How to Convert a BMC A-Series Cylinder Block From Automatic to Manual Transaxle

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In the USA, an Austin America has often been the source of a 1275cc engine for an early Mini that came with a smaller powerplant. Many Austin Americas have the optional 4-speed automatic, and the cylinder block is different enough to prevent its use on a manual trans without certain modifications.

This web page will tell you in great detail how to convert a 1275 block. For some streamlined, concise instructions aimed more at the experienced machinist, check out Kevin Green's procedure, written previous to mine, at Todd Miller's extensive Austin America website. Be sure to read it, because it contains good additional info & photos. Kevin graciously provided several corrections and additions to this article.

I have not converted a small bore automatic block, probably because few were imported to my country and the time & money would probably be better spent on a big bore. One difference I've heard of is the oil pump recess in a small bore automatic block is no deeper than in the manual block, so no spacer plate needs to be fabricated.

The automatic engine differences are:

- The oil pump recess in the back of a big bore block is 1/4 inch deeper to help make room for the much longer oil pump.
- The rear camshaft bearing is narrower.
- Two, rarely three, oil passages in the block aren't drilled.
- The engine oil pressure regulator valve seat "spool" has holes drilled sideways through it.
- Sometimes the oil dipstick hole isn't drilled.
- The primary gear has a larger diameter gear and different splines.

Engine items that are the same:

- Crankshaft and camshaft. Note that an automatic crank might be less likely to be cracked because of the additional torsional damping effect of the torque converter.
- Oil pump drive spider.
- "Bellhousing" and "oil pan" bolt pattern.

- Starter motor.
- All the small parts around the primary gear except the big bolt & keyed washer, which are much thicker. You could cut up the primary gear and press out the bushings to reuse if you want.
- The external oil pipe isn't the same, but on the later models, it's very similar. It's longer and you might be able to re-bend, shorten, and re-flare it to avoid buying a manual pipe.

Gearbox items that are the same:
(Save these goodies before throwing the automatic transaxle away or selling it on eBay.)

- The big double row ball bearing in the bottom of the cast aluminum converter housing at the transaxle input gear - it's the same as the one next to the manual trans output pinion gear. Make sure it has the circlip groove in the O.D..
- The idler gear thrust washers. These little things cost $20-30 each these days! The idler gear itself is much larger in diameter as is the primary gear and input gear because the automatic bevel gear assembly is larger in diameter than the manual mainshaft assembly and sits farther away from the crank, farther down in the trans case.
- The whole differential assembly, except for the crown wheel & pinion (which are much larger in diameter since the diff has to sit farther away from the larger diameter nested bevel change gear assembly than from the mainshaft in a manual trans), and the two aluminum output shaft end covers bolted to the sides where the case & diff housing meet. The differential is usually in much better condition than in a manual trans. It seems hardened steel chips ground off the manual gears get centrifuged into the area where the cupped brass thrust washers for the spider gears live and they stay there forever chewing up the washers & diff housing. (I'm tempted to drill exit holes in the housing to see if that'll reduce damage by letting the chips out. Note that the cupped washers have holes and the damage is always on the outside! Note that later washers have an anti-rotation tab.) If you want to convert your manual transmission to Cooper S inboard Hardy-Spicer U-joints, note that the following automatic parts are the same as Cooper S:
    - 22A1151 differential output side gear & shaft
    - 22A1152 drive flange
    - 27H7880 U-joint assembly

    The larger inside diameter Cooper S aluminum diff end covers can be hard to come by. A machinist friend once bored a pair of manual trans standard (rubber U-joint) covers to the Cooper S I.D., pressed in automatic / Cooper S bushings (22G421, they're the same too) and used an industry standard thinner section oil seal that was marked "GACO MI 137187 5/16."

- The speedometer drive parts. Note that the internal cable drive square is often rounded out. Note that the number of skew gear teeth can vary according to the final drive ratio and tire size on the ADO 16 (1100/1300) cars.

If there's any possibility someone will be using the old torque converter again, be sure to always have 3 equally-spaced bolts torqued into the hub of the converter where you install a torque converter puller. Otherwise, it'll most likely have an incurable oil leak in that area.

It's best to work with a completely stripped-down block so machining swarf doesn't find its way into delicate areas. This engine was disassembled because the car had rotted unloved & unwanted in a wet location for years and the engine would no longer turn over due to corroded pistons. Wouldn't it be nice if everyone used fogging oil? (Or noticed right away the car's only problem was stripped splines in the left front drive flange, an easy fix?)

It's possible to do the conversion on an assembled engine, but you have to take care not to get drilling chips in sensitive places. More later.

The engine with the pump removed in the left photo is a manual and the bare block in the right photo is an

automatic. The big inset for the oil pump on the back of the automatic block is 1/4 inch deeper to help make room for the much longer pump, which supplies oil to the transmission along with the engine. I think that's why there's a big core plug in the torque converter housing right behind the oil pump - the thin sheet steel plug gives more room for the pump than would a cast aluminum wall like on the manual trans clutch housing.

You'll need to fabricate a 1/4 inch thick spacer plate for the oil pump. The O.D. of the plate should be a slip fit or slight interference fit in the block to keep internal oil leakage low. The deeper, smaller diameter of the stepped recess in the block is a fairly well-controlled 3-9/16 dimension, so if you make the O.D. of the plate 3.562-3.564 inches you should be OK. If you have an inside mike or a dial caliper, take a block measurement.

Aluminum is easy to work with, but steel should work as well or better.

For long pump drive life, the oil pump should be centered in the block recess. With the new pump spaced 1/4 inch out from the original pump surface of the block, the pump will be sitting in the outer, larger diameter of the stepped recess, and it can be way off center, even with all the bolts in their sloppy holes. One way to positively center the pump is to machine the I.D. of the spacer plate to fit the pump snout. The snout's outer shape is not a controlled dimension in the design of this engine, and they come in a very wide variety of sizes & styles. You'll have to improvise on your own or consult a machinist. The I.D. of the plate above left was bored to .900 inch and bevelled slightly to snugly fit the pump on the right.

There have been *many* different oil pumps on the manual engines. Some are pin (or peg) drive, some are spider (or star or spline) drive, and some are slot (or spade or tongue) drive. The nomenclature refers to the shape of the drive on the cam, not the pump, except for the occasional use of "spline" or "tongue." Some pumps have three mounting bolt holes, some have four, and some have two. Perhaps through the years, the engineers realized they didn't need so many bolts. There are also different shaft lengths, depending on whether the block is a "small bore" like an 850 or 1100 or a "big bore" like a Cooper S or 1300. The overall block length is different because of the different bore spacing. Assuming you're keeping the stock camshaft with its spