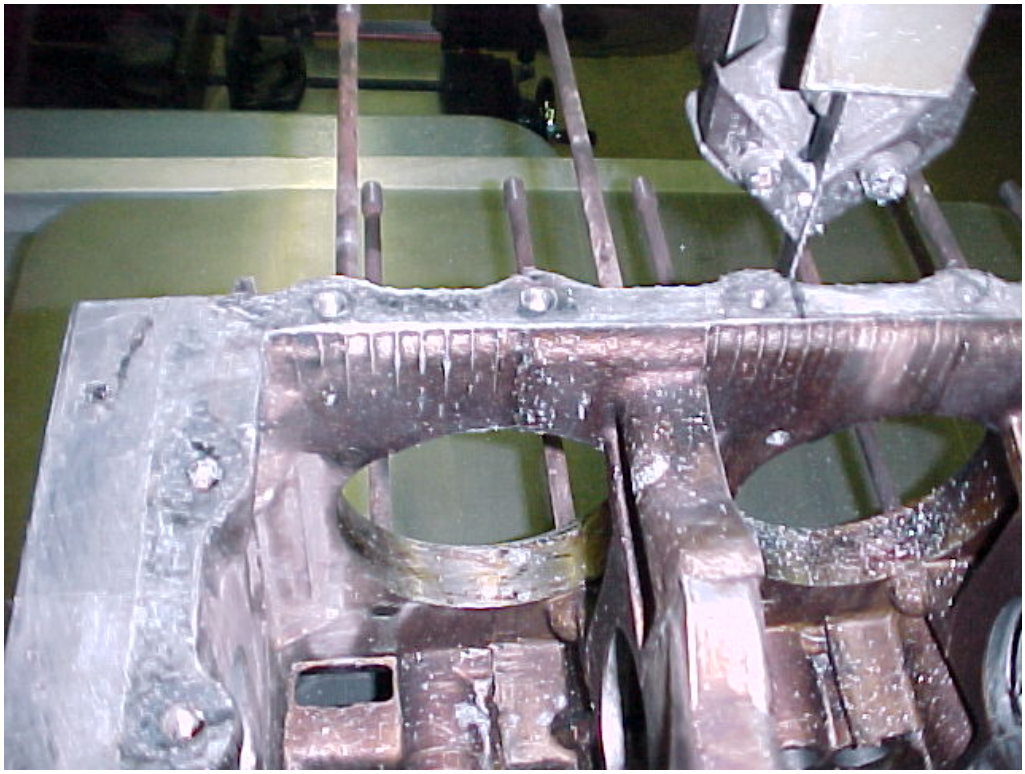
Tap the oil passage holes ¼ npt for the oil supply lines, see photo in back cover section. Install ¼ npt male to female elbows into the oil passages as shown making sure they go in far enough to clear the back cover, but not so far that they will block the flow of oil to the rear lifters. The oil supply lines are made up out of 3/8 6061-T6 tubing and AN fittings. The AN part numbers are called out on the photo.



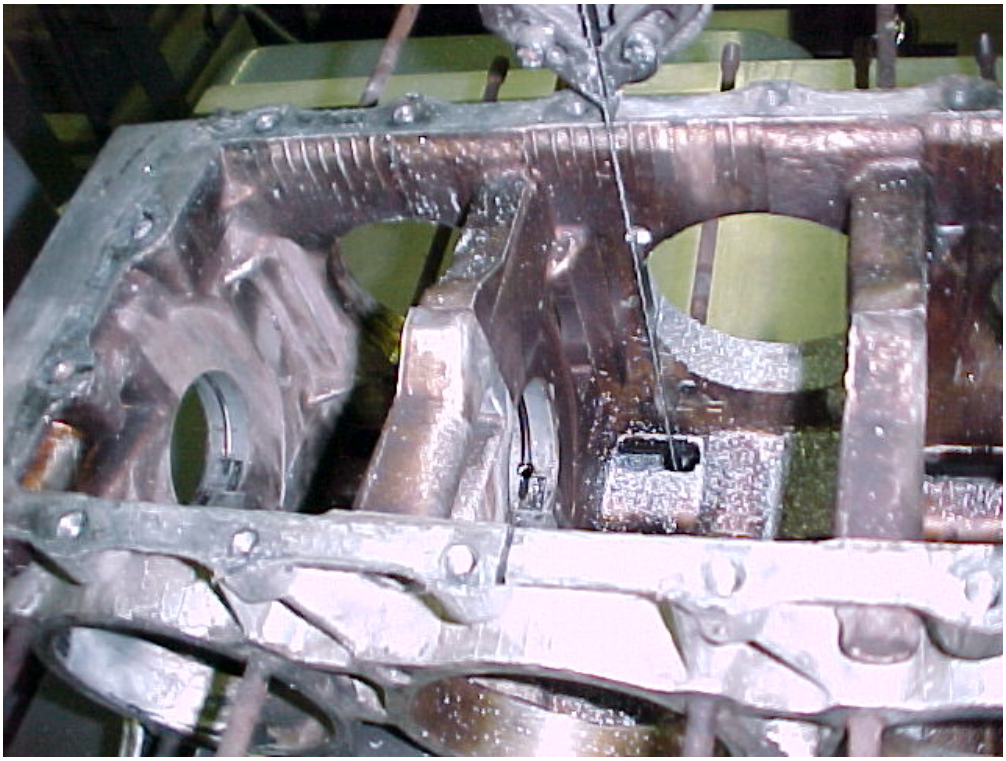
LEFT SIDE CASE BOLT HOLE BEING DRILLED ON A DRILL PRESS WITH A ½ INCH DRILL BIT.

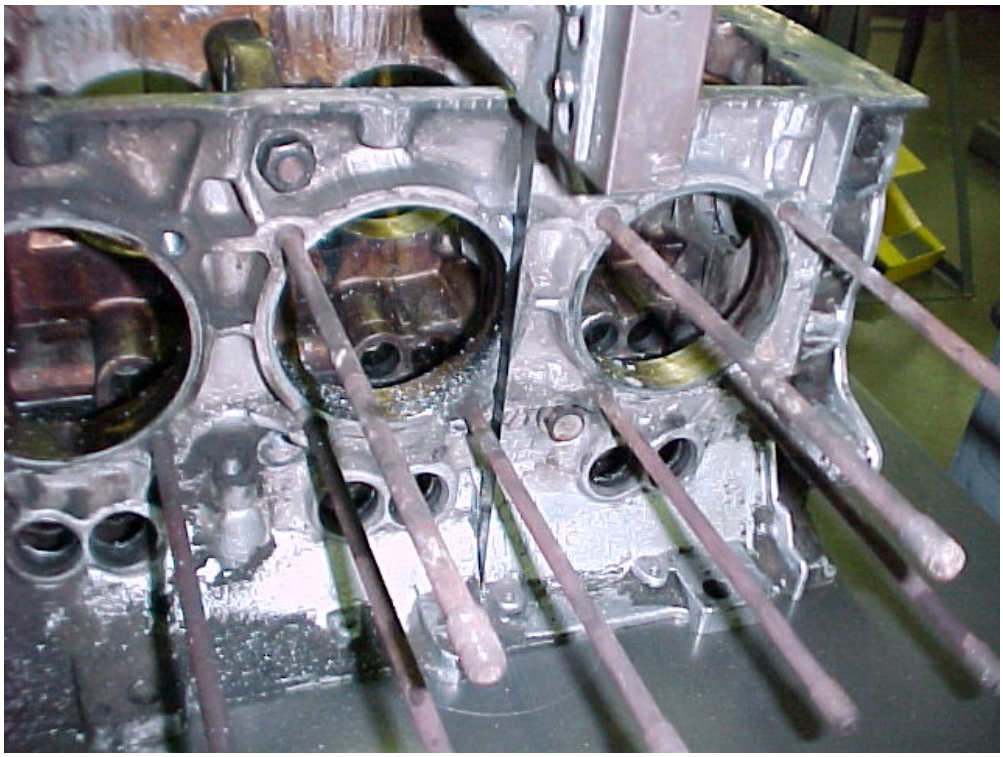


CASE HALVES BOLTED TOGETHER AND DRILLING AT LEAST ½ INCH PAST ENGINE CENTER LINE INTO RIGHT SIDE OF CASE.

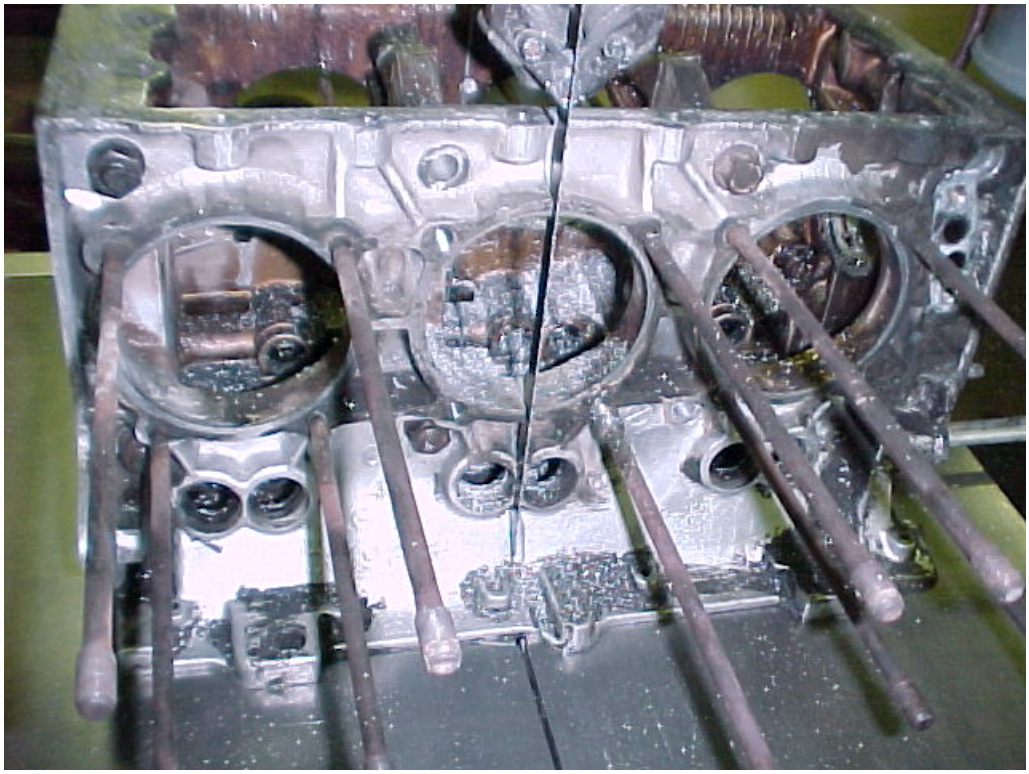


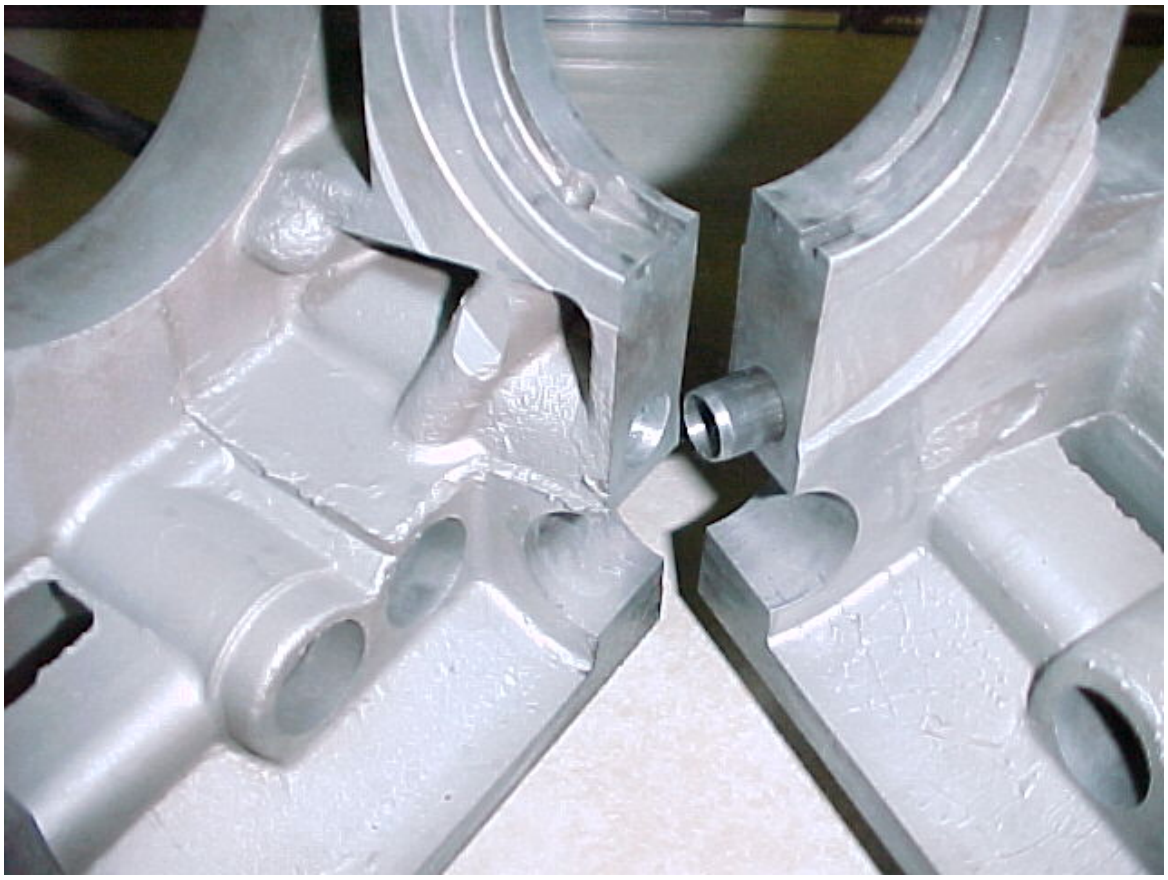
⇐FWD
CUT AFT OF 3RD TOP COVER BOLT HOLE ON RIGHT SIDE OF CRANKCASE.



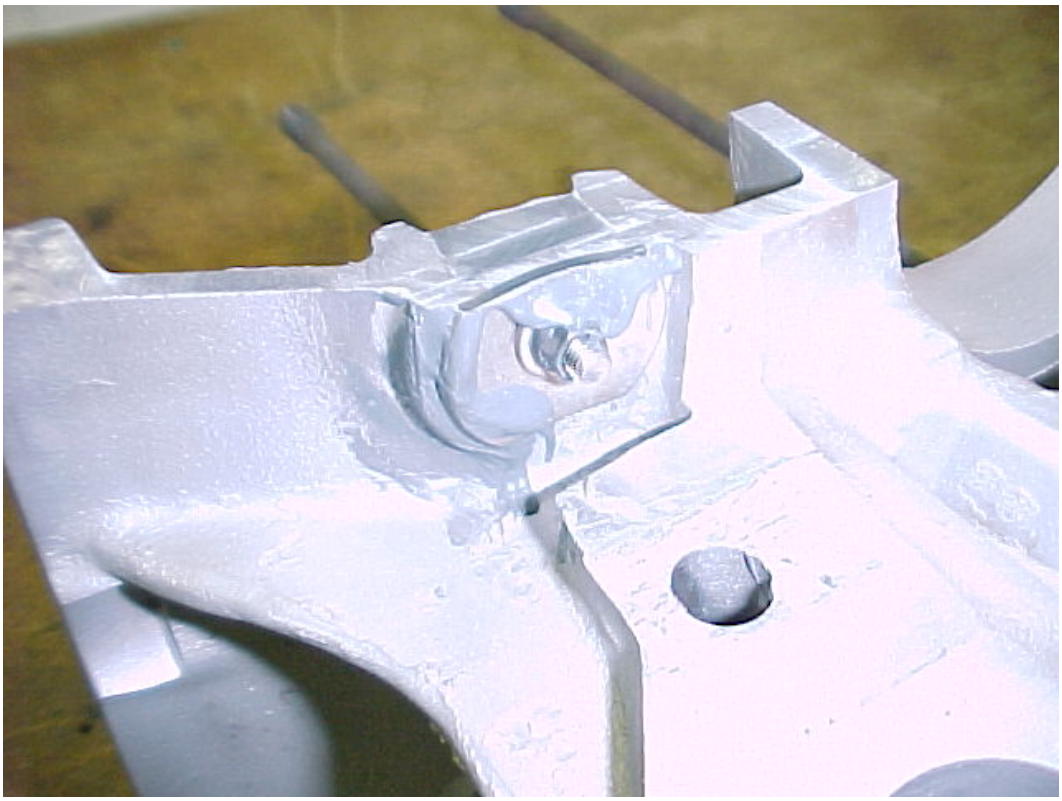


FWD⇒
CUT THROUGH UPPER CYLINDER STUD HOLE ON RIGHT SIDE

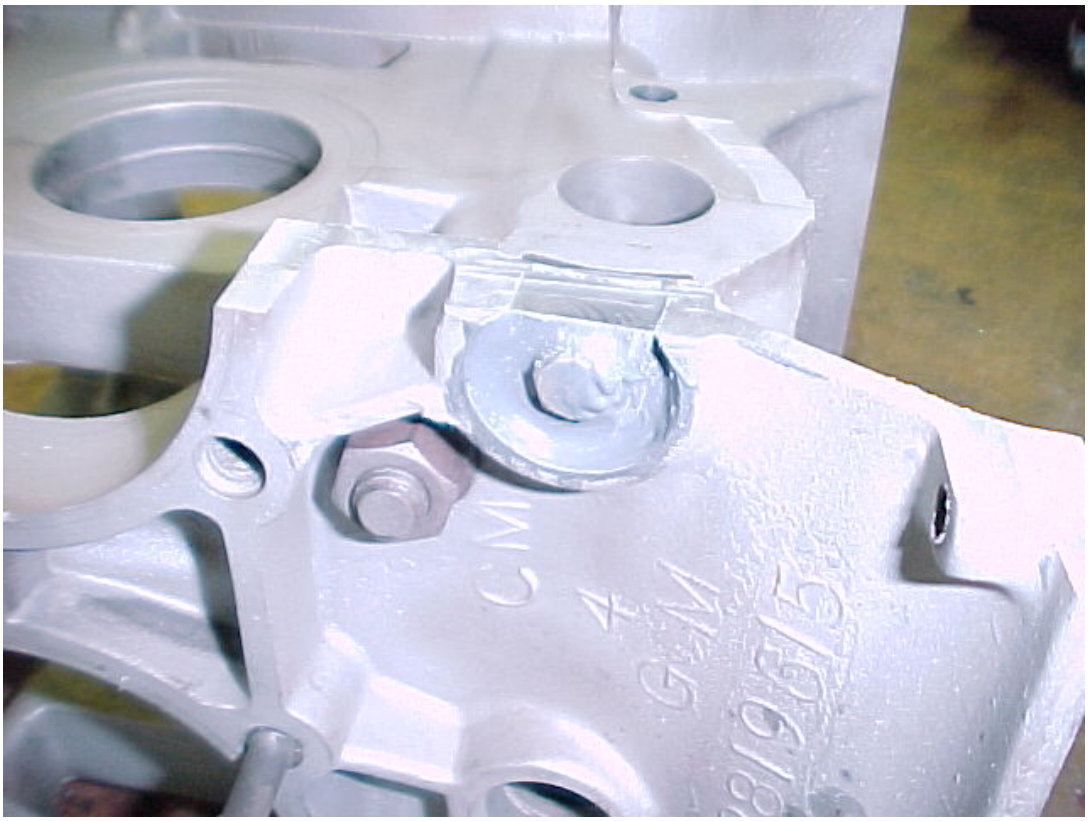




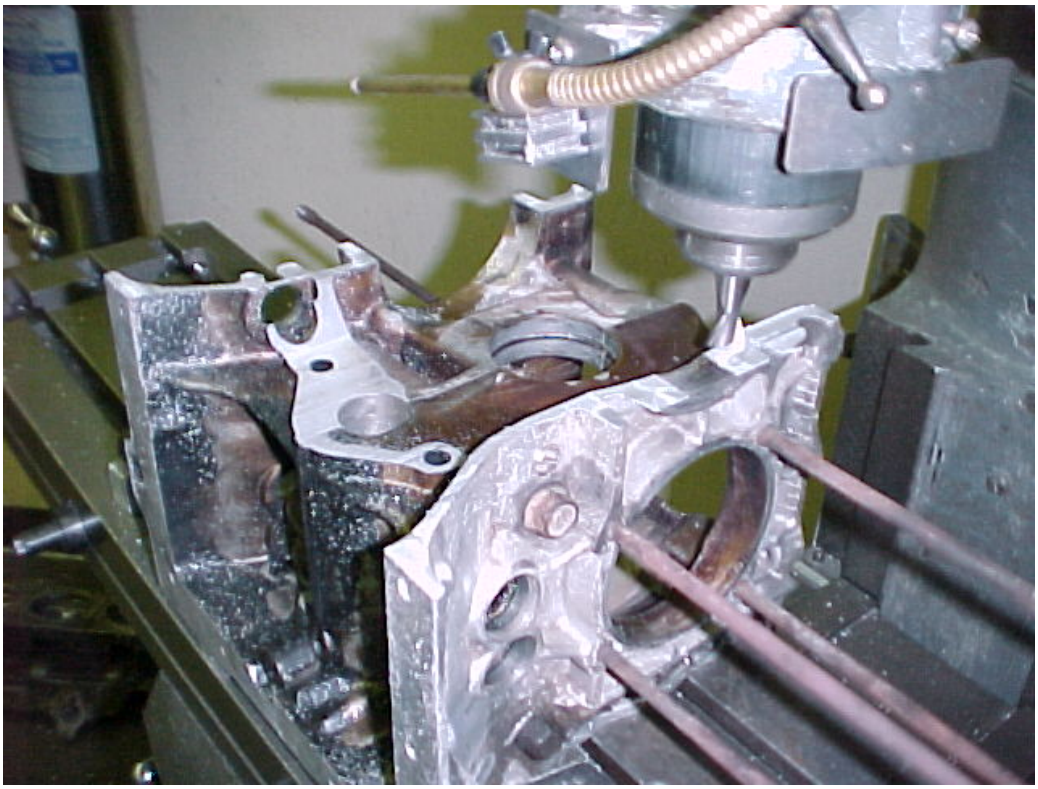
VIEW LOOKING AFT AFTER THE CRANKCASE IS CUT SHOWING THE ALL IMPORTANT DOWEL TUBE.



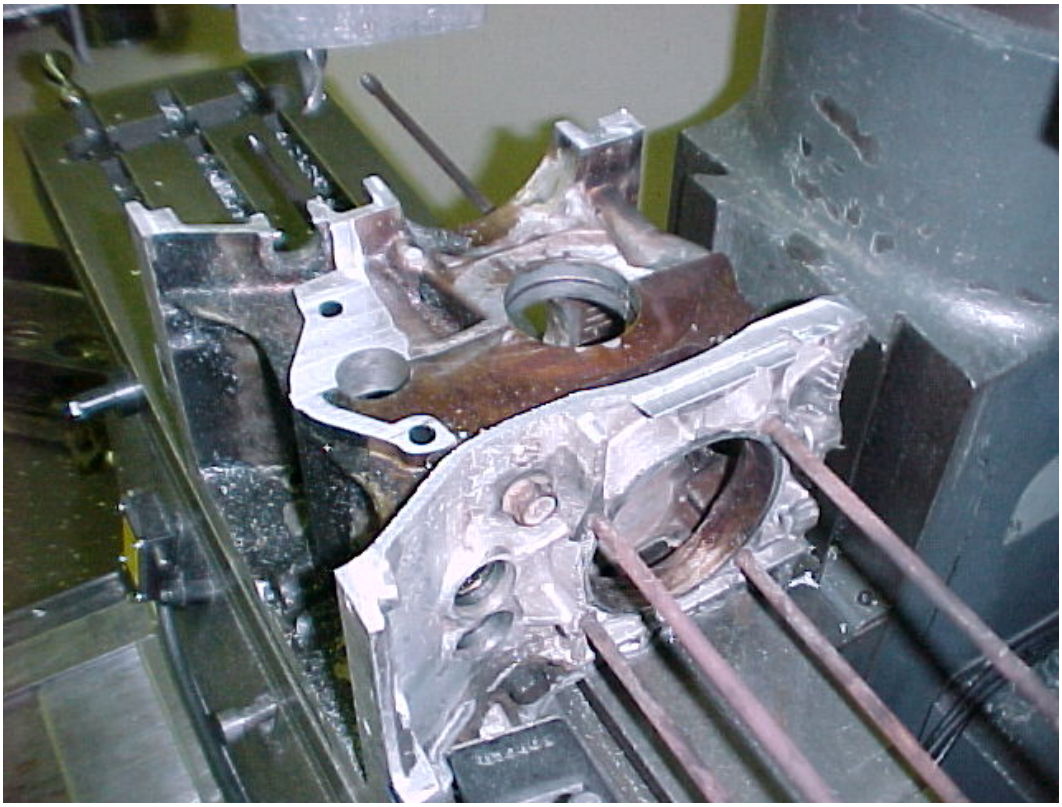
UNUSED LIFTER HOLE ON LEFT SIDE PLUGGED AND MILLED OFF.



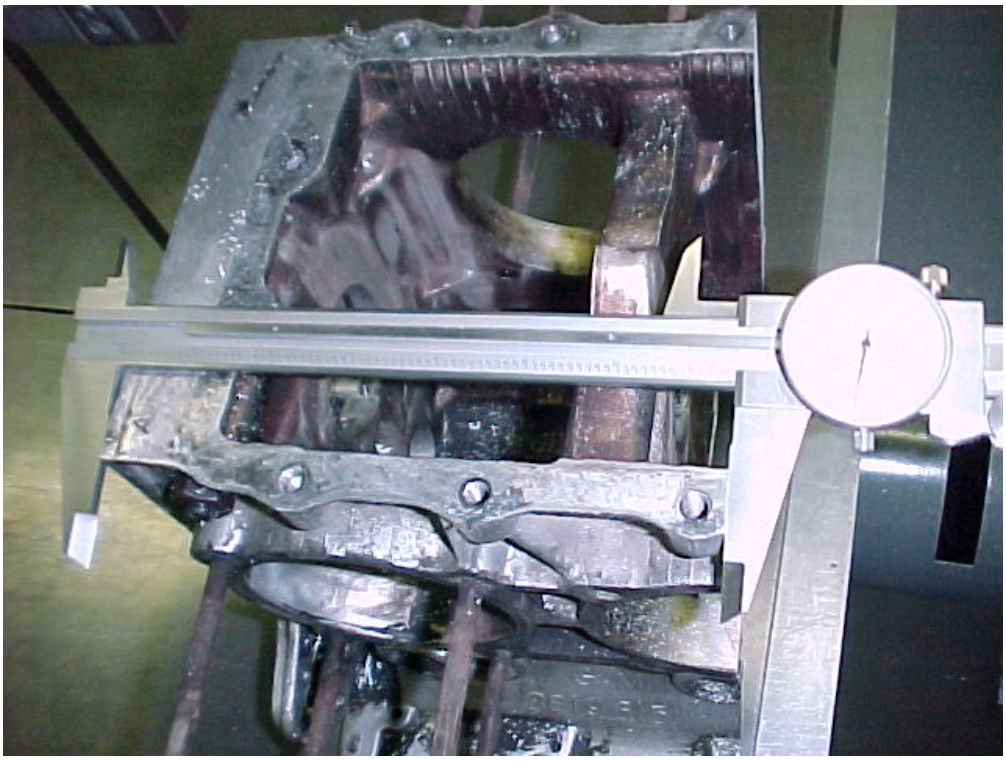
LIFTER PLUG SHOWN FROM OUTSIDE



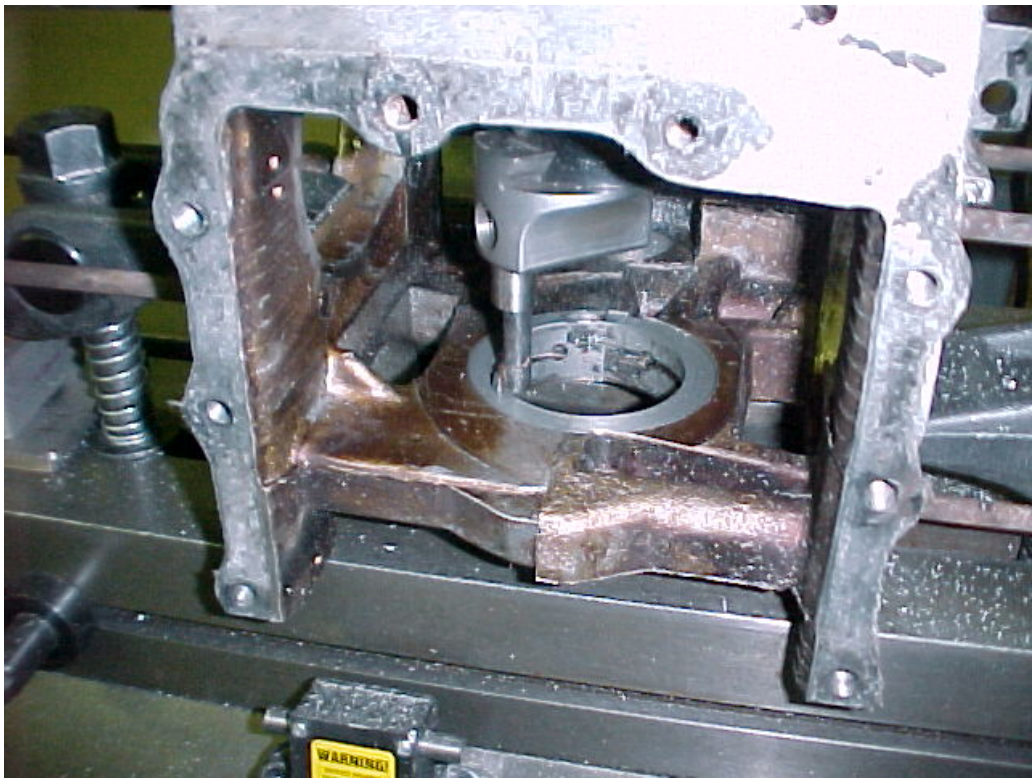
CRANKCASE CLAMPED DOWN IN MILLING MACHINE FRONT COVER SURFACE DO NOTICE CAM TUNNEL AND LIFTER BOSS CUT OFF.



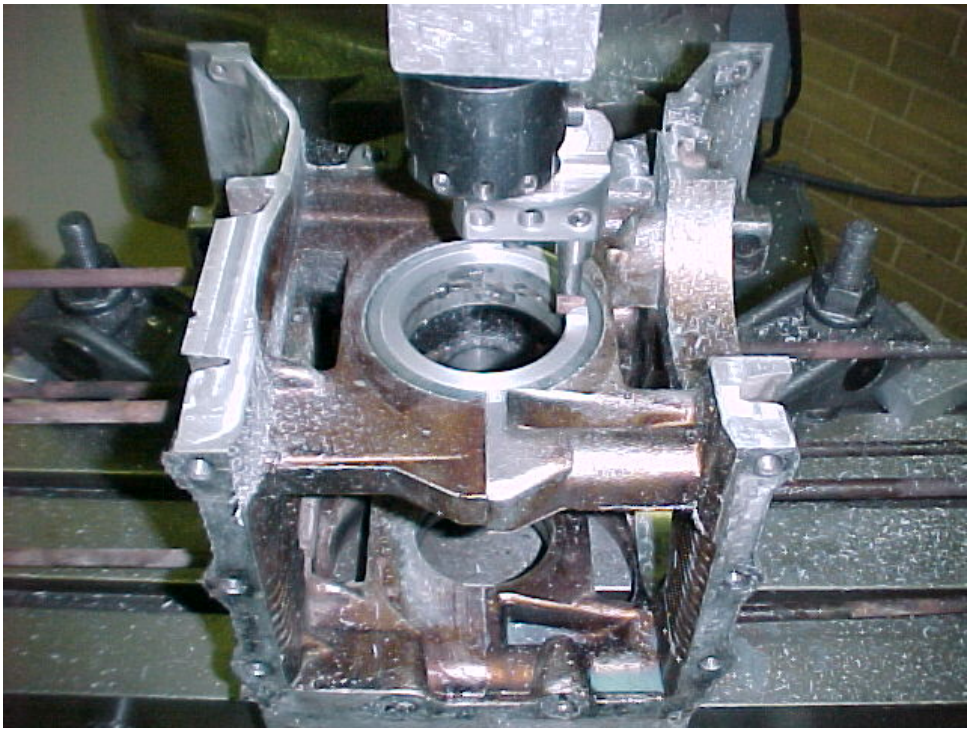
CRANKCASE REAR SURFACE AFTER MILLING.



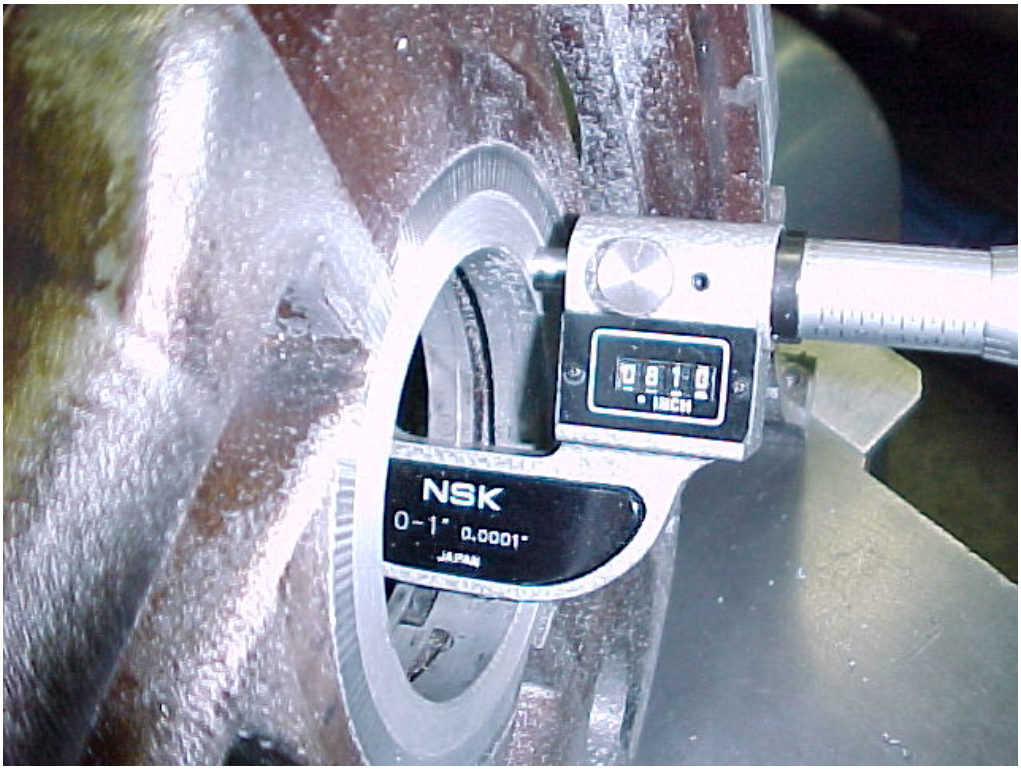
CRANKCASE MILLED TO 7.250 INCHES FROM FRONT COVER GASKET SURFACE



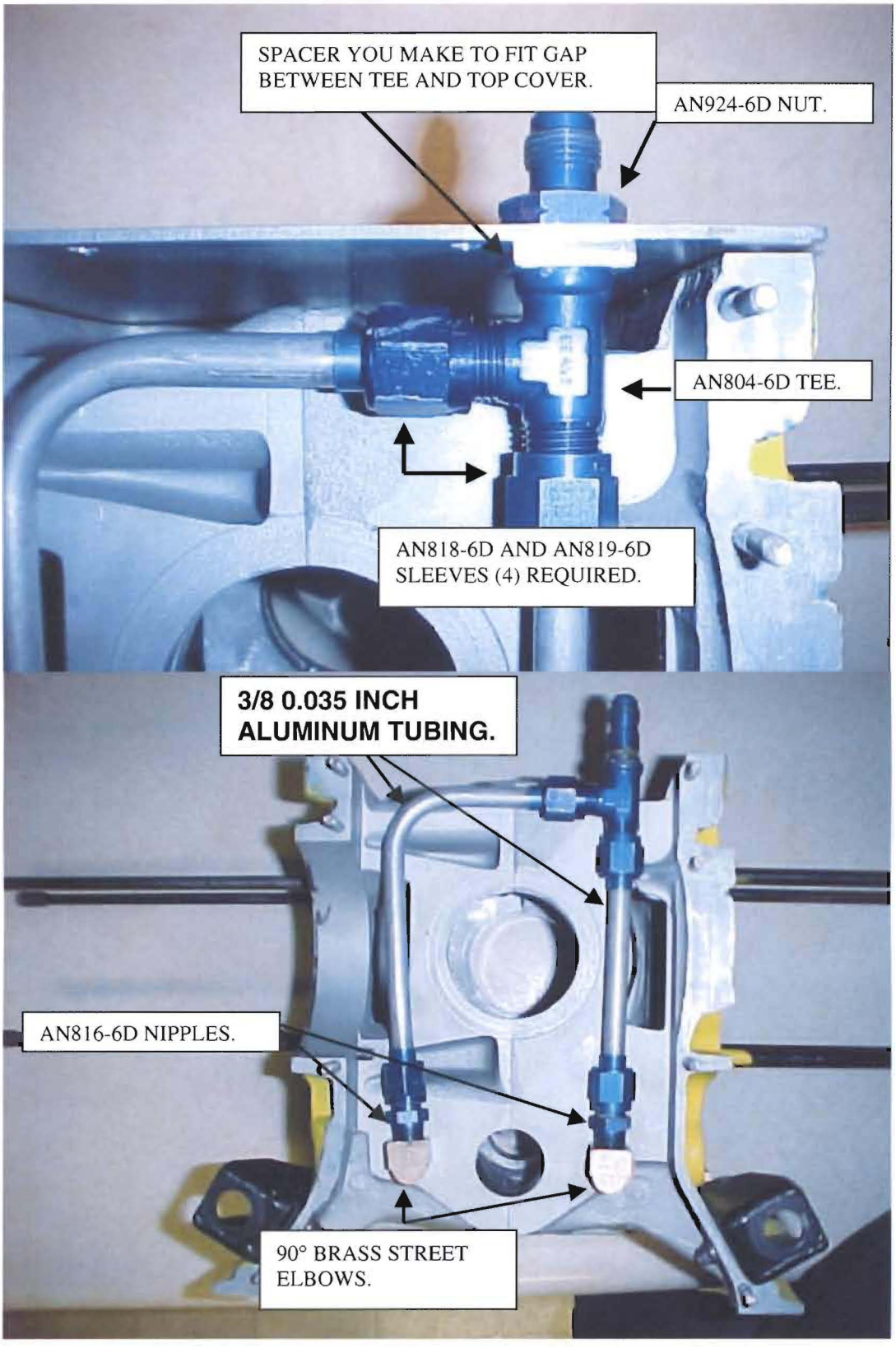
REAR MAIN WEB BEING MILLED OFF TO FIT THRUST BEARING. STOP JUST AS THE FRONT SURFACE CLEANS UP ALL THE WAY AROUND.

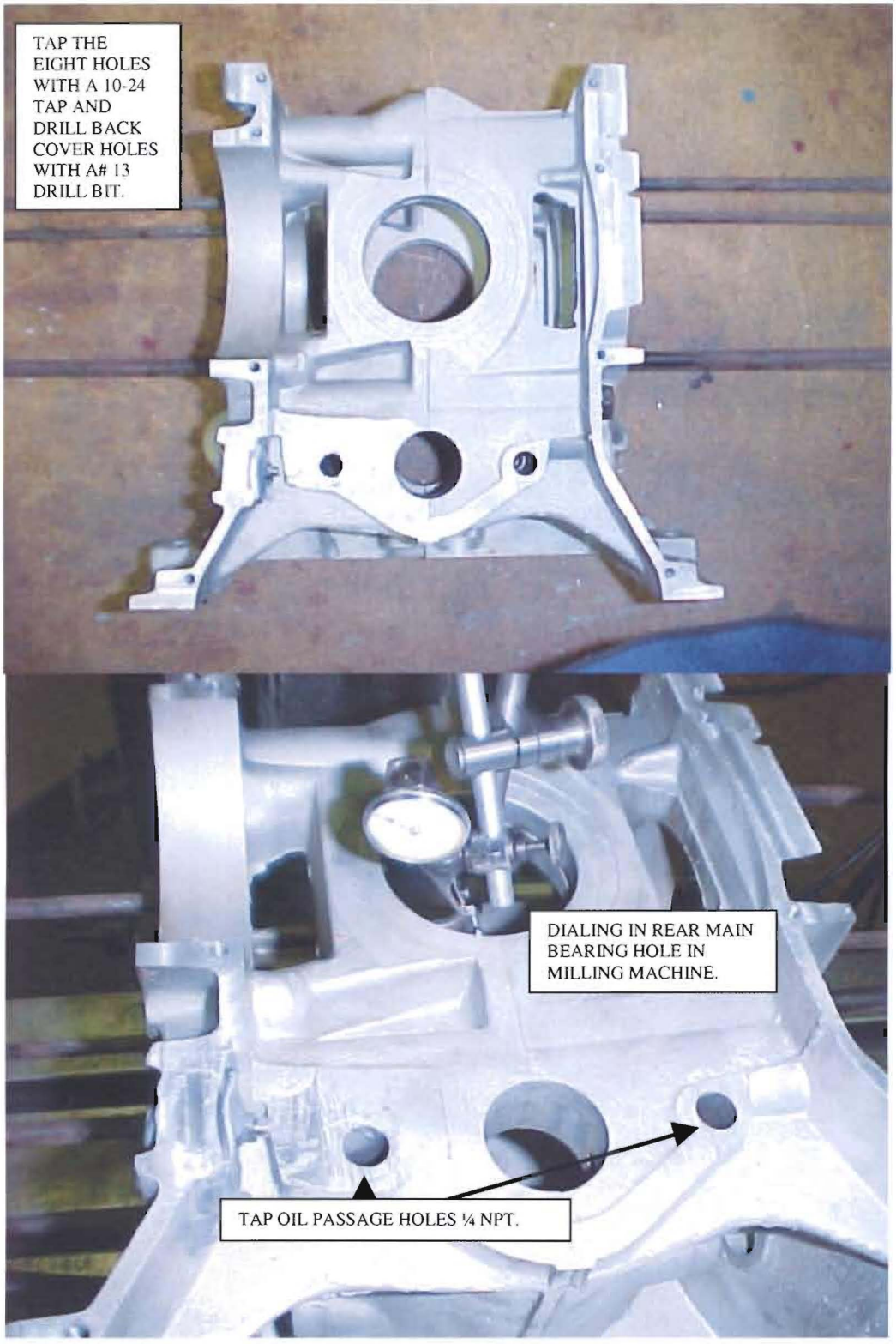


CUTTING THE REAR SURFACE OF THE REAR MAIN WEB FOR THE THRUST BEARING



MAIN BEARING WEB THICKNESS NEEDS TO BE 0.810 INCHES. CHAMFER HOLE TO FIT BEARING SHELLS.





BACK COVER

The back cover is made from 3/8 thick 6061-T6 plate. We purchased ours from our local metal supplier. Layout a template, using the back plate drawing, out of thin metal to make sure the mount holes in the block won't break through anywhere when you drill them. If you find any holes that might break through an edge, compensate for it when you drill your 3/8 plate. After cutting several crankcases we have found slight differences between them. GM must have had several molds with subtle differences. Cut the plate as shown in the drawing and drill the eight mounting holes with a number 24 drill bit in a drill press. This is the correct drill size for a 10-24 tap. You won't be tapping the back plate, but you will be using it as a guide for drilling and tapping the back of the crankcase. Also at this time cut the magneto and oil pump holes using a fly cutter in a drill press to the sizes and locations shown in the back cover drawing. Clamp the plate to the back of the crankcase as shown aligning the top, bottom and left side cylinder hole gasket surfaces. There isn't much room for error because the engine block rear surface is fairly thin-walled and for this reason the back cover cannot be used as a mounting plate for the engine. The holes that get tapped into the back of the crankcase must be located carefully. Drill through the holes in the back plate with the number 24 drill bit in the drill press, ¾ of an inch into the crankcase. Remove the plate and tap the holes in the crankcase with a 10-24 tap. The cast aluminum crankcase must be tapped 10-24, this is 3/16 inch course thread. Fine threads will strip out very easily. We don't feel there is enough material on the back edges of the crankcase for larger screws or bolts. Drill the holes in the plate out with a number 13 drill bit, again in a drill press. It is a good idea to do just two diagonal holes, then screw the plate on with two screws, then complete the rest of the holes. This will keep the back plate from slipping while you drill the block. Following these steps will ensure that each time you remove and replace the back plate it will be perfectly aligned. The alignment of the magneto drive and oil pump depend on your accuracy in these steps. Now you can screw the plate on with eight, 10-24 screws. You can find them at your local hardware store. Scribe around the outside of the crankcase and cut off the excess aluminum plate. The back cover plate must be flush with the outer crankcase surfaces where the lower engine mount fittings will be installed. Make left and right gasket strips out of .032 gasket paper to go between the back cover and the crankcase. You will need the gaskets in place when you set up the oil pump and on final assembly.

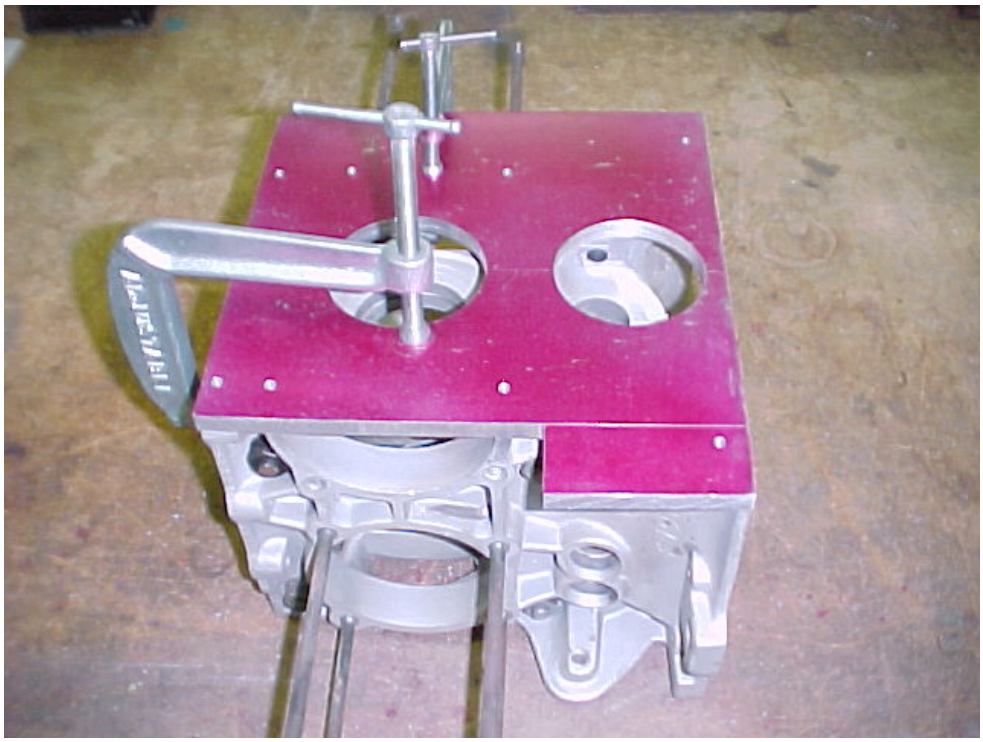
Next you need to bore out the hole in the back plate for the magneto. With the back cover removed, clamp the block in a milling machine with the rear surface up, see photo. Using a dial indicator in the spindle locate the center of the rear main bearing. This could also be done in a good solid drill press. Lock the crankcase in place and reinstall the back cover. Bore the hole to the diameter of the magneto you are using, probably 3.25 inches. Now the hole in the back plate is perfectly aligned with the crankshaft center. Put your magneto in the hole and mark the location of the two mounting holes and drill and tap them 5/16-18.

Fabricate, or rent from UltraVair Aviation, the oil pump alignment tools, see drawing. Slip the alignment bushings into the camshaft main bearings, see photo, and slide the alignment shaft through the bushings until the tip sticks out of the rear plate. With the oil

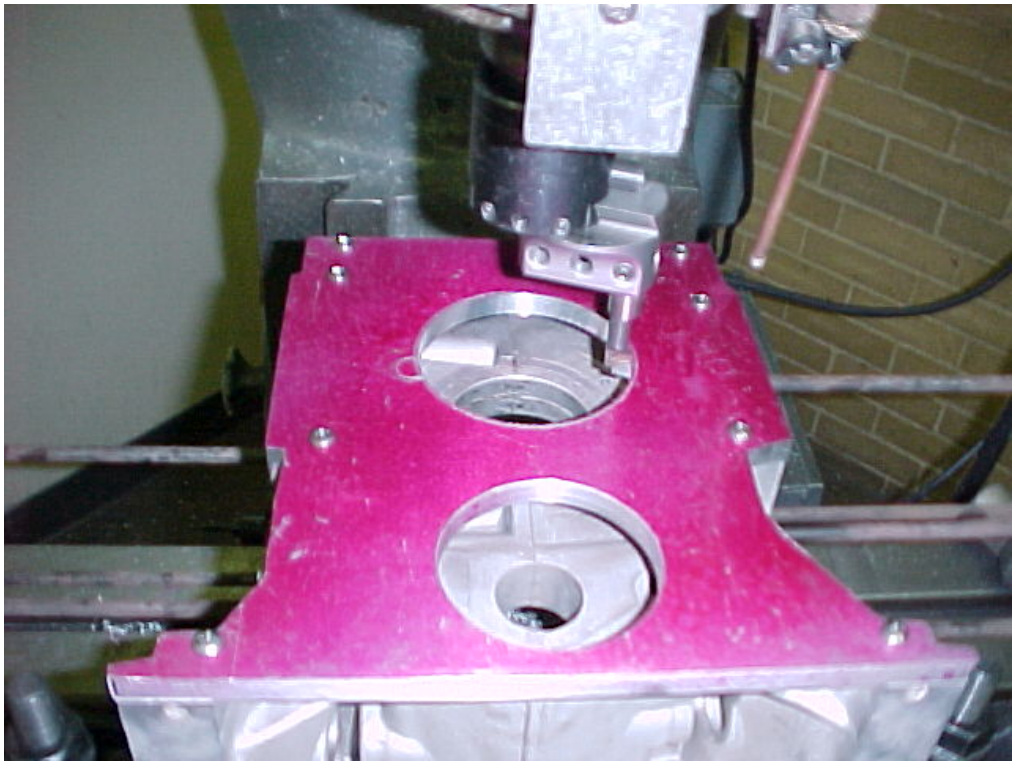
pump inside the oil pump housing, slip the oil pump drive gear hole onto the alignment shaft. Clamp the oil pump in place and make sure the alignment shaft moves freely in the pump. In the drill press, drill through the four oil pump mount holes with a 5/16 drill bit. You can either just mark the rear plate with the 5/16 drill bit and then dill and tap the back plate, or you can drill all the way through the back plate and use 5/16 bolts and locknuts. Notice in the photos that the lower left bolt will pass through the flange of the oil pick up tube. Bolt the pump and housing on with 5/16 bolts and recheck the alignment of the pump with the alignment tool. If you need to make an adjustment, you can drill the pump and pump housing out to 11/32, re-align the pump and retighten the bolts. If you do this, turn the back plate over and drill two 1/8 inch holes through the back plate and into the pump housing as shown in the photo, then press in 1/8 inch roll pins. This will ensure alignment any time you remove the pump.

The next step is to modify and install the oil pick up tube. Study the photos carefully. Drill a 5/8 hole through the back plate that will line up with the bottom of the slot in the oil pump housing. Make a template if you need to. There are no hard dimensions, you just have to cut, heat and bend the pick up tube until it is as centered in the crankcase as you can get it and ¼ inch below the oil pan gasket surface. The tube should slip into the back plate about ½ inch. Now make a flange out of .063 4130 sheet with a 5/8 inch hole in it as shown in photo and weld it to the pick up tube so it can be bolted to the back plate as shown in photo. Drill a number 10 hole through the oil pick up tube flange and the back plate on the outboard side of the tube. Next drill a number 21 hole into the pump housing and tap the pump housing 10-32. Install a 10-32 bolt in the outer hole and the 5/16 bolt from the pump goes in the inner hole of the pick up tube flange. We drilled and tapped our back plate oil pump holes, so we welded a 5/16 nut to the pick up tube flange. This way we can remove the pump without taking the back cover off. On final assembly make a paper gasket to go between the pick up tube flange and the back plate to ensure no air is sucked into the pump.

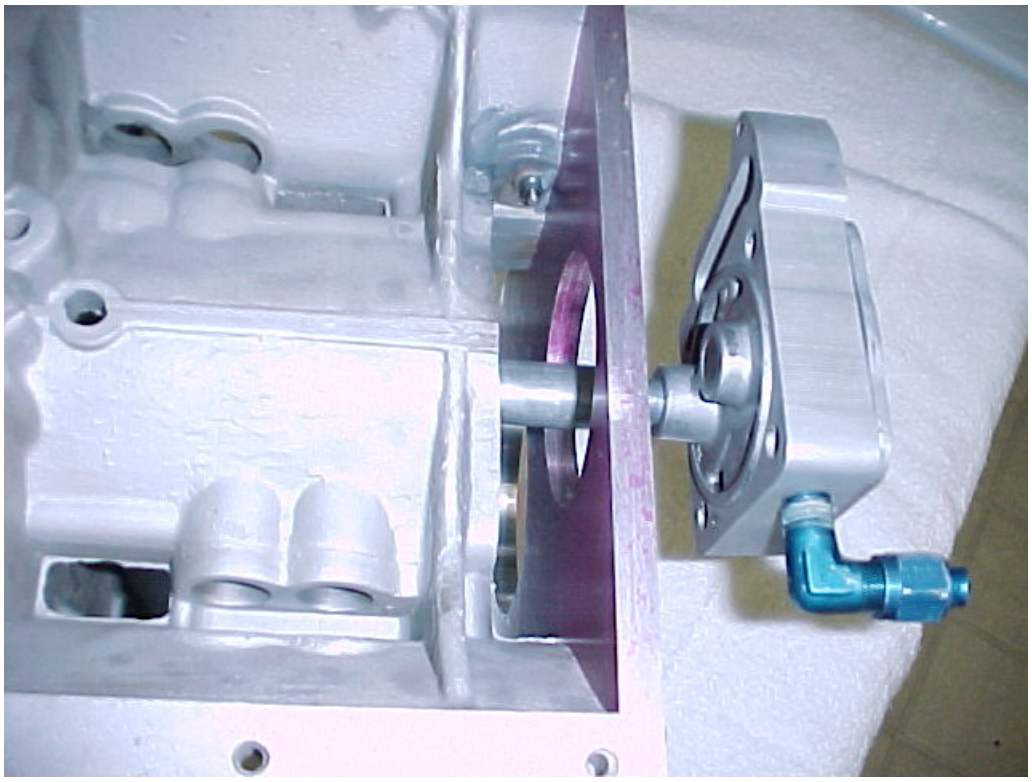
The dipstick tube is installed by drilling a 3/8 hole approximately as seen in the photos. Drill the hole through the back plate at about a 45 degree angle, then press the stock Corvair dipstick tube in using JB weld in the hole. Smooth the JB weld out so there won't be any leaks. After the JB weld dries bent the tube up along the outside of the plate and clamp it to the back plate with a bolt, stand-off, and a clamp as shown in the photos. Bent the tube inside the crankcase until it clears everything with the back plate installed and is 1.5 inches above the oil pan gasket surface. Cut the dipstick down so it flush with the bottom gasket surface. Mark your dipstick so your oil level will be one inch above the bottom gasket surface. We also found that you will need an o-ring to fit inside the cup at the top of the dipstick so it will seal on the top of the dipstick tube to keep it from leaking.



LINE UP TOP, BOTTOM AND LEFT SIDE GASKET SURFACES AND CLAMP BACK COVER IN PLACE. DRILL THROUGH HOLES INTO CRANKCASE WITH A #24 DRILL BIT IN DRILL PRESS.

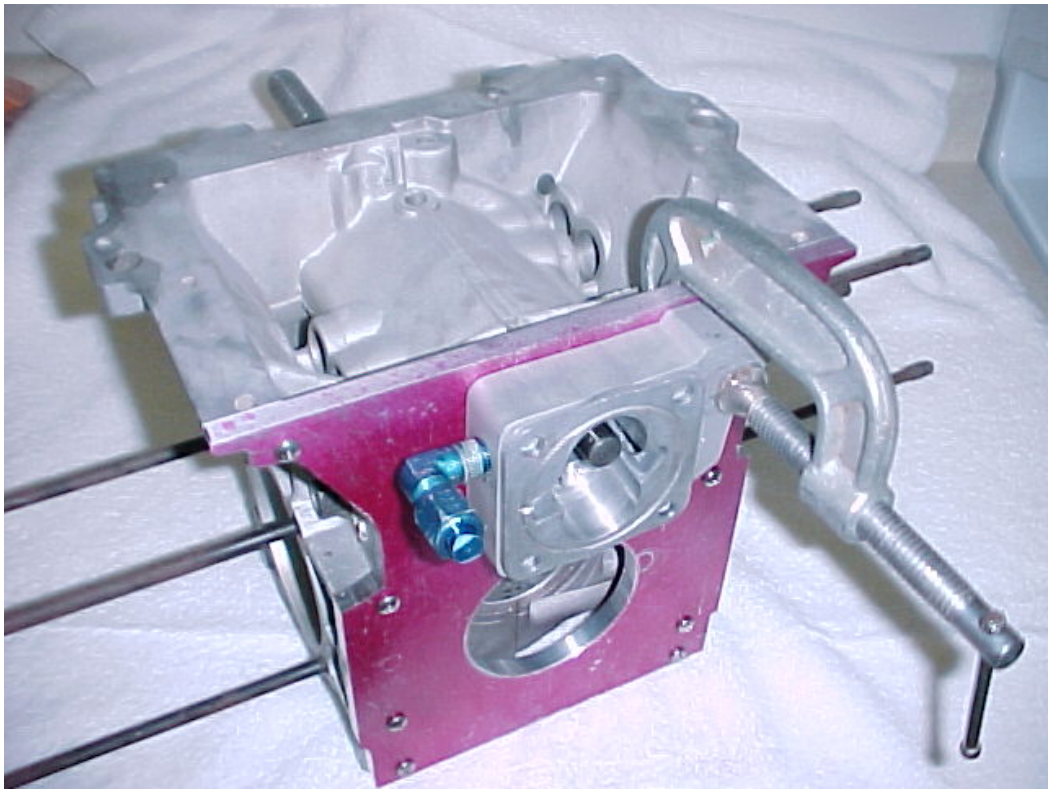


BACK COVER SCREWED ON AND MAGNETO HOLE CUT TO 3.250 INCHES CONCENTRIC WITH MAIN BEARING. BACK PLATE TRIMMED.

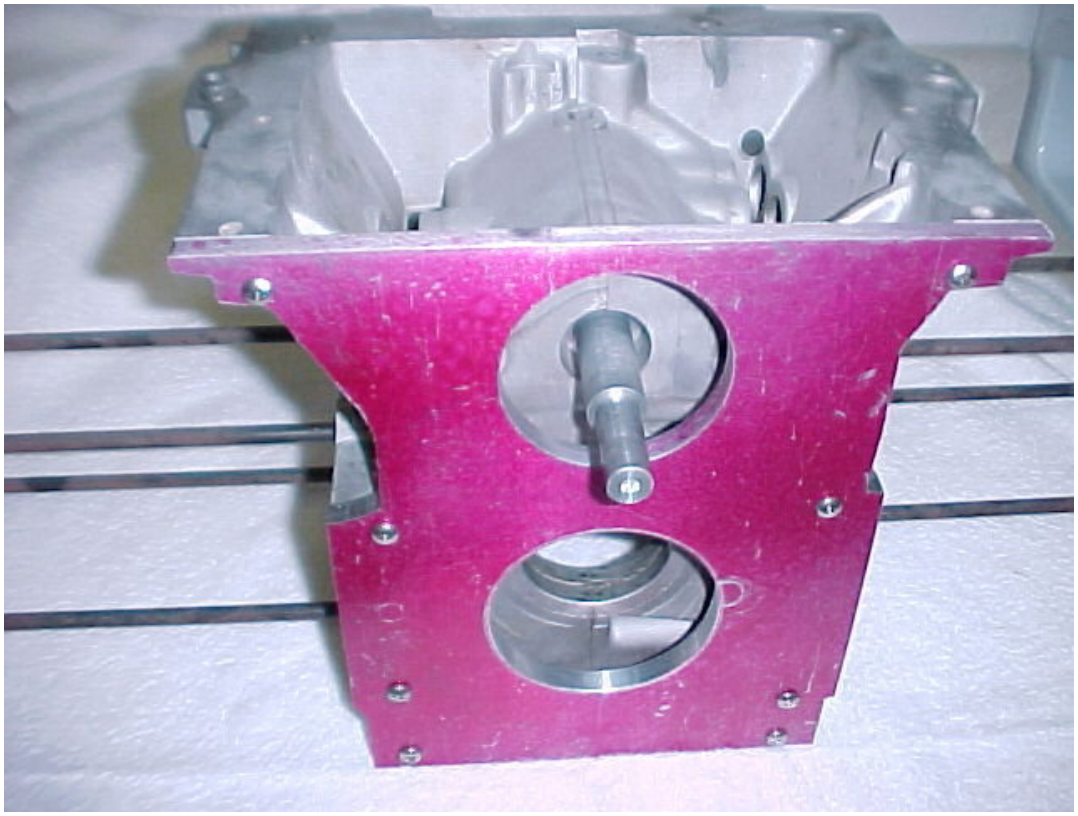


OIL PUMP INSIDE OF OIL PUMP HOUSING SLIPPING ONTO ALIGNMENT TOOL.

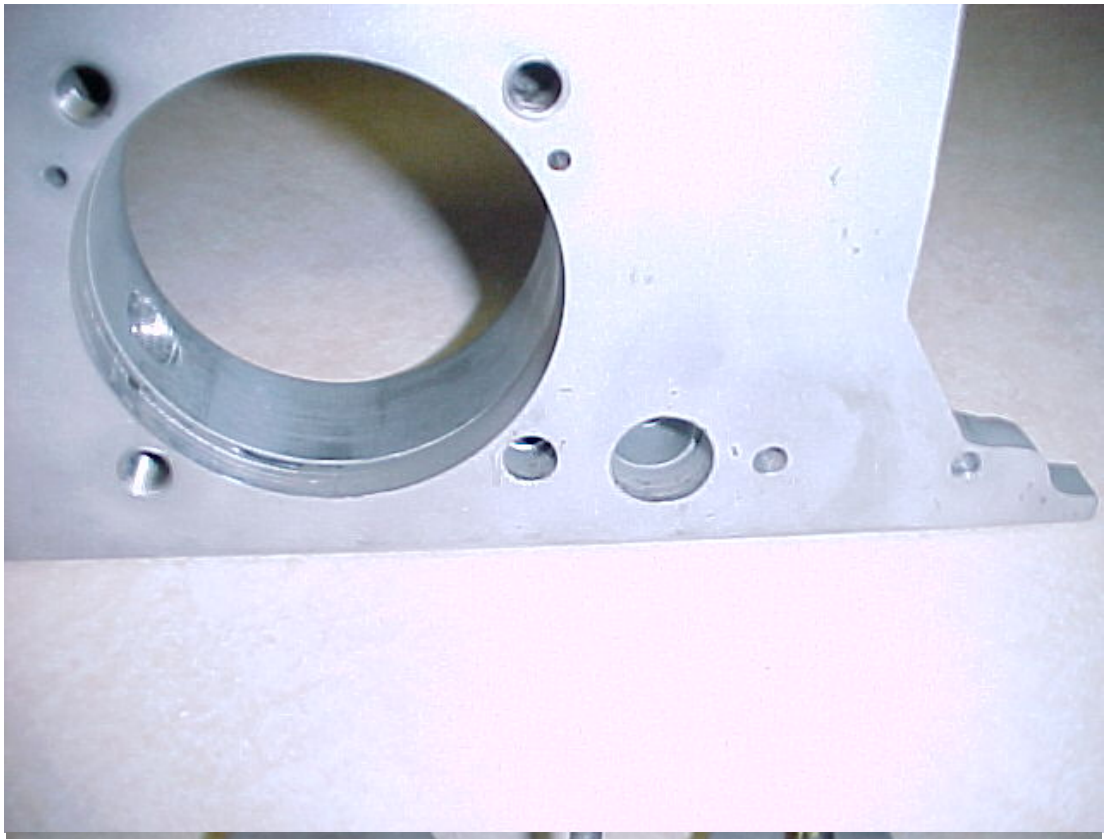
OIL PUMP ALIGNMENT TOOL.

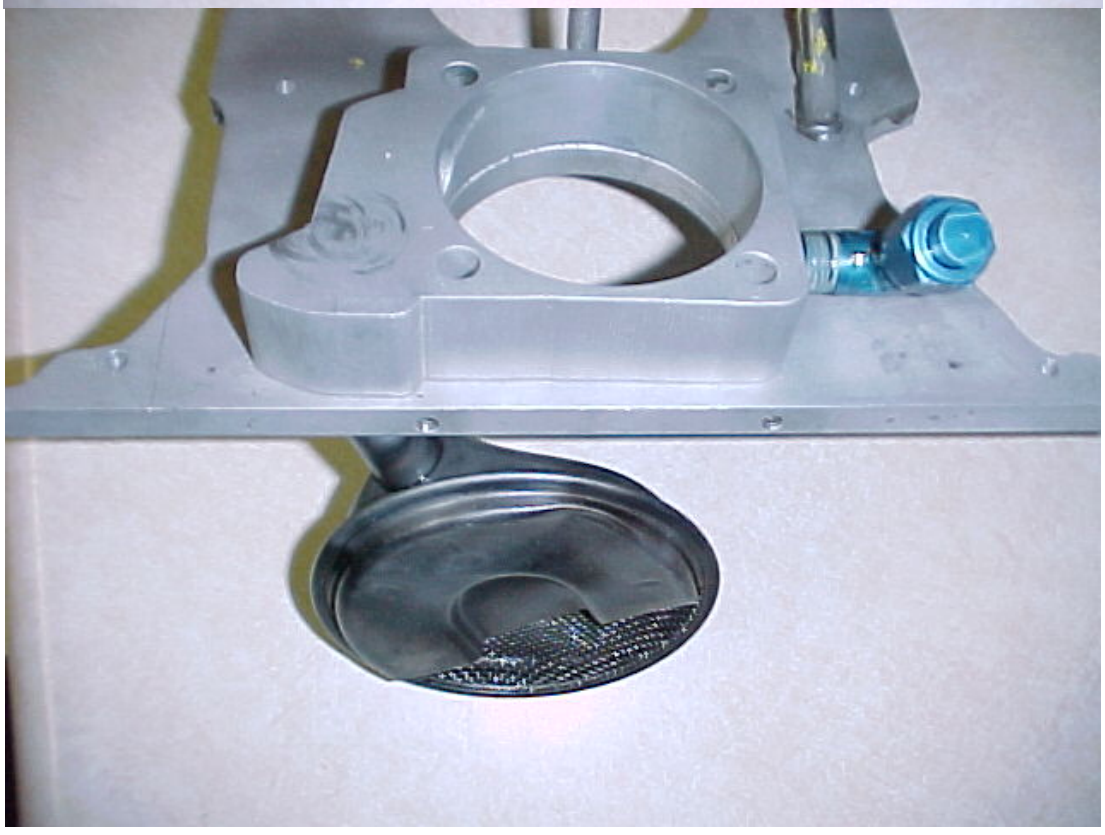


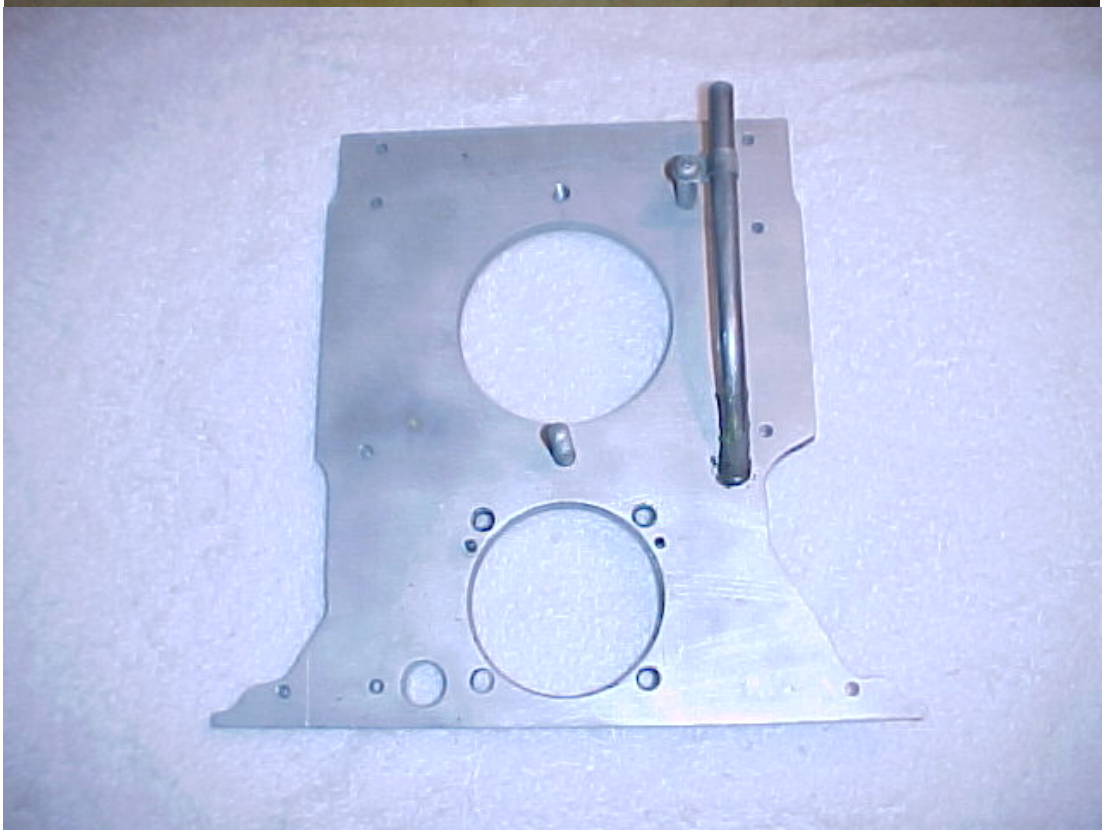
OIL PUMP ALIGNED, CLAMPED AND READY FOR DRILLING THE FOUR BOLT HOLES.



OIL PUMP ALIGNMENT TOOL INSTALLED.



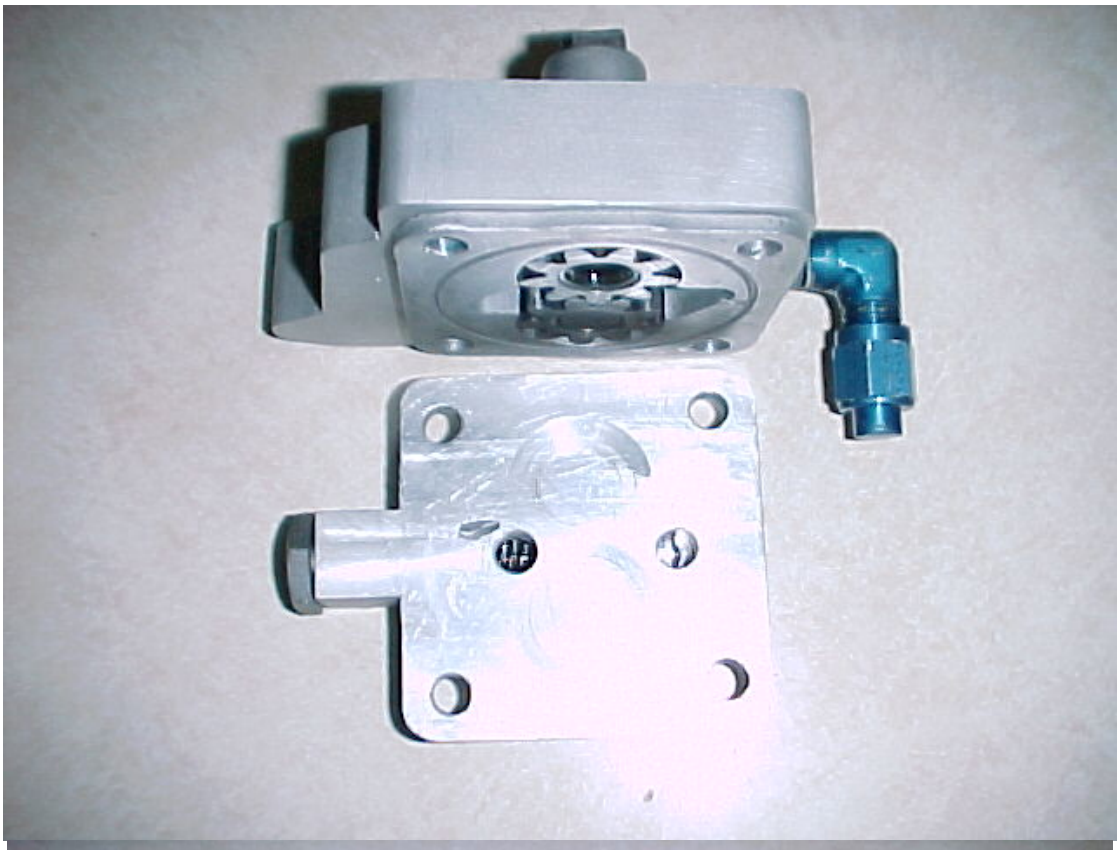


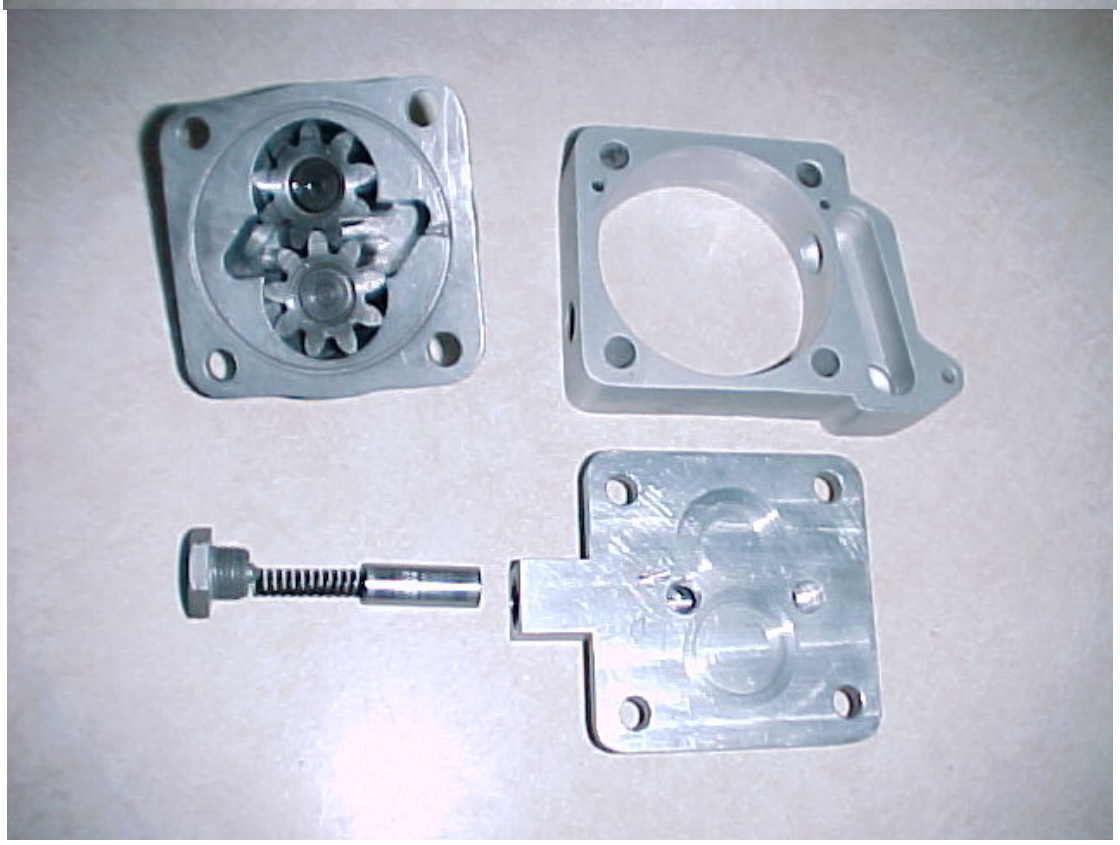


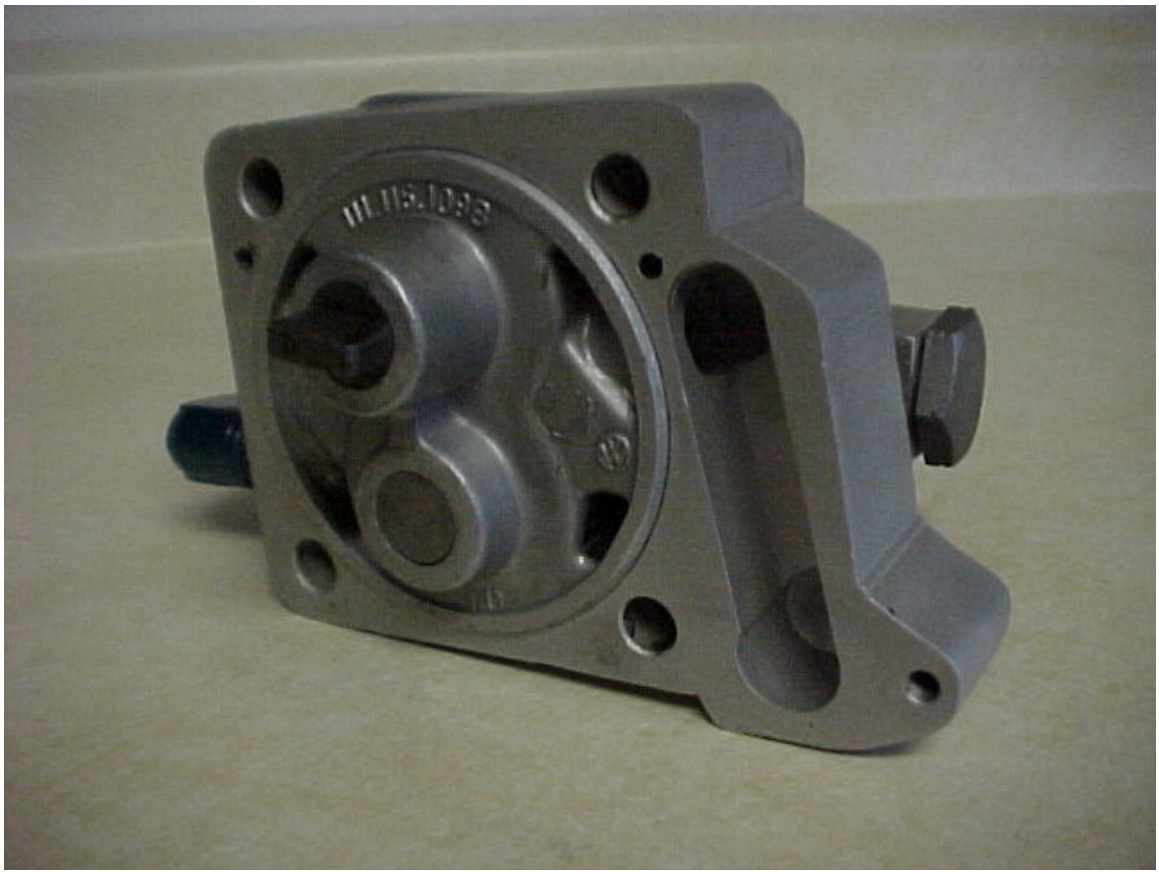
OIL PUMP

The oil pump is a 26 mm VW oil pump. They are available from Great Plains Aircraft Supply Company. The pump is driven off the back of the camshaft and will turn the opposite direction on the UltraVair engine, but it doesn't care. The inlet is now the outlet and vice versa. The oil pump is pressed into the oil pump housing, see drawing, then aligned and bolted to the back cover, see back cover section. The pressure relief valve from the Corvair engine back cover is used in the oil pump cover, see drawing. The relief valve bypasses oil from the high-pressure side to the suction side to regulate the pressure. The pump cover is very straightforward, but please note the small hole drilled at an angle. This hole gives the oil behind the piston a place to go when the piston moves down its bore. Without this little hole, there would be a hydraulic lock behind the piston and your pressure would go wild. Also notice that the relief valve piston hole must be drilled so that the piston will not completely block the hole on the pressure side of the pump. The relief valve will not function if it is allowed to completely block this port. The pump cover / pressure relief valve was designed with the same geometry as the back cover of the Corvair engine. We always see a steady 40 psi above idle and 30 psi at idle.

The pump is normally installed with no gasket between the cover and the pump. You will have to make gaskets for between the pump and pump housing and also between the pump housing and the back plate. We used .032 thick gasket paper from our local auto supply store. Once you bolt it all together on the back plate, make sure the pump turns freely. If it doesn't turn freely, you might have to put the thin paper gasket that usually comes with a new pump between the pump and the cover. Either way, apply a thin coat of silicon sealant in the groove around the perimeter of the pump face. There is a small groove that connects the perimeter groove to the suction side of the pump. This is to apply suction all around the pump cover to prevent leaks. Since the suction side is now our pressure side it is important to fill this groove in with the silicon sealant to keep the cover from leaking.







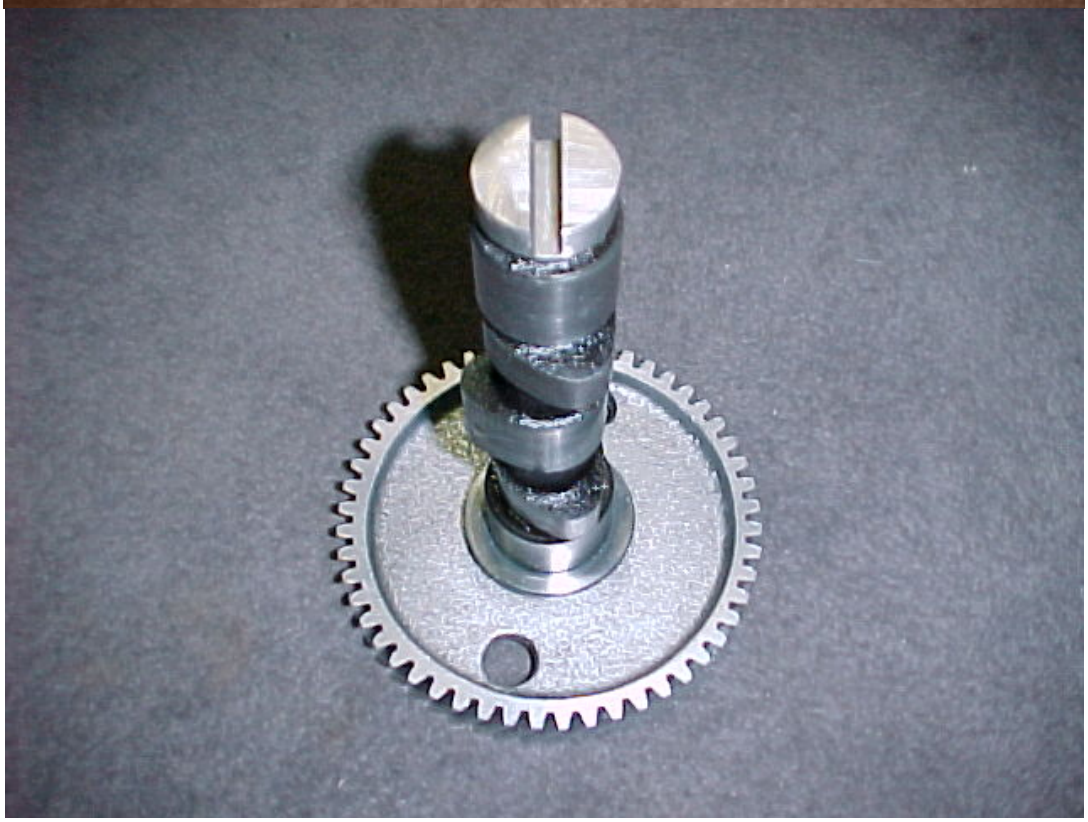
CAMSHAFT

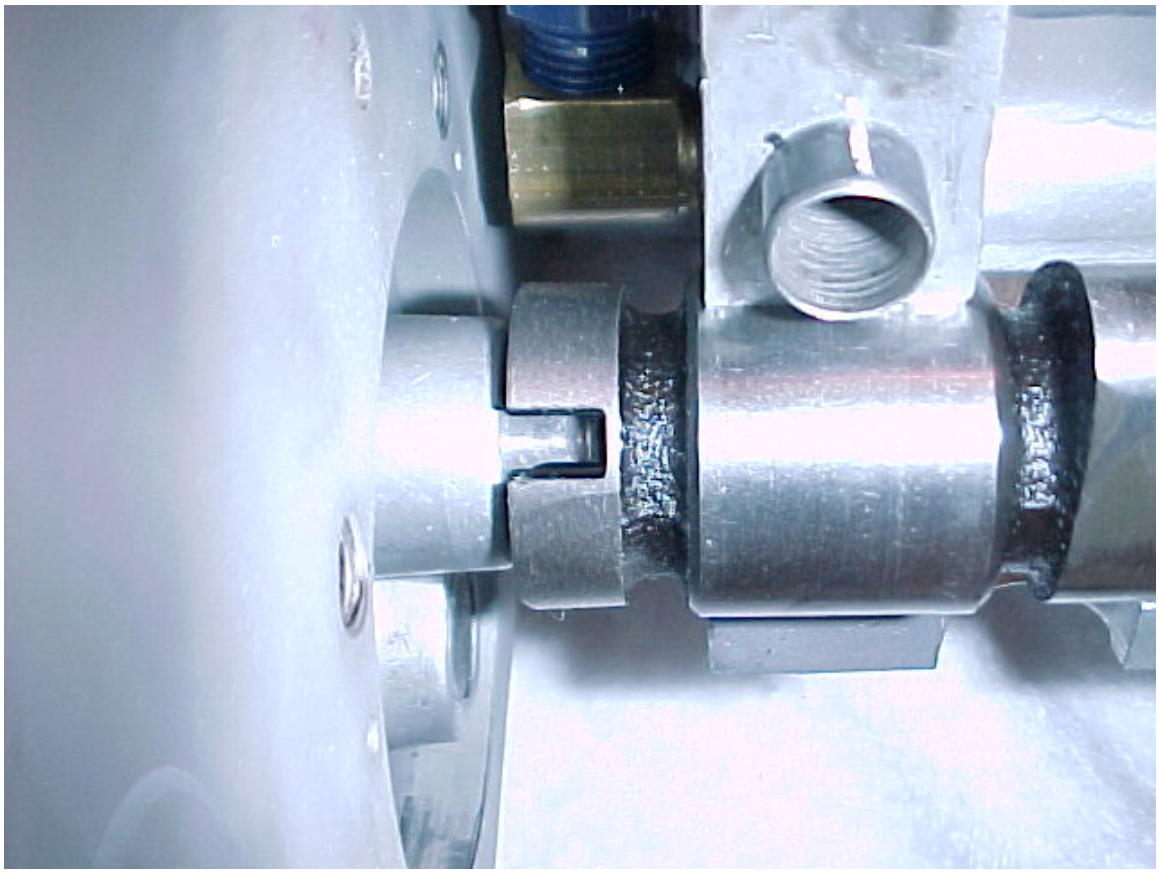
The camshaft is the most mysterious component in the engine. Choosing the correct camshaft can improve the performance of your engine. We used the stock 1964 110 hp camshaft in our prototype engine and we were completely satisfied with its performance. William Wynne (the six cylinder aircraft engine authority) suggested we try the camshaft he uses in his engines. He has many years of flight experience with Corvair engines and has tested several camshafts. He uses the "OT-10" camshaft and we feel it is the best camshaft for our engines. Whichever camshaft you choose the same modifications must be done.

Bolt your case halves together and make gaskets out of gasket paper for the back plate, oil pump housing and oil pump and temporarily bolt it all together. You need the gaskets in place before you cut the camshaft to length. Now cut the camshaft to length. If you've kept the crankcase dimensions correct, the camshaft will need to be 6.300 inches from the backside of the thrust washer to end of the camshaft. It needs to be long enough to fully engage the oil pump drive tang without pushing on the oil pump drive gear. See the photos. It also needs a slot milled in the end to drive the oil pump. The slot must be centered in the camshaft .220 wide and .320 deep. Again, it must be deep enough to clear the end of the oil pump drive tang and not push on the oil pump drive gear. You will be cutting the camshaft right through a lobe, this is the hardest part of the camshaft. You can grind the lobe round after you cut it. It doesn't have to be perfectly round though. The slot will have to be milled on a milling machine after centering it off the camshaft main bearing journal. If the slot is not perfectly centered it will put side loads on the oil pump drive tang and could cause the pump to fail.

The aluminum camshaft gear should be replaced with a new one if you press it off of the camshaft. Pressing it off camshaft broaches out the hole and makes for a loose fit when reinstalled. We thought about turning off half the width of the camshaft gear and half the teeth off of the flywheel hub gear to save weight because we are only turning 4 lifters instead of 12, and are theoretically only putting 1/3 of the load through the gears. We are driving the oil pump off of the camshaft though, and decided to leave things alone.

Once you have the camshaft cut to length and the slot cut install it with the back plate, pump and gaskets and make sure it turns smoothly while it's engaged with the pump. Also, check again that there is clearance between the end of the camshaft and the oil pump drive gear and clearance between the end of the drive tang and the bottom of the slot in the camshaft.





CRANKSHAFT

Cut the crankshaft as shown in the photos. If you don't have a good cut-off band saw, you can probably take the crankshaft to your local steel supplier and have it cut. You will need to press the flywheel flange off so you can re-tap the threaded holes in it to 3/8-24 and also so you can chuck the crankshaft the lathe. Fabricate the counterweights as shown in the drawing out of 5/8 inch cold rolled steel. You will notice that the counterweight fits the aft position as drawn although you might have to grind off a few high spots on the crankshaft to get to fit right. The forward crankshaft cheek takes quite a bit of grinding to get the counterweight to fit. We put strips of aluminum held on by hose clamps over all the bearing journals, then ground down the front crankshaft web with a four inch angle grinder until it looked like the back web. Weld on the counterweights, keeping the bearing journals protected. The counterweights must have their straight edges vertical when the pistons are at top dead center. We welded ours on with a DC arc welder using 1/8 7018 rod.

Now chuck the crankshaft in a lathe, center drill the end for a live center, then true up the counterweights to an outside diameter of 4.87 inches and cut a 1/8 inch chamfer on the outsides of the counterweights. The inside of the counterweights need the same chamfer to clear the pistons, but you have to do it by hand with a grinder because the rod journal is in the way while it's in the lathe. Once you have a true and polished forward thrust face on the crankshaft you can face off the back of the crankshaft main journal 1.00 inch aft of the forward thrust face. If it gets faced off shorter don't worry, you can add a shim between the 1/8 inch thrust plate and the crankshaft to compensate. We had use a shim on the prototype because we cut the crankshaft a little too short. You can see our shim in the photo with all the crankshaft parts laid out. There are several places in this engine where you can shim things to compensate.

If you intend to use the engine in the pusher configuration, you will have to add enough filler rod in the corners of the counterweight to crank throw junction so that when this surface is trued up in the lathe it will form a complete surface for the bearing to run on. We haven't tested the engine as a pusher, so we don't make any claims in this respect.

Drill and tap the crankshaft in the center drilled hole ¼-28 to hold the magneto drive and thrust plate in place while you drill the four holes which hold it all together. Fabricate the thrust plate and magneto drive puck as shown in the drawing but don't counterbore the holes yet. Bolt the magneto drive and thrust plate on using the center bolt and align the magneto drive slot as shown. This is to keep the magneto upright when it is properly timed and bolted to the back plate. The slots in the magneto case have plenty of room for adjustment so there is no real critical angle for the magneto drive puck. Just align the slot as seen in the photos and notice the one ¼ inch hole just misses the unused oil hole in the back of the crankshaft. Next drill through the four holes into the crankshaft with a number 3 drill bit. One of the holes will pass through the unused oil hole as you drill through and must be drilled deeper than the other three. Remove the magneto drive and thrust plate and mark them so they will go back on the same way. Now drill the four holes in the magneto drive and thrust plate out to ¼ inch and counterbore to the

dimensions shown in the drawing. Also drill out the center hole to 1.000 inch to clear the magneto center nut. Tap the four crankshaft holes ¼-28. Remember that one hole is deeper because of the oil hole and it will need to be drilled ¼ inch through the oil hole, then tapped ¼-28 below the oil hole. Now bolt the magneto drive and thrust plate back on using AN-4 bolts, the bolt that goes through the unused oil hole will have to be longer of course.

Check the distance between the thrust surfaces and shim or reface the back of the crankshaft to get .008 - .012 endplay on the thrust bearing. As stated earlier you can make a shim between the crankshaft and thrust plate if you don't have enough end play.

Press the flywheel flange back on to the crankshaft. Bolt the prop hub on with AN-6 bolts and put the prop centering bushing in its hole and tap the center of the crankshaft using the bushing and hub as a guide for the tap, see photo. Use a 1-14 tap for the center crankshaft bolt. The hole in the end of the crankshaft is very close to the correct size for tapping and it should tap fairly easily.

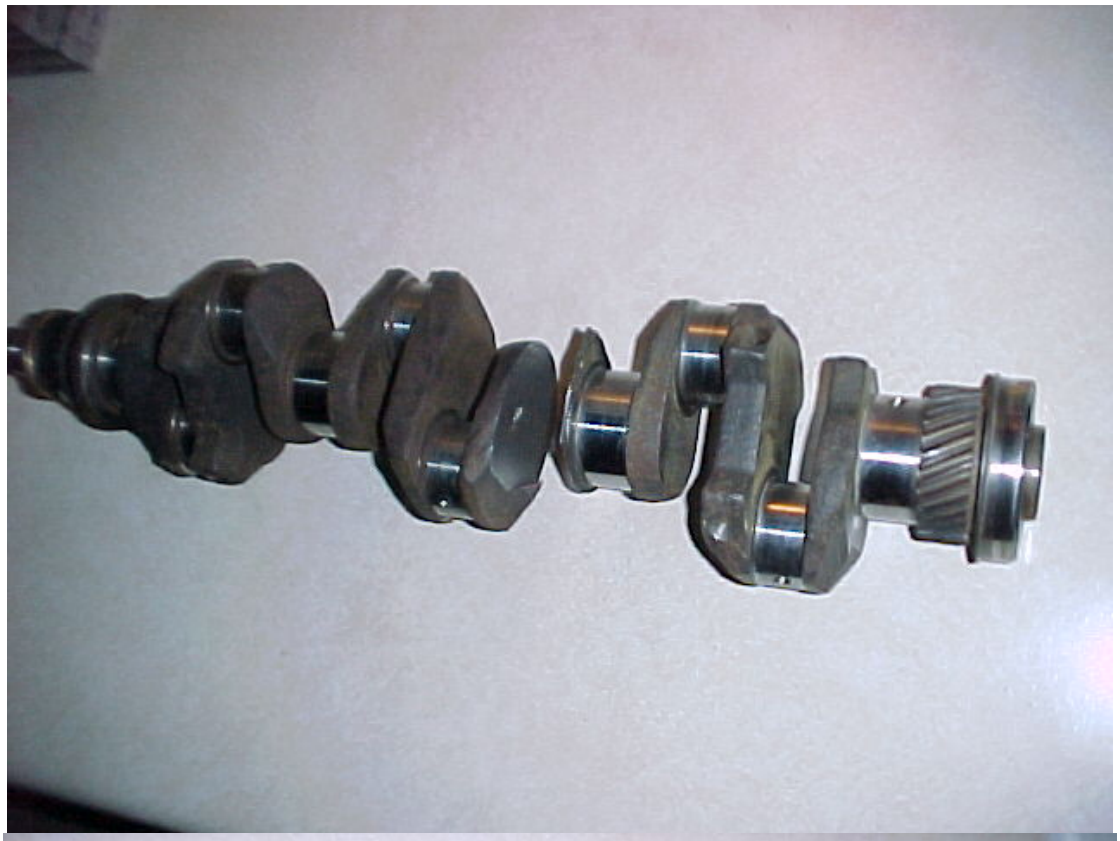
We had our crankshaft statically balanced only and are very satisfied with the lack of shuffle or vibration. We only statically balanced our crankshaft because we know we have less counterweight on the crankshaft than the theoretical 100% of the rotating mass plus 50% of the reciprocating mass, but we physically can fit anymore mass in the crankcase. You may get advice from your local automotive machine shop on balancing contrary to this, but it works fine for us.

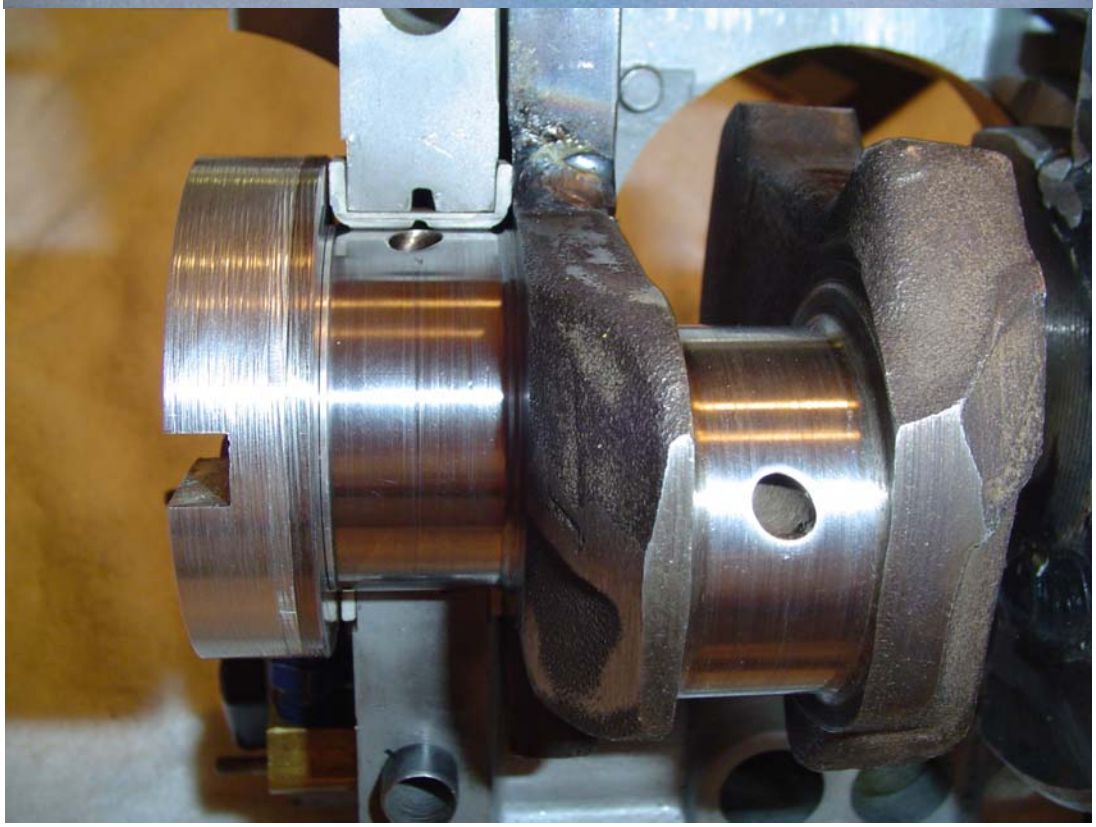
PROP HUB

The prop hub is made from a piece of one inch thick 6061-T6 aluminum plate. Make it according to the prop hub drawing. You will also need to make the prop hub centering bushing and two crush plates. These are also 6061-T6. We put one crush plate on each side of the prop. The prop bolts are installed with the bolt heads behind the prop hub and the nuts on the outside of the prop. You have to put the prop bolts in the prop hub before you install it. This means you need to know the length of your bolts for the prop you are using before you bolt on the prop hub. Since there is no pressed fit on the prop hub it can be removed and replaced easily while the engine is assembled.

Once you've made your prop hub, bolt it to the crankshaft using AN-6 bolts and slip the centering bushing into its hole in the hub and tap the end of the crankshaft 1-14 NF for the center bolt. The hub and center bushing make a good guide for getting the crankshaft threaded straight. The existing hole in the end of the crankshaft is very close to the proper size for tapping and should thread fairly easily. Next we made a center bolt out of a grade five 1-14 bolt. We turned the head down shorter and drilled a ½ inch hole through the center of it to save weight. This bolt keeps the flywheel flange from slipping off the crankshaft.

When installing the hub permanently, put Locktite on the AN-6 bolts and on the center bolt.





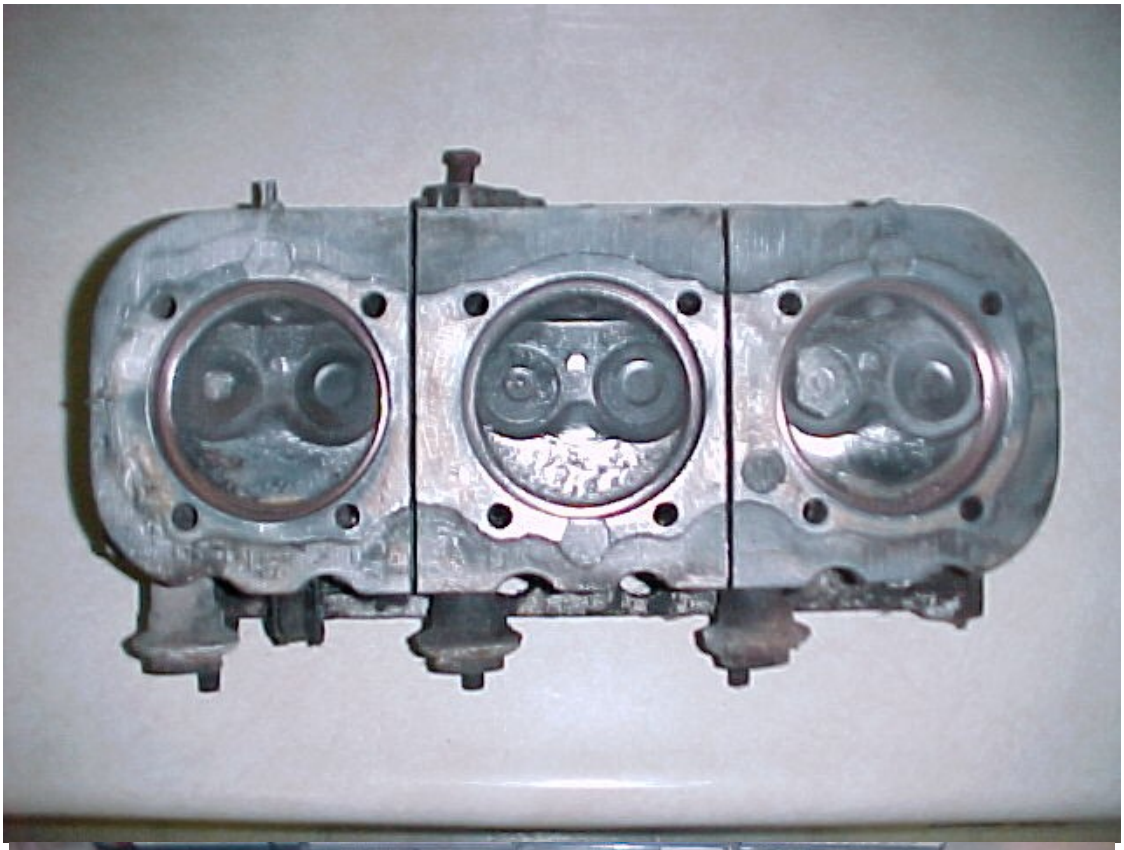
HEADS

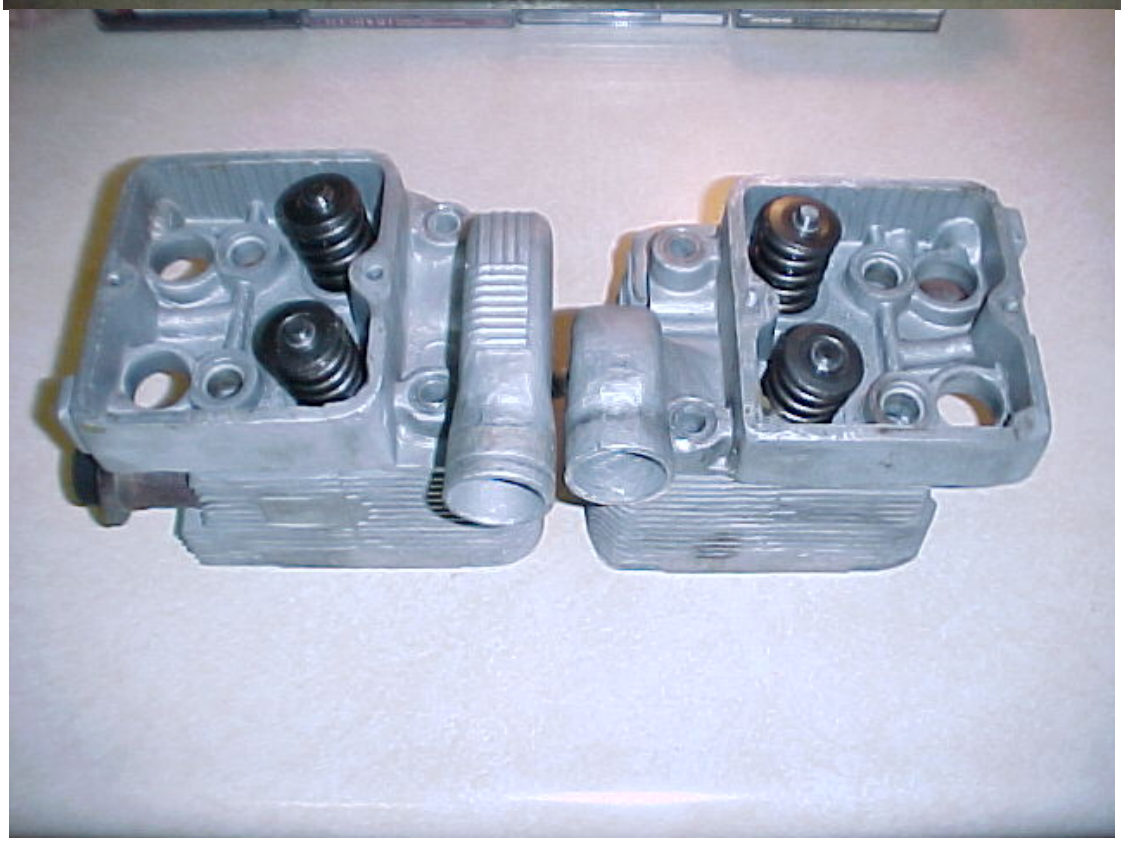
As mentioned in the introduction, both heads can be made from one Corvair head. The first photo of this section shows a cylinder head with a damaged center cylinder combustion chamber. This head is useless for a six-cylinder engine, but perfect for a two- cylinder engine. Since this head was damaged, we got it for free! The heads are cut through the slots already cut in the fins as shown in the photo. Make your cuts on the center cylinder side of the slots in the fins. This will leave a little more material around the exhaust port closest to the slot. You will need to knock out the center cylinder exhaust tube because it will be in the way when you cut. When you knock out the tube notice how easily they come out. You may want to make a plate to hold the other two in while you work on the heads. In the photo showing the heads turned over after cutting, you can see that the rocker area on one head is longer than the other. The next photo shows the ¼ inch 6061-T6 aluminum plates that get welded in to complete the rocker area. Notice that one plate goes inside the rocker area and the other goes outside. This make the valve covers closer to the same size. Grind down the little rib in the bottom of the rocker box on the side that the plate goes inside. You can leave the plates a little higher than the valve cover gasket surface, then mill or sand them down on a large belt sander. Or you can weld the plates in even with the gasket surface and carefully file them after welding.

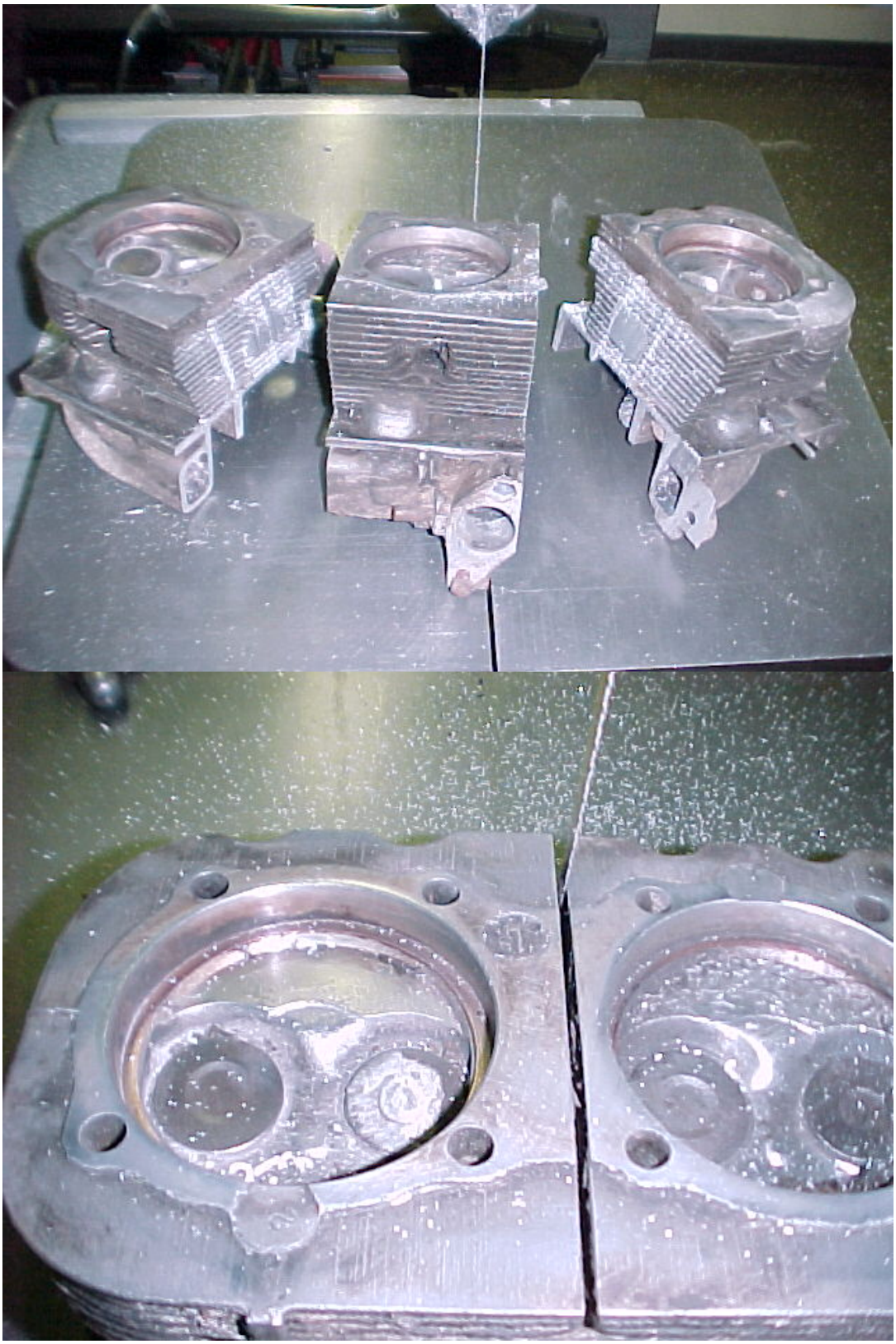
The valve covers are cut as shown and gas welded together while they are clamped to the heads. We used a small sanding disc in a die grinder to smooth out the welds paying close attention to the gasket surfaces.

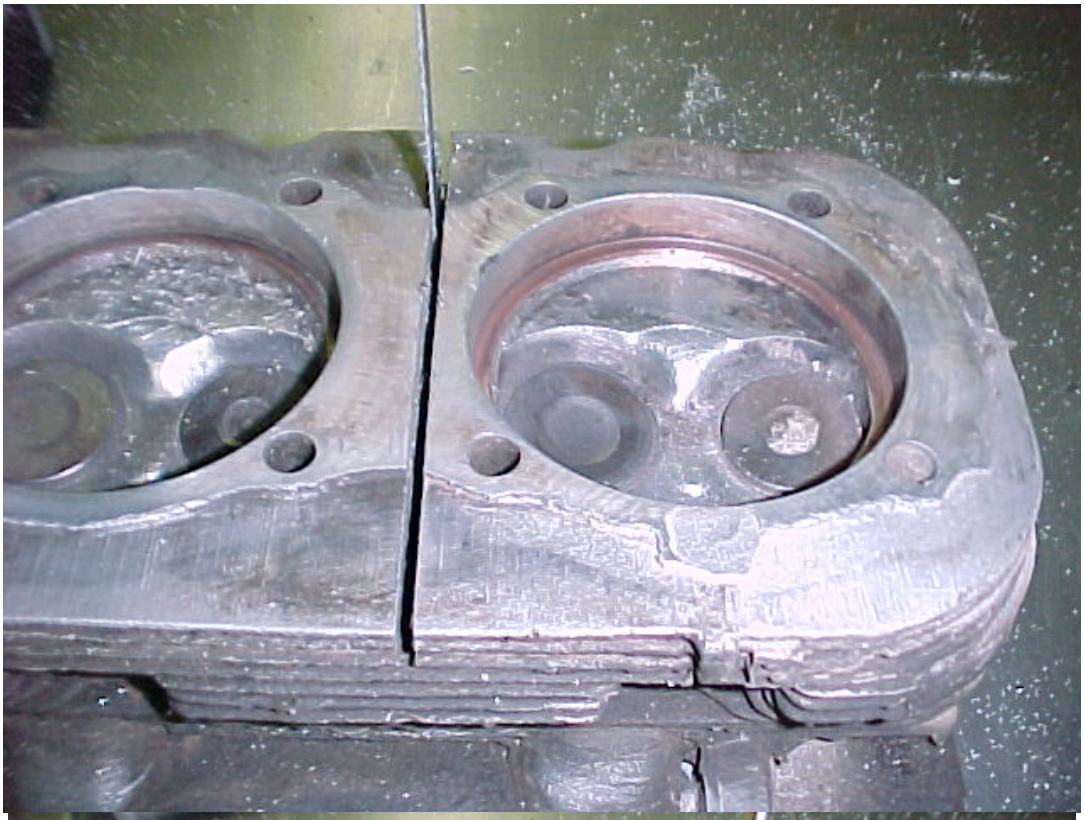
The next step is to weld a 1 ½ inch by .125 wall 6061-T6 tube to the intake log and blend the inside of the port with a rotary file. We used heavy walled tubing because the carburetors are hanging off them and it has roughly the same inside area as the Corvair intake.

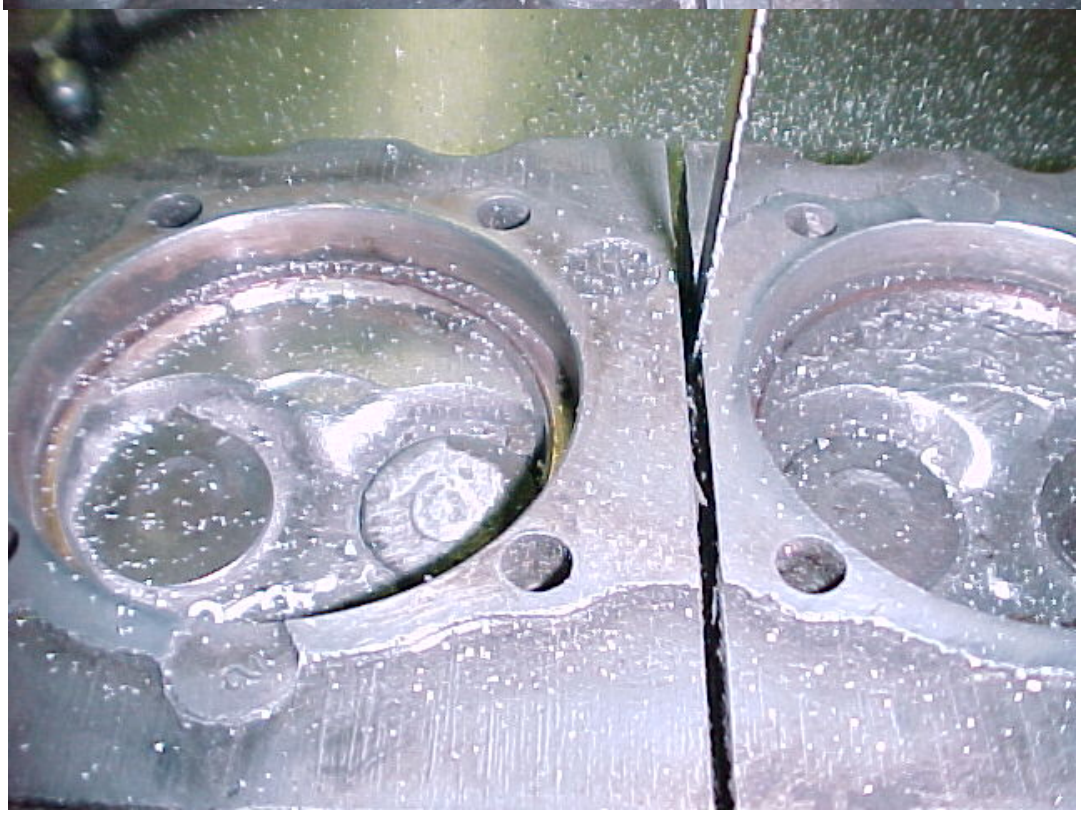
We put new silicon bronze valve guides in our heads, had the seats reground and used new stainless steel valves and new springs and keepers. These parts are very inexpensive and worth the effort. There is a lot of aluminum you can cut or grind off around the intake logs to lighten things up. You will also need to remove the themostatic spring and rod if they are still there.

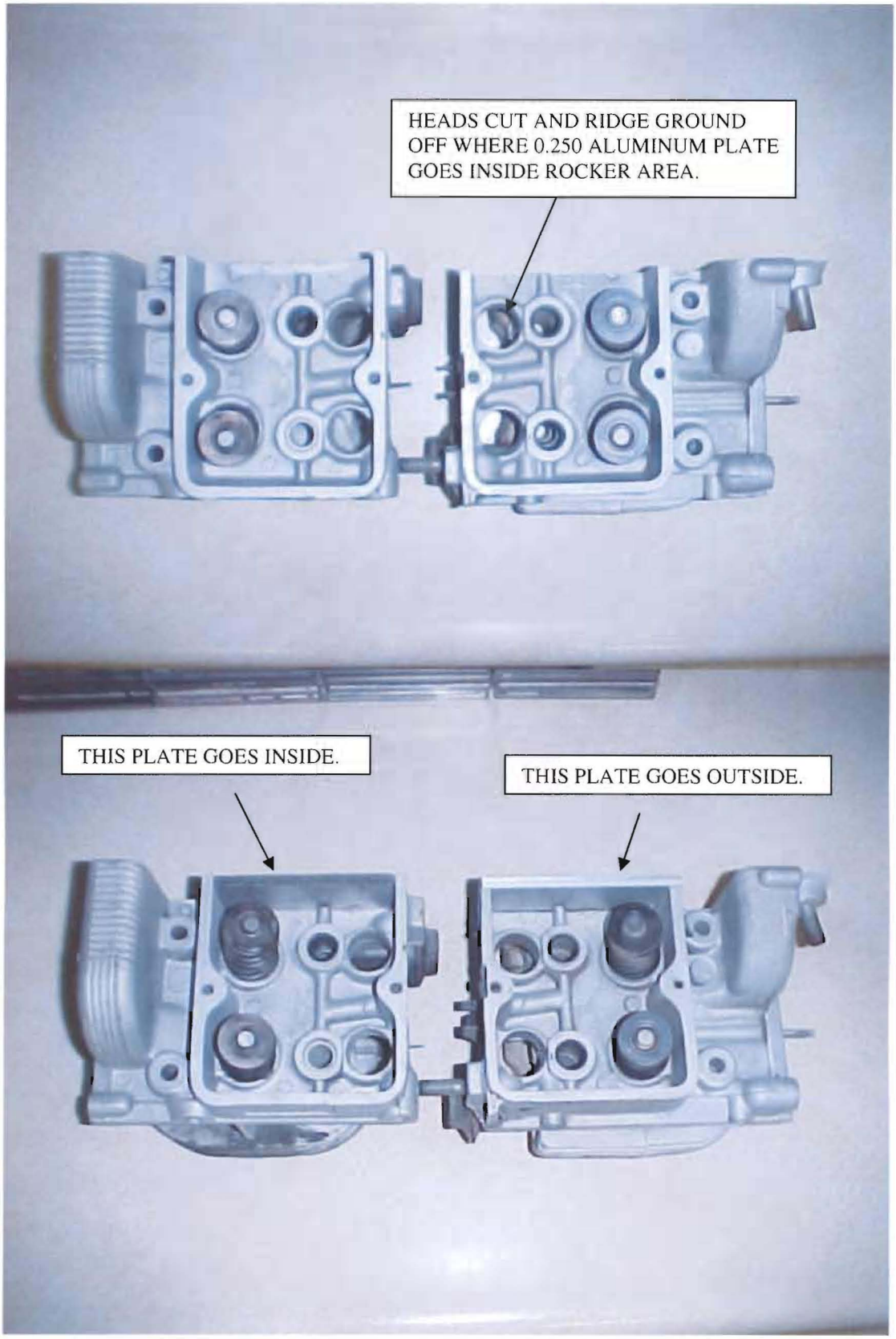


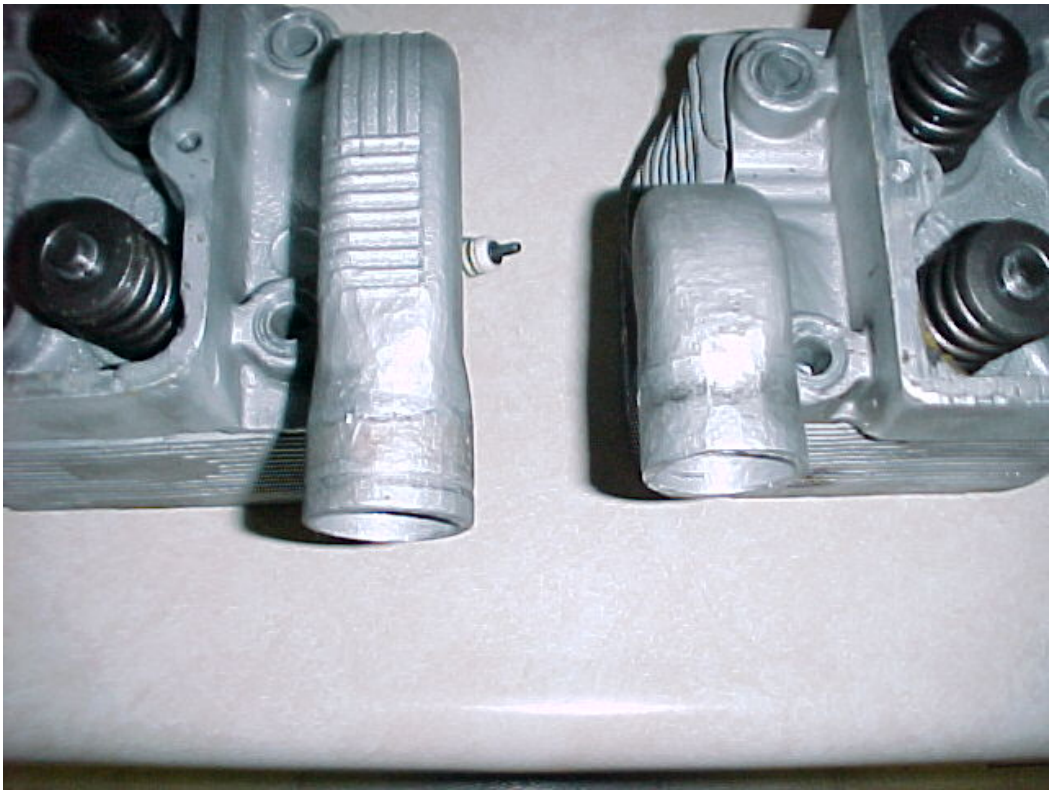




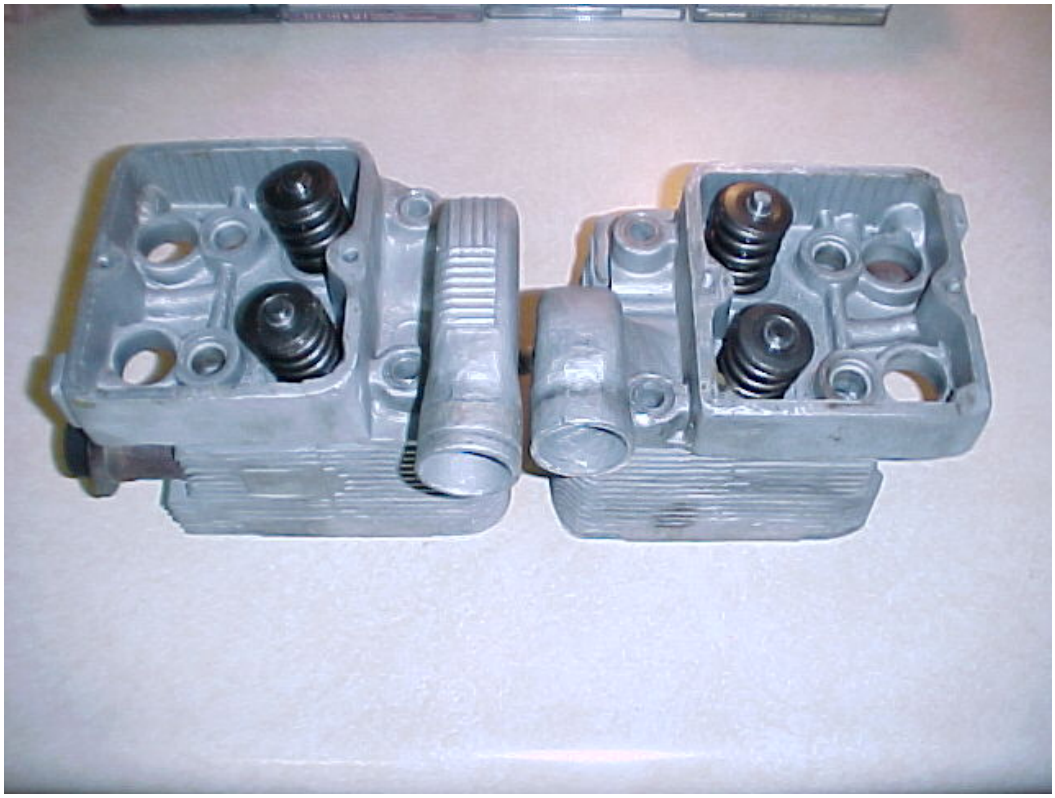








INTAKE TUBES AND 0.250 INCH PLATES WELDED IN. REMOVE VALVES FOR WELDING.



FINISHED VALVE COVER (LEFT) AND READY FOR WELDING (RIGHT).

BLEND OUT INSIDE OF INTAKE PORTS.

OIL PAN AND TOP COVER

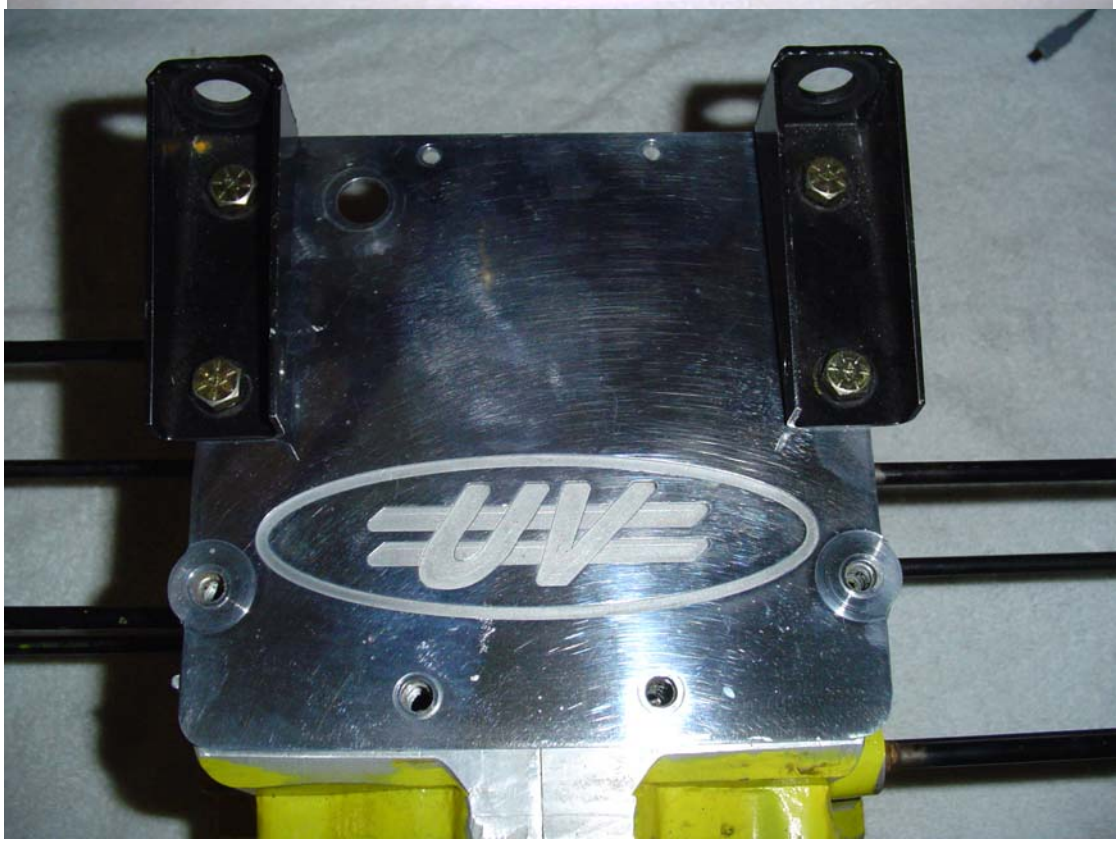
The oil pan is made by cutting and welding the stock pan. You can see in the photos where we cut and welded the pan. Once the rear part of the pan is welded on you will notice that the outer rear holes no longer line up. To correct this we elongated the holes and welded ¼ inch large area washers over the holes. We also drilled and tapped the back plate 10-24 for the inner two holes. Be sure to get the holes centered fore and aft in the back plate so the gasket will seal properly. We also welded 3/16 inch large area washers over these holes to spread the load. Grind the weld down smooth on the gasket surface. The oil pan gasket is made from Felpro 1/8 cork gasket material,

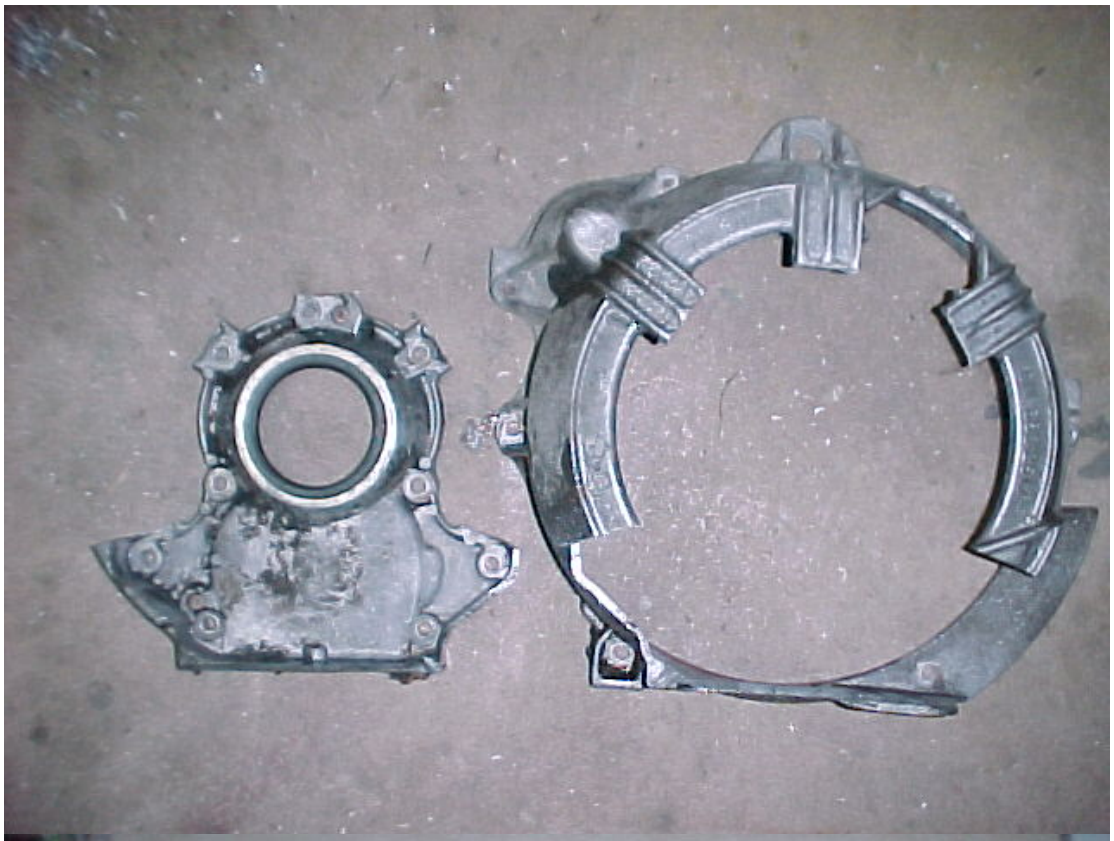
The top cover is a simple flat sheet made from .090 inch 6061-T6 aluminum. We made a paper template off the top of our engine, then transferred it to the aluminum and cut and drilled it. Also mark and drill the hole for the AN 804-6D oil fitting. Add 2 more 3/16 holes along the back edge then drill and tap into the back plate. Just as with the oil pan, make sure to get the holes in the middle of the plate so the gasket will seal properly. The top cover gasket must be made out of good quality gasket paper because the top two engine mount fittings bolt on top of the cover. Don't make the gasket out of cork or anything that will squish because eventually the engine mount fitting bolts will work loose. Use the same .032 thick paper gasket material you used on the back plate and oil pump.

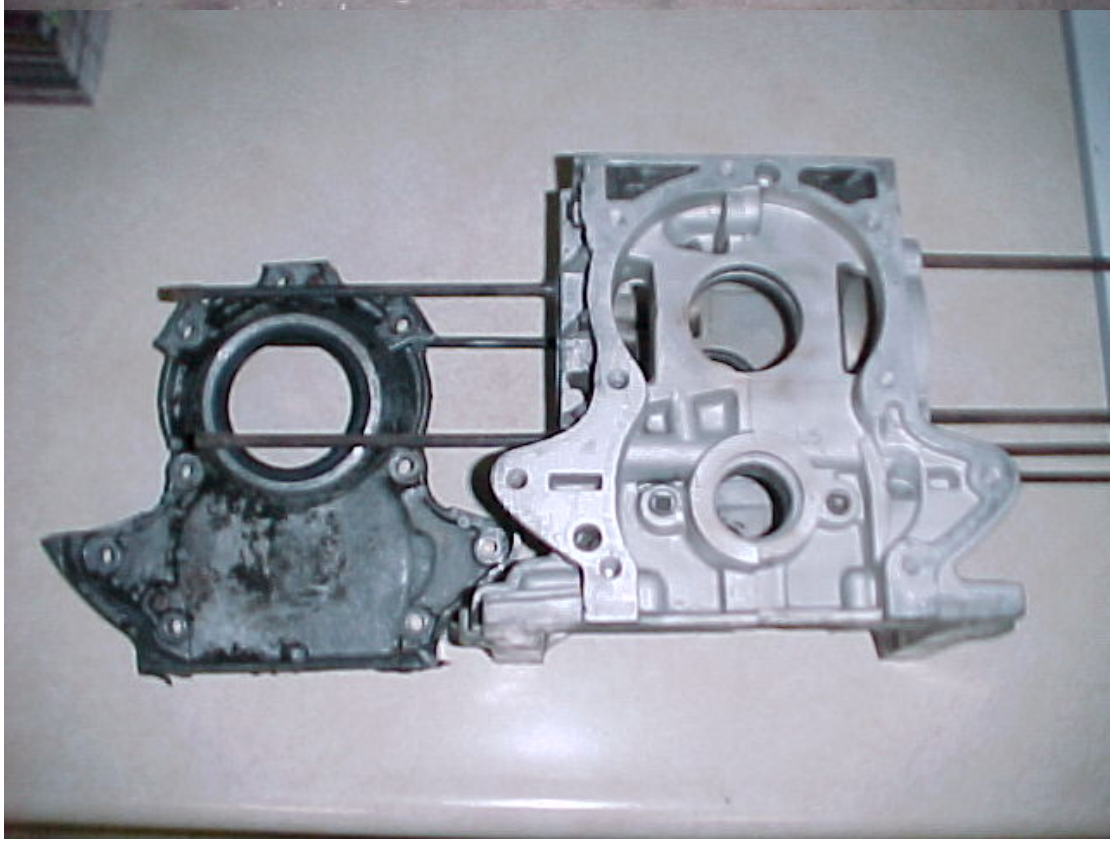
FRONT COVER

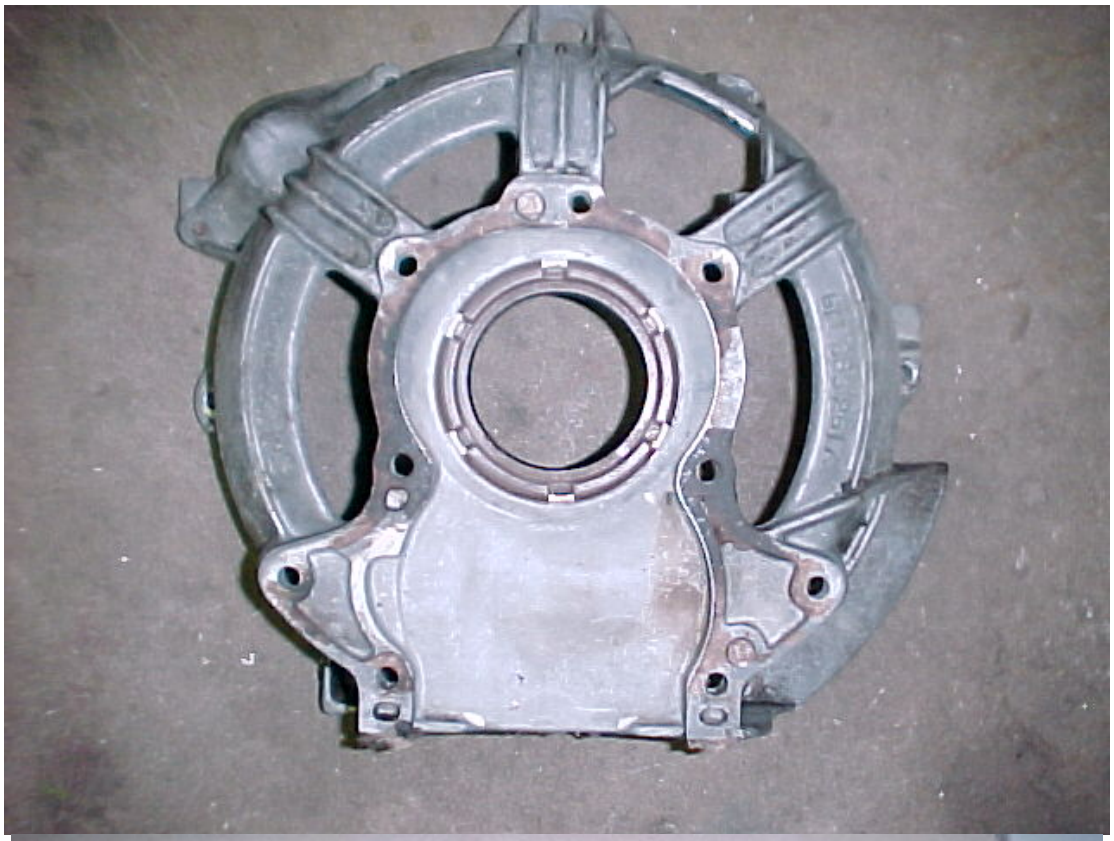
The front cover is simply made by cutting it out of the Corvair bell housing. You can use a hack saw, band saw, saber saw, or saws all. If you have a choice, use a bell housing off of an automatic transmission, there's less material to remove. The photos do a good job of showing where to cut. On our prototype engine we cut off the two large lower ears and cut off the matching ears on the crankcase. This required welding in a piece of aluminum on the left side of the crankcase and milling it to complete the gasket surface. In retrospect, it was a lot of extra work for nothing, but it can be done if you want the front of the crankcase to be narrower.

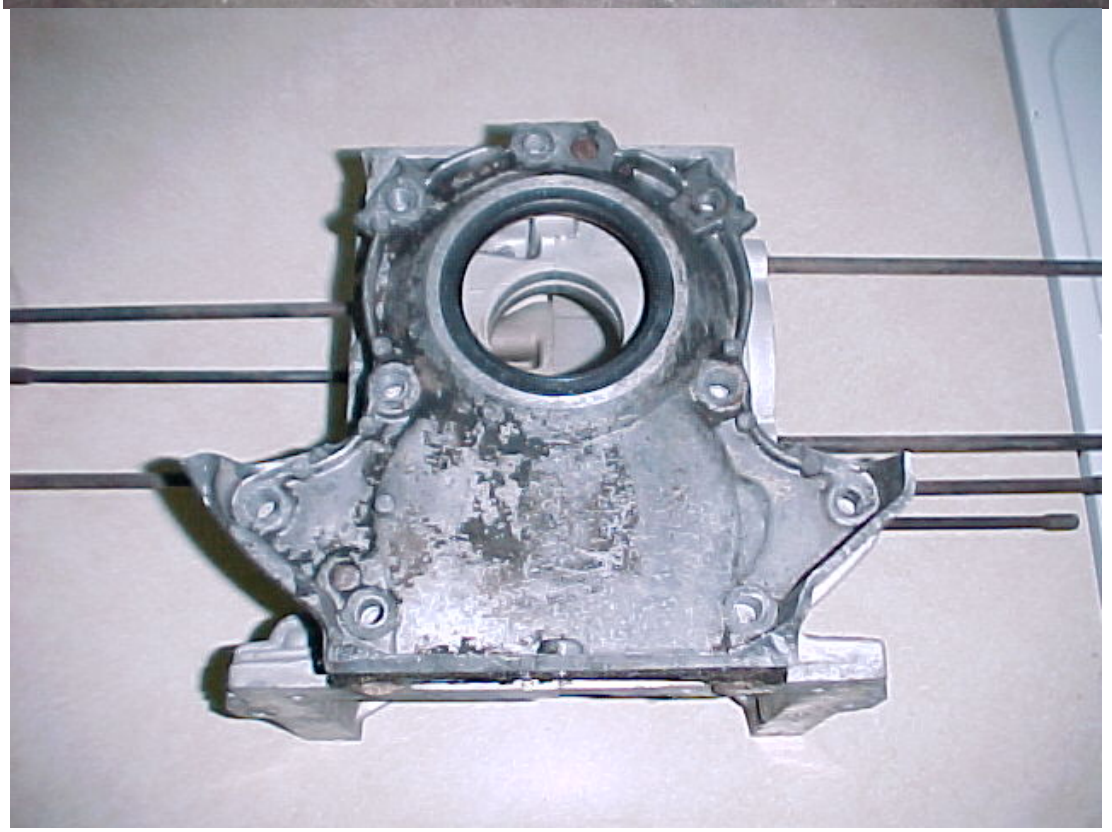
Be careful when cutting the front cover not to mar up the gasket surfaces. Always replace the front seal. The front cover gasket is the only gasket you will need to buy, the rest you will have to make from gasket material. Use thread sealer on any bolt holes that are threaded through into the crankcase.











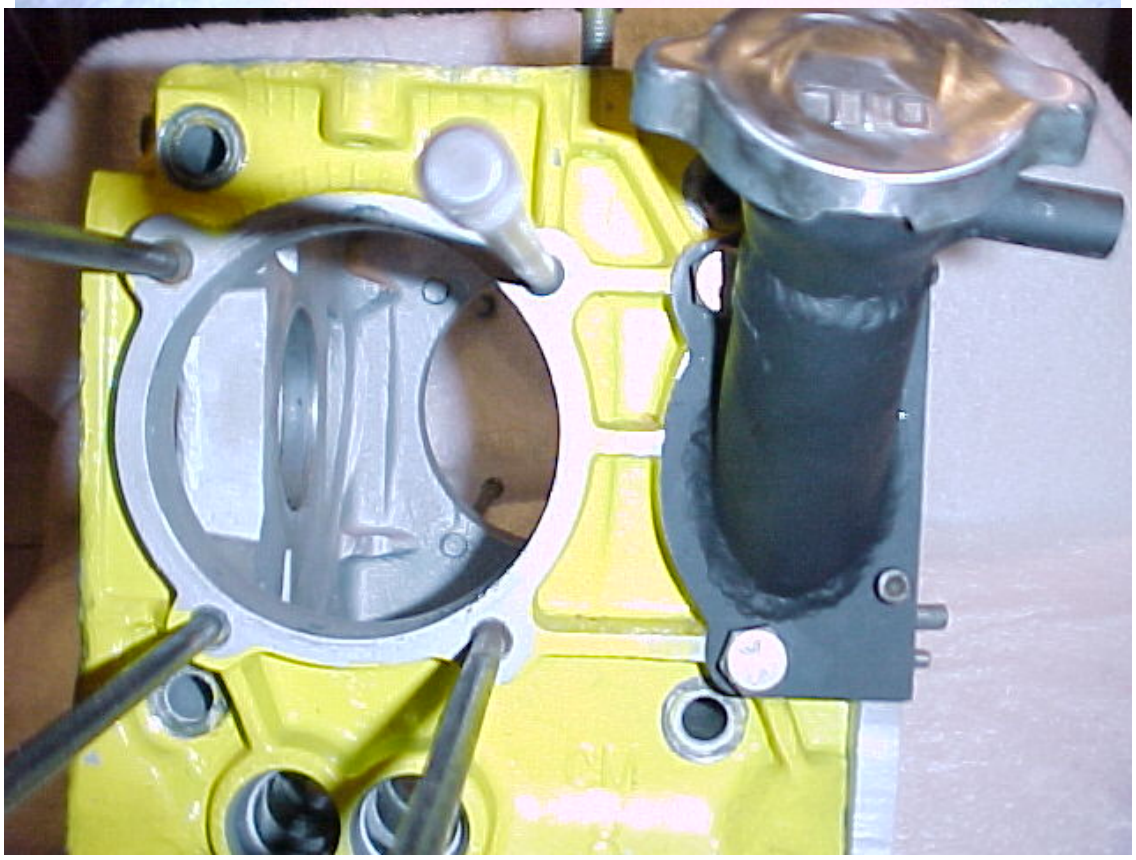
OIL FILL TUBE

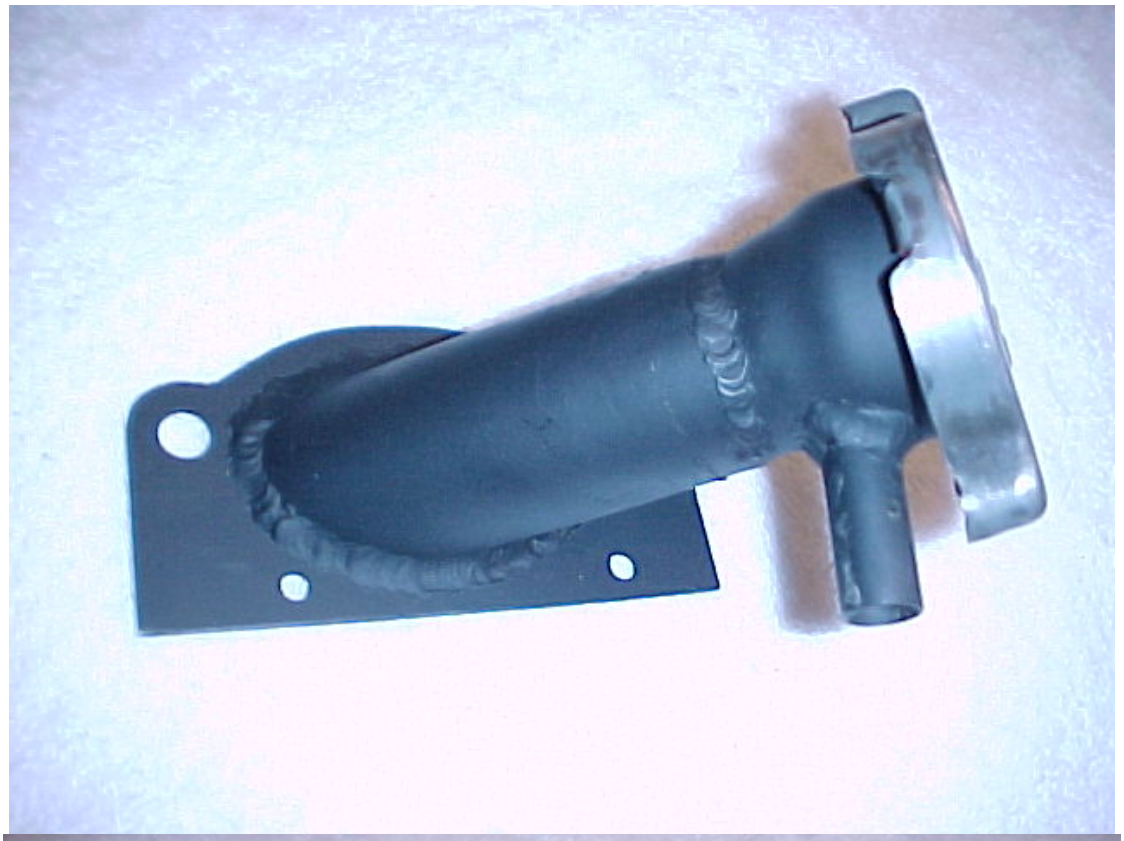
The oil fill tube fills in the unused half cylinder hole on the left side of the engine. Make a plate out of .090 4130 steel to cover the cylinder hole and the two cylinder stud holes. Drill two 3/8 inch holes in the steel plate so you can bolt the plate on using 3/8 course threaded bolts into the cylinder stud holes, make yourself a template. Also drill two more 3/16 inch holes along the back edge of the steel plate and thread two matching 10-24 holes into the back plate, see photos. The tube is a short piece of 1.5 inch exhaust tubing cut at an angle and welded to the steel plate. The length and angle depend on your installation. Before welding the tubing drill about 25, 1/8 inch holes in the steel plate inside the tube perimeter. These holes act as a baffle to prevent oil spray from leaking out the breather tube. Cut the Corvair filler tube as seen in the photos and weld it to the top of the1.5 inch tubing and use the Corvair oil cap. Drill a ½ inch hole near the top of the tube and weld a short piece of ½ inch steel tubing to connect a breather hose on to. We also put a copper or stainless steel mesh pot scrubbing pad in the filler tube to act as an air-oil separator. We bought ours at Wal-Mart in the kitchen section. Be sure to use a pad that is a one-piece woven pad, not steel wool or anything that can come apart. When adding oil, pull out the mesh or it will take a long time for the oil to pass through it. Make a gasket for between the plate and the crankcase and you're done.

We tried several different ideas for venting the crankcase and this oil fill tube solved all of our oil leak and oil spray problems. Initially we used a PCV valve as a check valve to let the crankcase pressure out as the pistons moved down, then close and create a partial vacuum as the pistons traveled back up. We tried several different locations on the engine for the PCV valve, but always had an oil mist spraying out of it. Then on one flight down the runway the valve stuck shut and the crankcase pressure built up until it blew out just about every gasket in the engine. The oil fill tube works well with no moving parts, so there's nothing to fail.

OIL FILTER

We strongly recommend you install an external oil filter in your oil system. Great Plains Aircraft has a remote filter bracket in their catalog. Make 3/8 hoses for use with AN fittings. Oil flows out of the oil pump and into the "IN" port of the filter bracket, then out of the "OUT" port and into the fitting in the top cover of the engine. Mount the filter bracket wherever you can and install a Fram PH-8A, or similar filter. We like to mount our filter vertically if possible so you can fill the filter with oil before you install it. This gets the oil pressure up faster after an oil change because the pump doesn't have to fill the filter first. We also drilled and tapped the filter bracket on the side of the "OUT" port 1/8 NPT for an oil pressure gauge line.





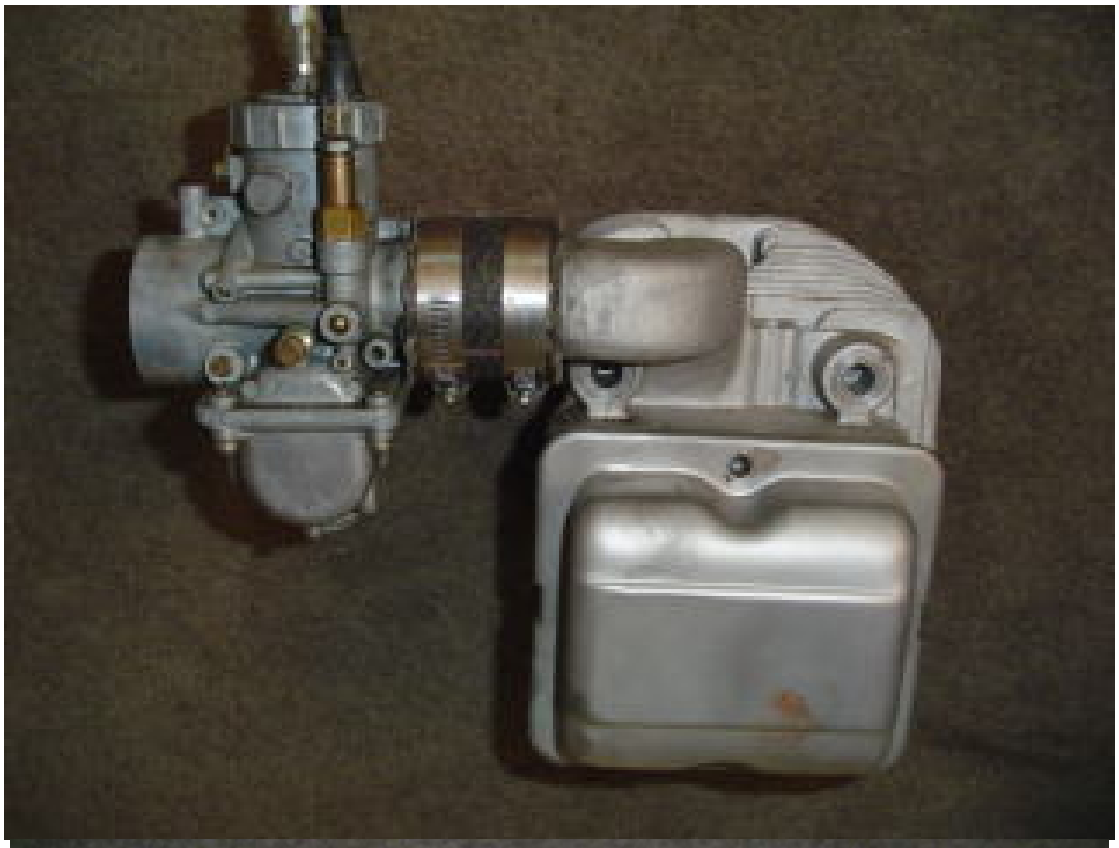
CARBURETORS

Choosing the correct carburetor setup depends on your installation and it's as much art as science. We started out with a single sidedraft carburetor mounted below the engine with a 1.5 inch tubular intake manifold, but switched to two 28mm Mikuni carburetors mounted directly on the cylinder heads. The single carburetor below the engine was a Harley Bendix motorcycle carburetor. We were plagued by a stumble just off idle when the engine idled for any length of time. After a lot of adjusting and re-jetting we found the problem was fuel pooling in the bottom horizontal section of the intake manifold. Fuel was atomizing in the carburetor, but then turning back to a liquid at low rpm because there wasn't enough air velocity to take the fuel up to the heads. This wasn't a problem at higher power settings, but we had to wait for the pooled fuel to burn off before the engine stabilized at a given power setting. We felt we were wasting a lot of fuel for nothing. At Oshkosh 2003 we had a lot of helpful tips from ½ VW owners and builders about the problem. One solution offered was to install a Zenith updraft carburetor as seen in the Great Plains catalog. Another was to eliminate the horizontal portion of the intake manifold and run the intake tubes up at a direct angle from the carburetor to the heads. The solution we chose was to install a carburetor on each head. The weight of the extra carburetor was offset by the loss of the steel tube intake manifold. We gained an additional 100 static rpm and instant throttle response and stable EGT. We have left the engine idling for 30 minutes, then opened the throttle quickly and it accelerated instantly. We feel this is the best setup for us.

We are using gravity feed from a high wing mounted tank so we haven't experimented with a fuel pump. The back cover can be tapped somewhere near the top for a pipe threaded nipple and a hose from that can be run to a Mikuni fuel pump. Crankcase pressure and suction should drive the pump just as it would in a two-cycle engine. When we do test this setup we will post the results on our website. **www.ultra-vair.com**

EXHAUST

Our exhaust was made from 1.5 inch mandrel bent tubing purchased from JC Whitney. They sell 180 degree U-bends. We simply cut and welded as needed. We made 1/8 inch steel plates as seen in the photo for the flanges. Put Corvair exhaust doughnuts on the exhaust tubes and make sure your exhaust system pushes up on the exhaust tubes to keep them pushed against the heads. We tried individual pipes and the two into one system shown. The two into one system gave us a 75 rpm increase in our static rpm. Your installation will dictate which system you will use.



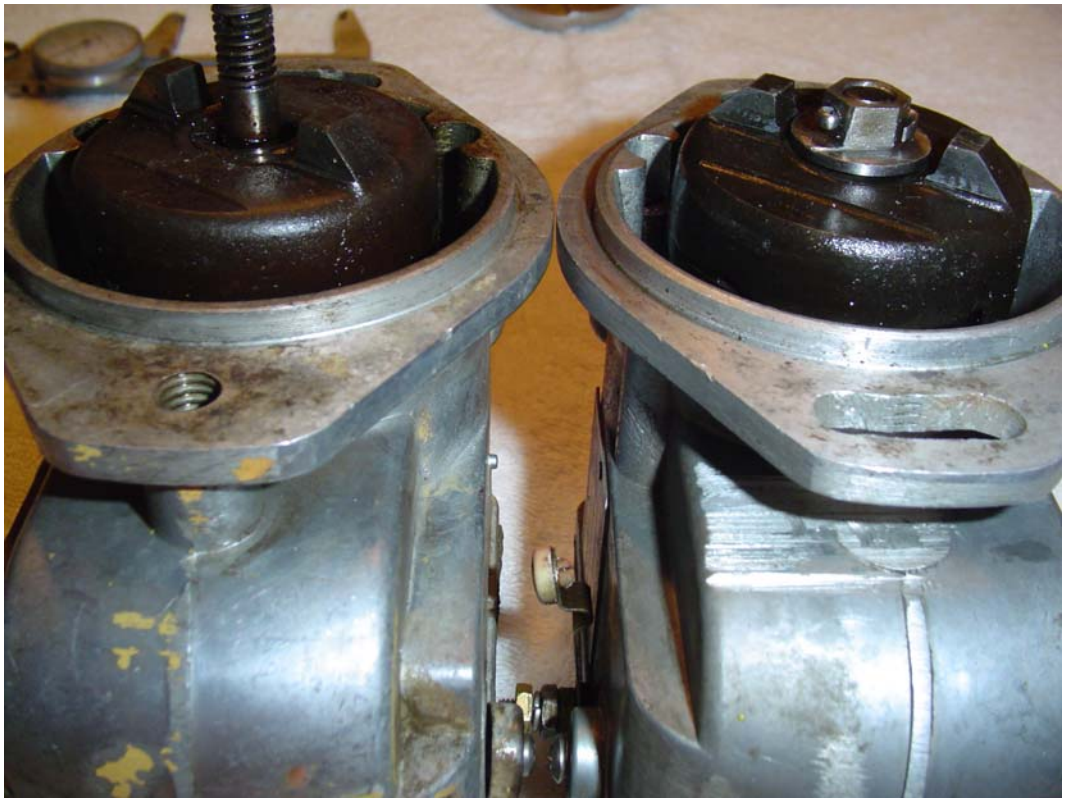
IGNITION

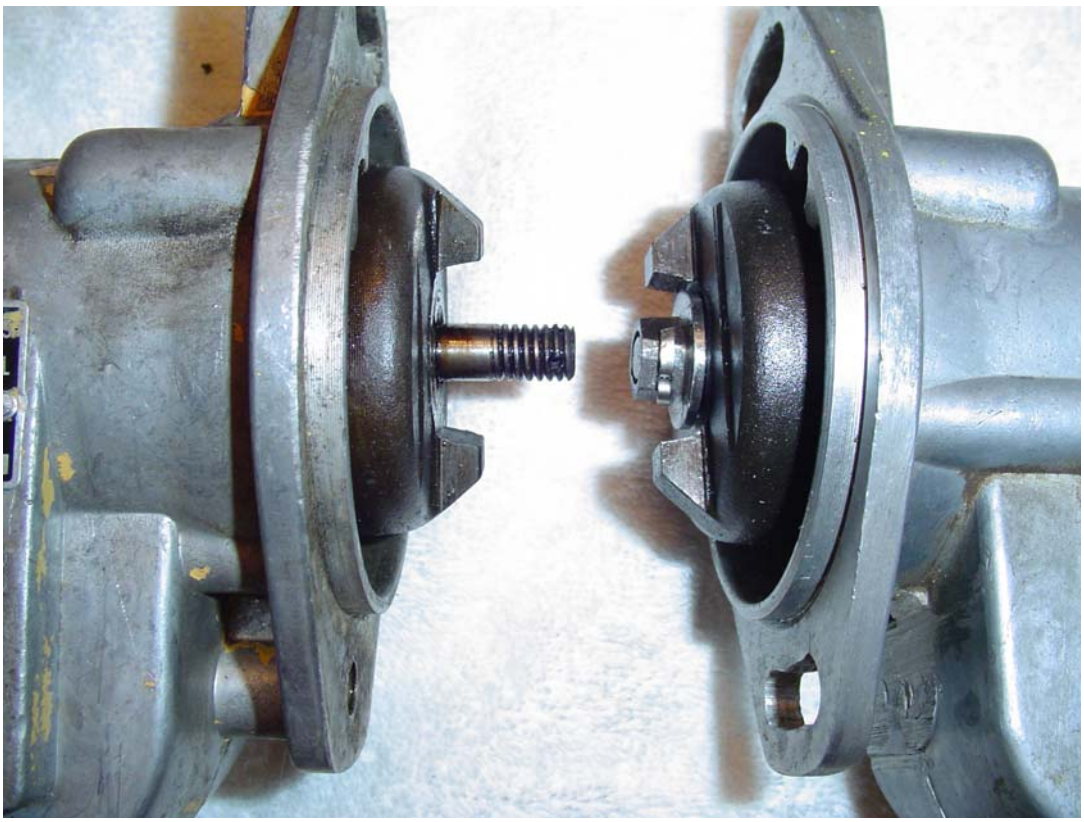
We use a Fairbanks Morse X1-2B7-1 magneto off of a Wisconsin 2 cylinder engine. This magneto is very light and simple. It doesn't have a rotor or gears in it, instead it has a coil with 2 outputs. The magneto fires both plugs at the same time, one cylinder is on the power stroke and the other is on the exhaust stroke. Your lawn mower has been running this way forever, it works, it's simple and there are less moving parts. You can use other magnetos as long as they rotate the proper direction and have an impulse coupling for starting. The photos show the modification to the magneto case for the upper mount bolt. The threaded boss is cut off and the hole is slotted to allow timing adjustment. The shaft is threaded down farther and shortened so it won't run into the back of the crankshaft. You will also need to drill a new cotter pin hole. Do a test fit just like you did with the camshaft. Make sure the magneto is fully engaged in the drive puck slot, but not pushing the crankshaft forward.

We set the ignition timing at 27 degrees BTDC. We have also been experimenting with total loss crank-fired ignition to simplify the back cover. You wouldn't have to cut the magneto hole and you could simplify the trust plate, but as of this writing we are only offering plans for the magneto ignition.

Spark plug wires are made up of NGK caps and 7 mm multi-strand plug wire out of the Aircraft Spruce catalog. The brass ends at the magneto cap were purchased at our local NAPA store, take your magneto with you and they can find the correct ends. We soldered the brass ends on to the wires.

We use AC 44F spark plugs with the little nipple removed off the tip so they will work with the NGK caps. We set our plug gap at .025 inch.





ENGINE MOUNTS

Make the four engine mount fittings as shown in the drawing. They are made out of .090 4130 steel sheet. Be sure to weld in the doublers. The upper mount fitting bolt into the back two top cover bolts on each side. Use 5/16 course threaded grade eight bolts long enough to go all the way to the bottom of the threaded bosses. Don't drill the mount holes on the bottom two fittings until you clamp them in place on the crankcase. The lower two fittings can be trimmed shorter after drilling the mount holes. Trimming is very important on the right side of the engine to clear the push-rod tube. As you can see in the photos, there is an AN-4 bolt and nut on each side of the web of the crankcase. Use thread sealer on the AN-4 bolts to prevent oil leaks. The lower fittings rest on top of the oil pan bolt bosses and need to be in-line with the top fittings. In other words, they all need to stick past the back cover the same amount. You should also smooth out the sides of the crankcase underneath the lower fittings.

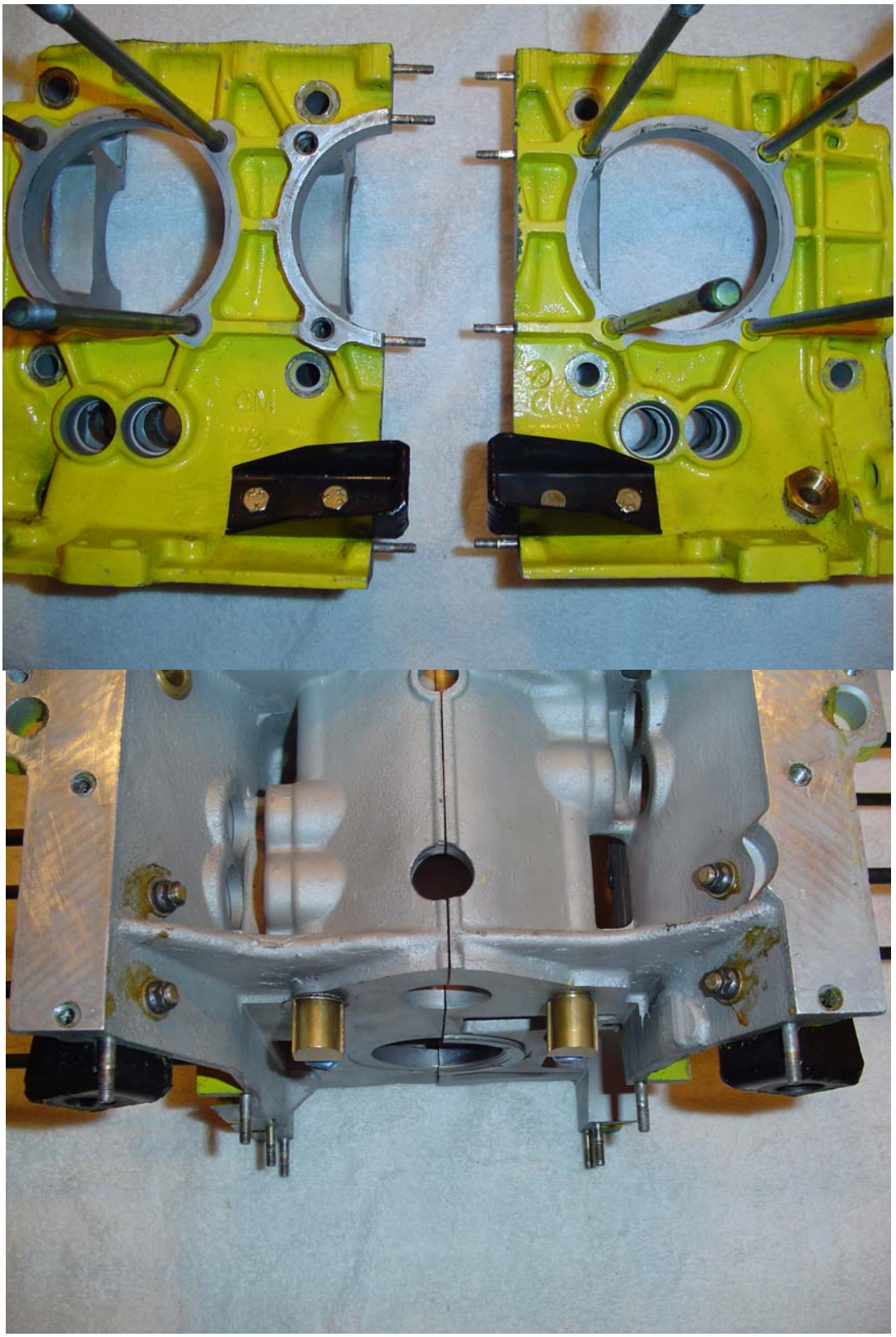
The mount bushings are automotive shock absorber bushings purchased at the auto parts store. They are installed with their shoulders inside the 5/8 inch holes in the fittings. AN-6 bolts and thick washers that cover the entire bushing without rubbing on the fittings complete the mounts.

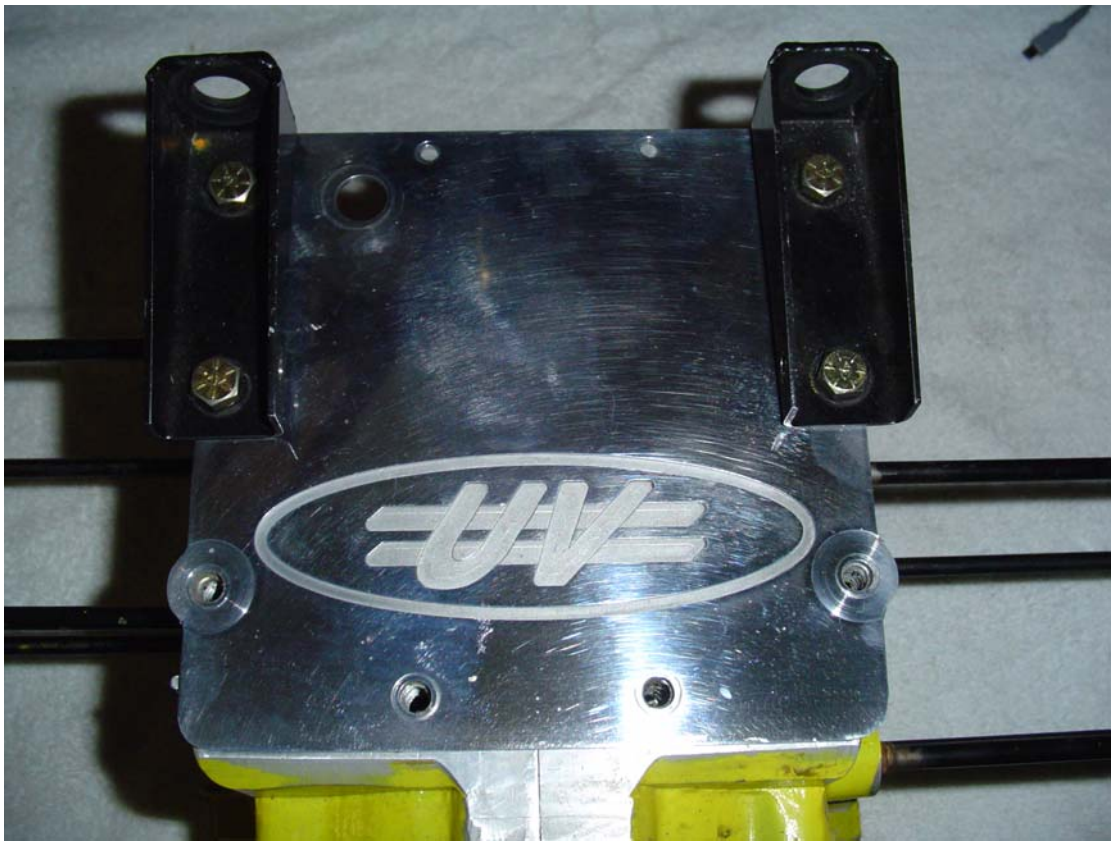
If you need a cradle type mount you can leave off the top two fittings and add a 4130 cross tube between the lower two fittings extending out inline with the two large ears cast into the crankcase and use them for the forward mounts. The six-cylinder aircraft engines use the crankcase ears for their mounts with automotive shock absorber bushings vertically.

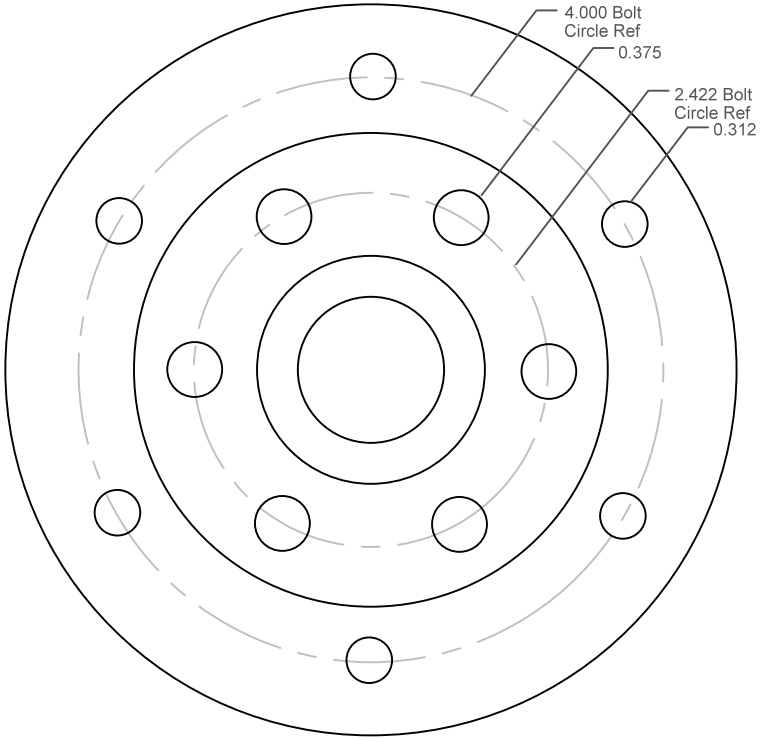
We will be glad to help you with your particular mounting situation.

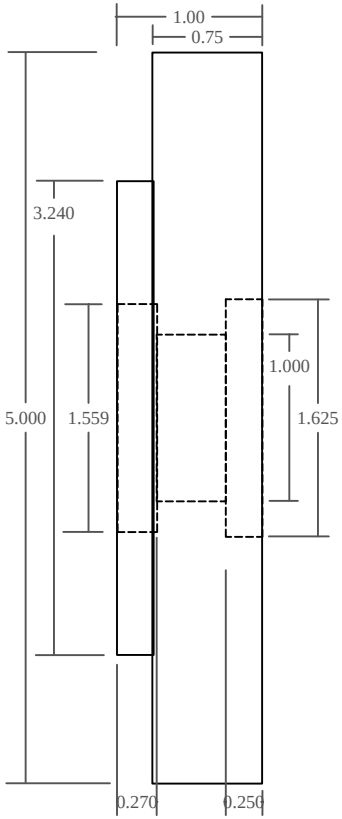
PROPS

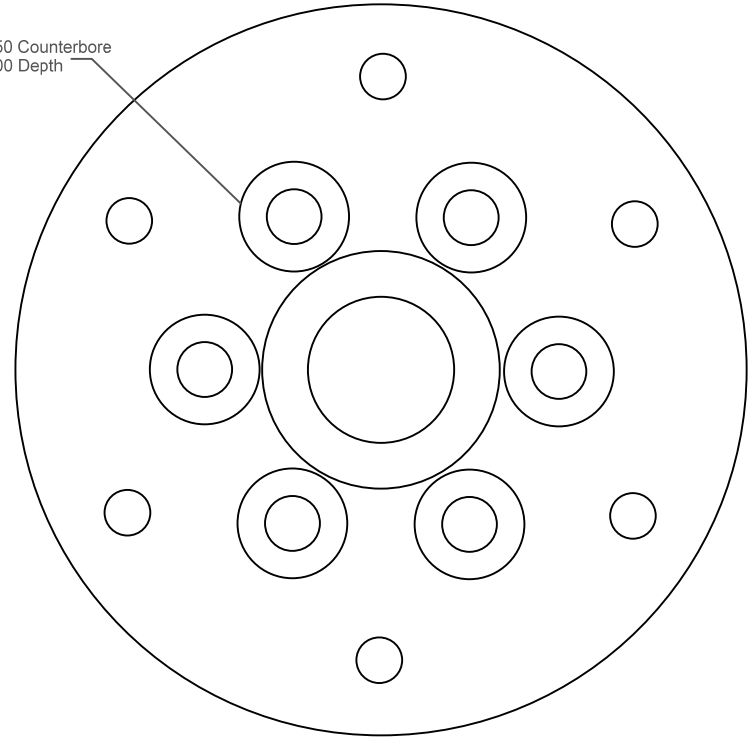
The prop hub has the same bolt pattern as the ½ VWs. The UltraVair engine rotates the same direction as the VWs so any prop suitable for the ½ VW engine is suitable for the UltraVair engine. We recommend a 54 X 24 prop if you are building a stock engine with a stock Corvair cam. We will be testing an OT-10 cam in the near future and will post our prop recommendations on our website.











Material: 6061 T6

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

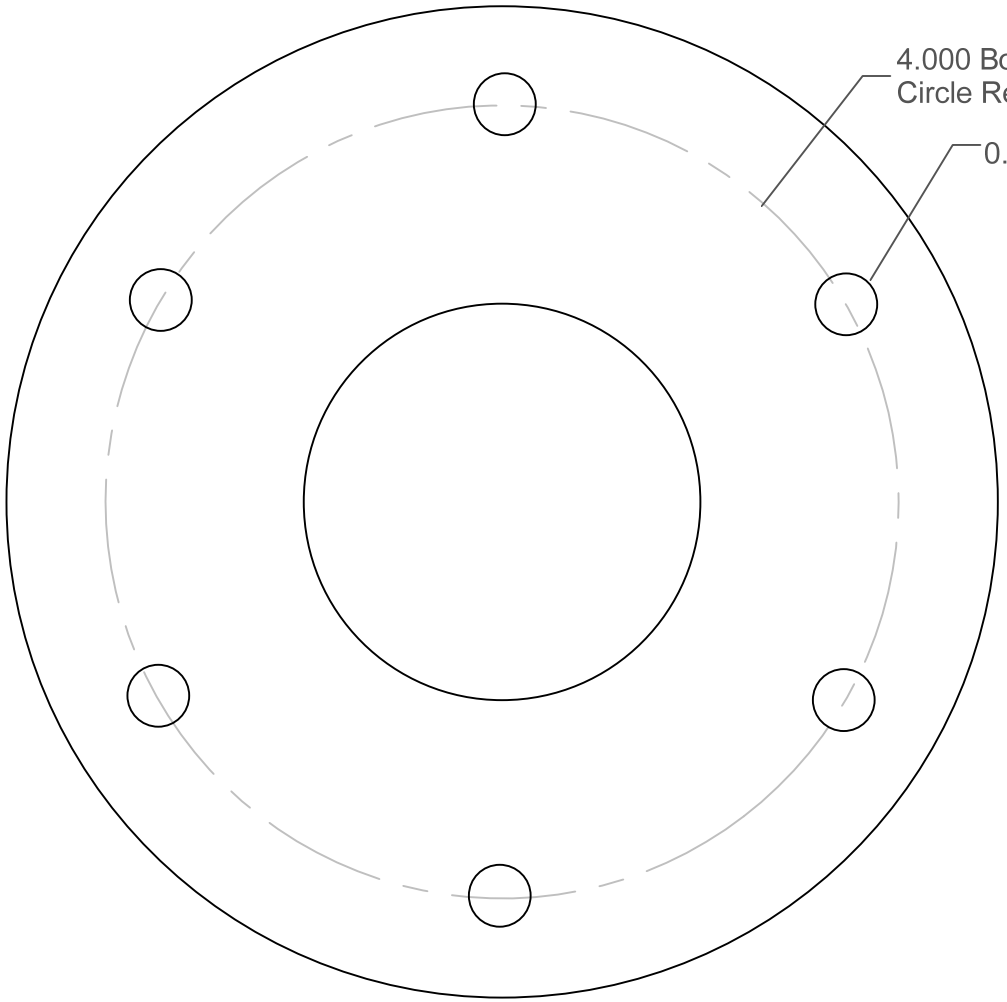
UltraVair Aviation LLC
Cedar Rapids, IA

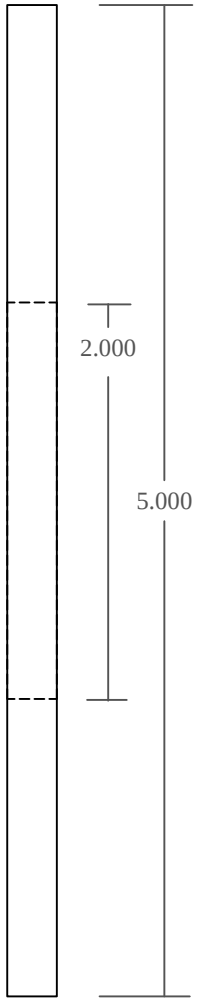
TITLE

PROPELLER HUB

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-001	

SCALE		SHEET
Not to Scale		1 OF 1





Material: 0.250 6061 T6

Prep Kurt Bryant

Apvd Fletcher Burns

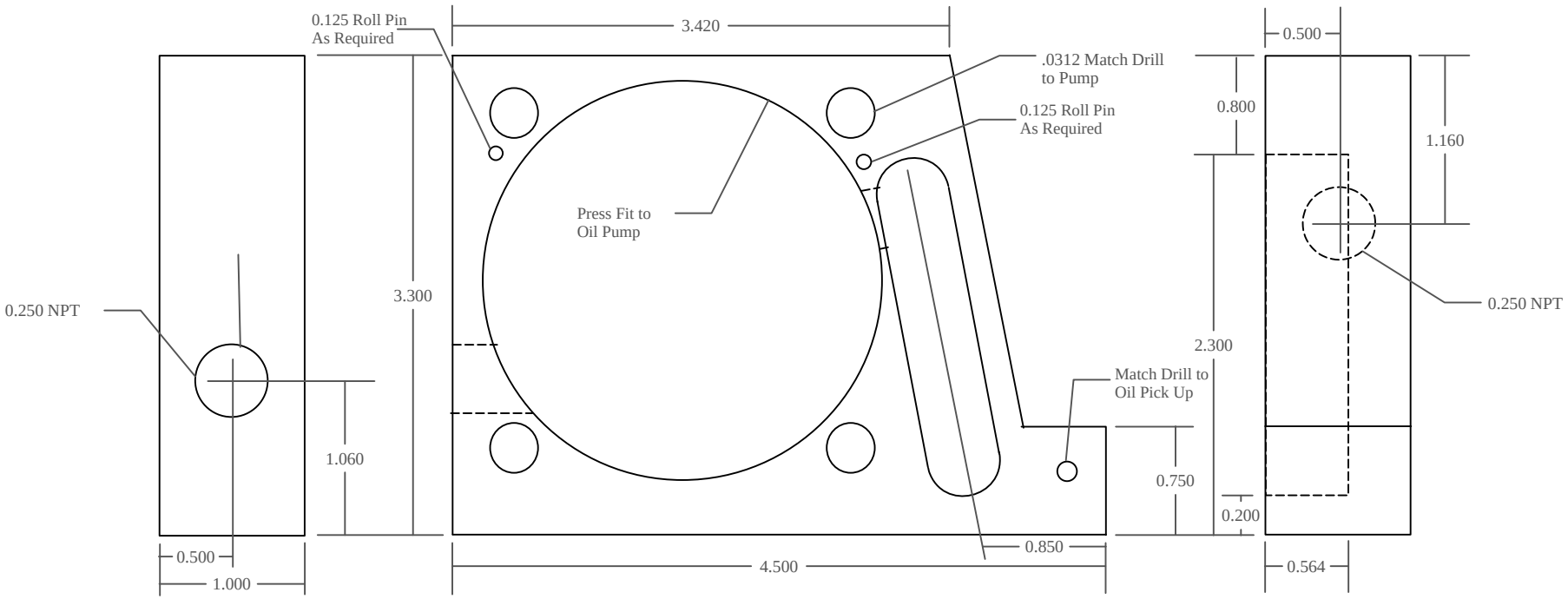
UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Propeller Hub Crush Plate

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-002	

SCALE		SHEET
Not to Scale		1 OF 1



Material: 6061 T6

Prep Kurt Bryant

Apvd Fletcher Burns

UltraVair Aviation LLC
Cedar Rapids, IA

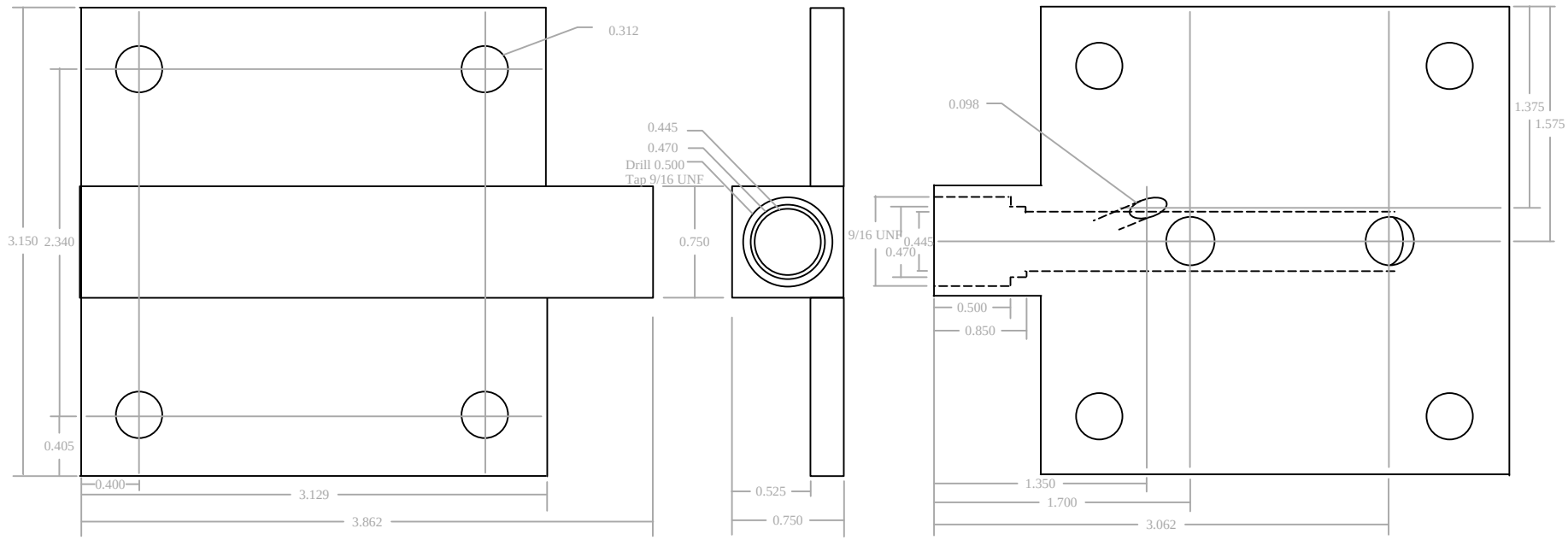
TITLE

Oil Pump Housing

SIZE	CAGE CODE	DWG NO	REV
A		0-55A-006	

SCALE Not to Scale

SHEET 1



Material: 6061 T6

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

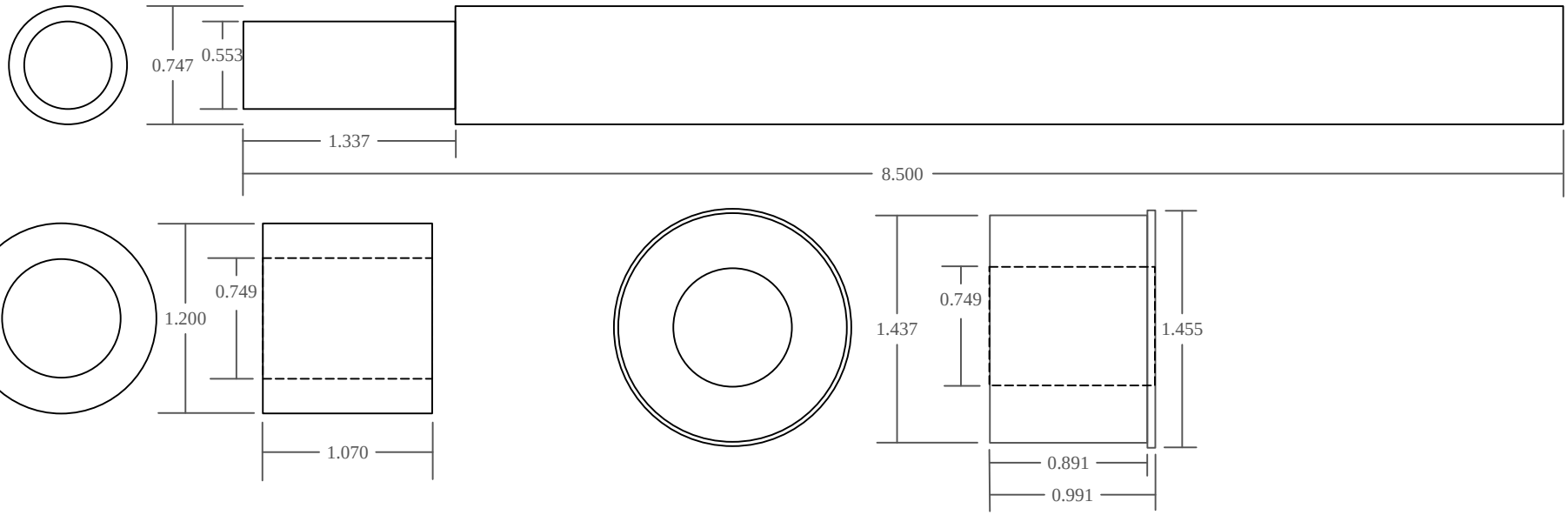
UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Oil Pump Cover/Pressure Relief Valve

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-005	

SCALE		SHEET
Not to Scale		1



Material: 6061 T6

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

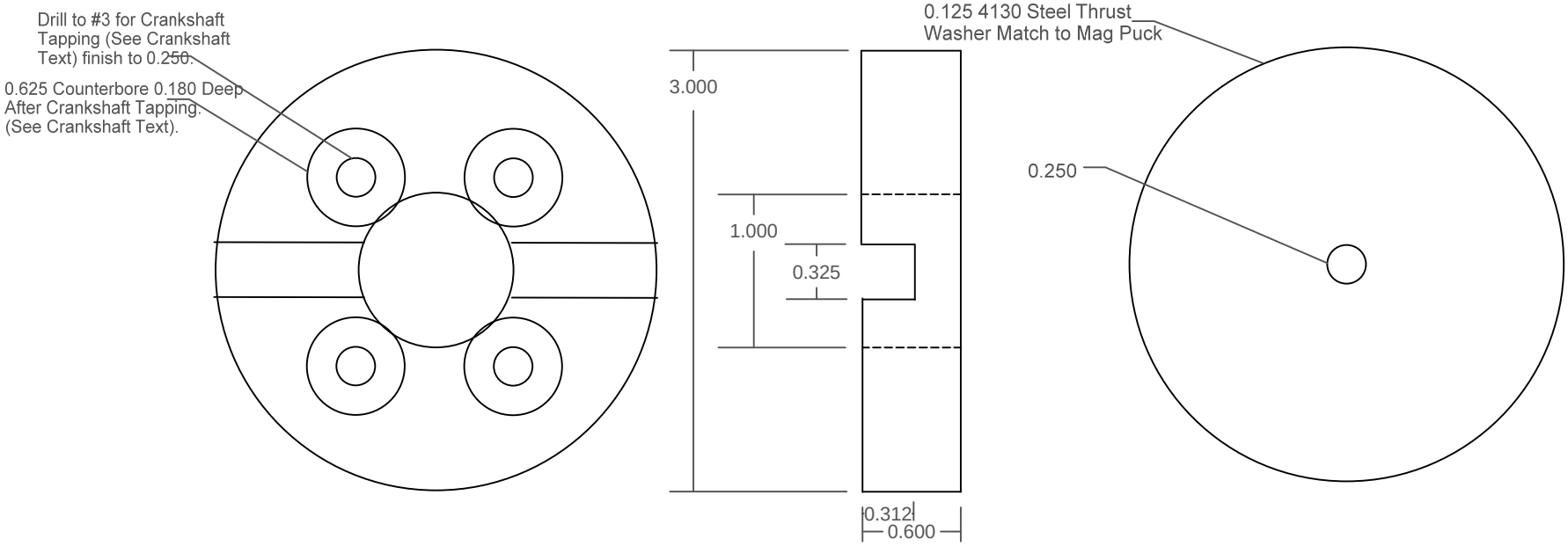
UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Oil Pump Alignment Tool

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-008	

SCALE		SHEET
Not to Scale		1



Material: 6061 T6 (Puck)
4130 (Thrust Washer)

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Magneto Drive Puck/Thrust Washer

SIZE	CAGE CODE	DWG NO	REV
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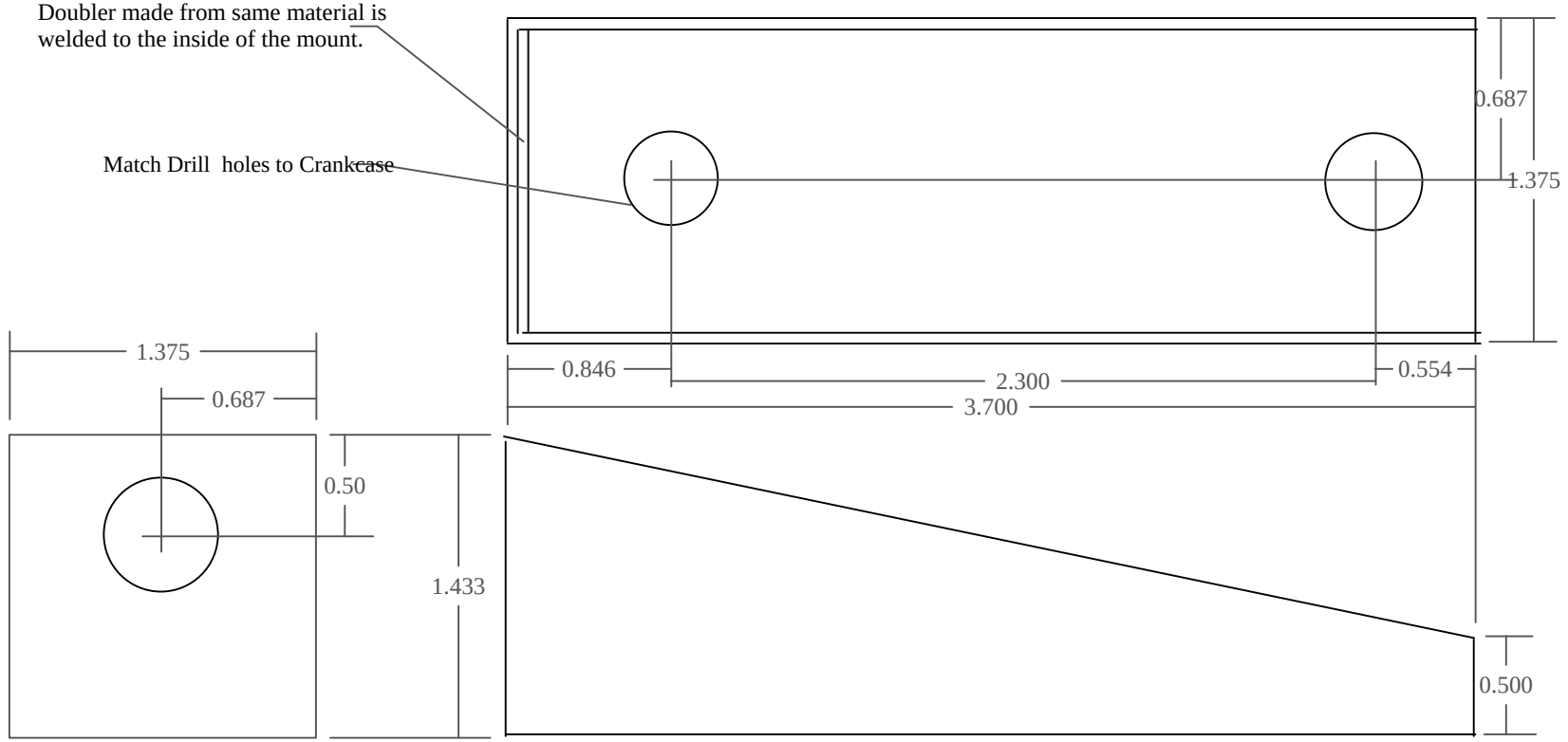
SCALE Not to Scale

SHEET 1



MATERIAL: 0.090 4130 Steel

Note: All dimensions are approximate. Design and fabricate brackets to match engine and airframe.

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

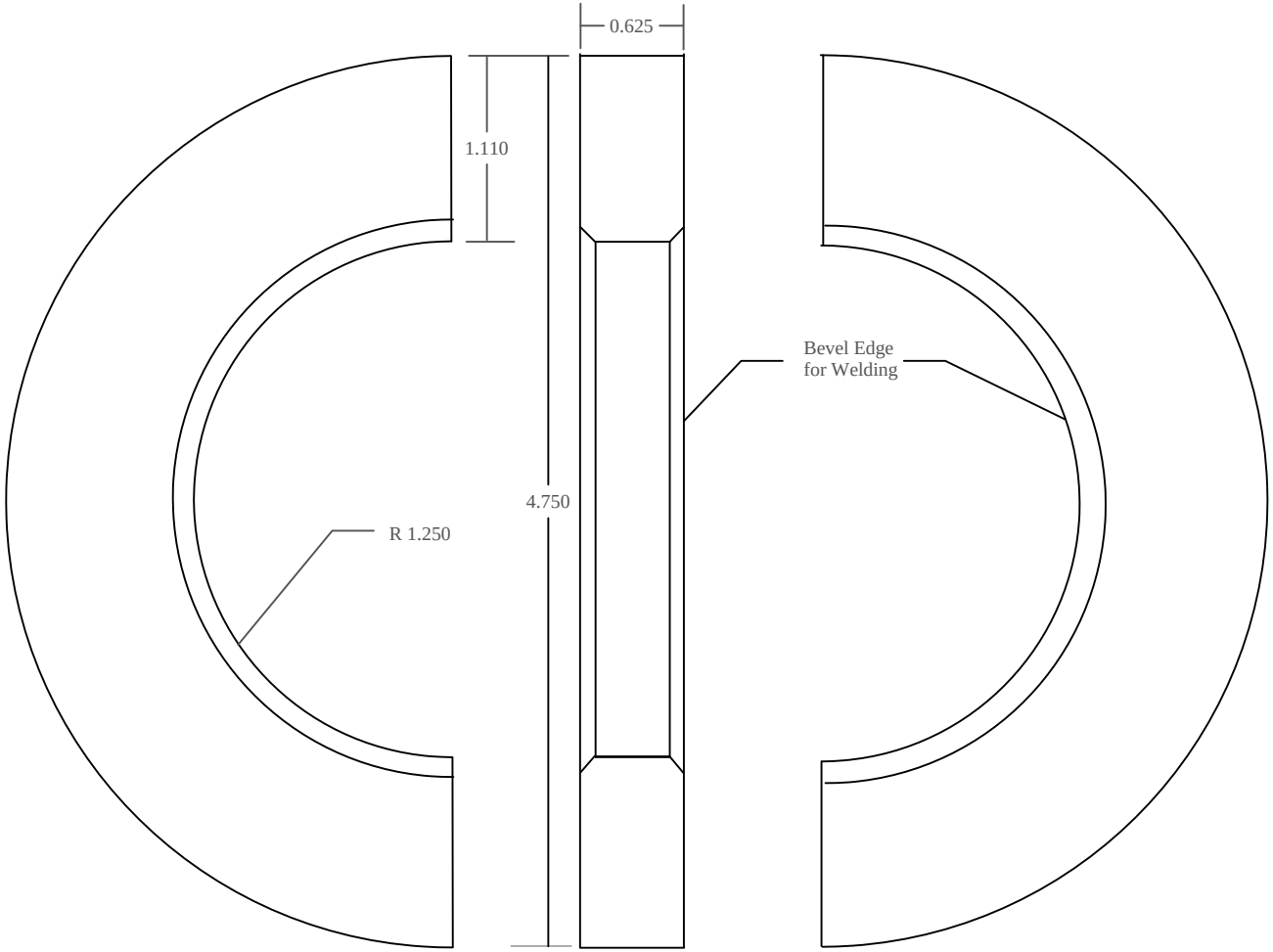
UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Engine Mount (4 required)

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-010	

SCALE		SHEET
Not to Scale		1



Material: 0.625 Cold Rolled Steel

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

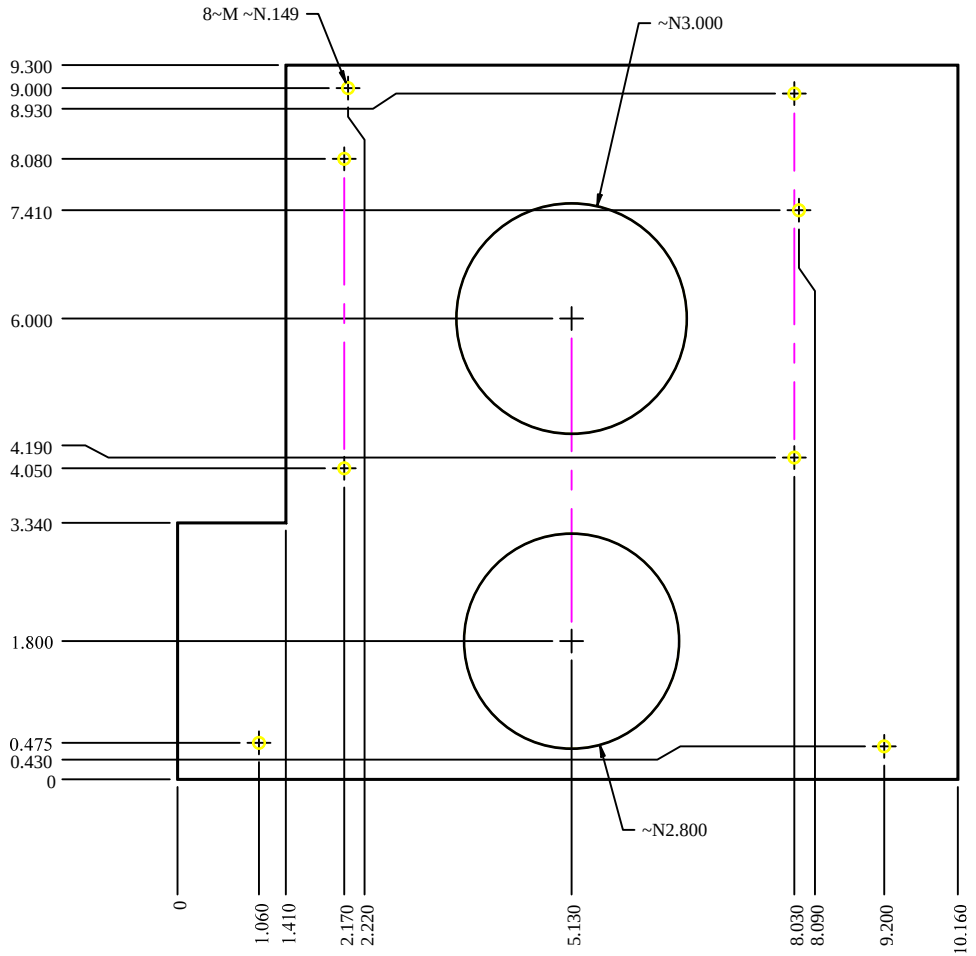
UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Crankshaft Counter Weight

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-004	

SCALE		SHEET
Not to Scale		1



Material: 6061 T6

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

UltraVair Aviation LLC
Cedar Rapids, IA

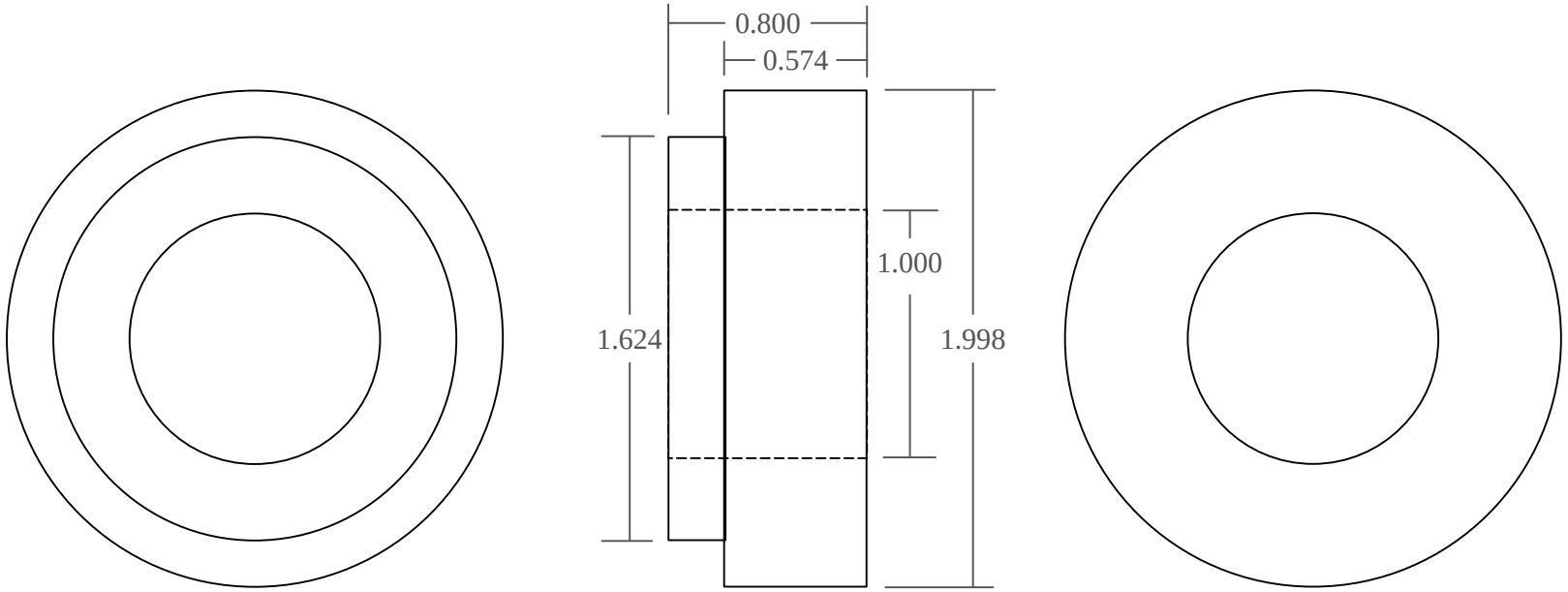
TITLE

Back Plate

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-007	

SCALE Not to Scale

SHEET 1



Material: 6061 T6

Unless otherwise specified dimensions are in inches.

Prep Kurt Bryant

Apvd Fletcher Burns

UltraVair Aviation LLC
Cedar Rapids, IA

TITLE

Prop Hub Centering Bushing

SIZE	CAGE CODE	DWG NO	REV
A		O-55A-003	

SCALE		SHEET
Not to Scale		1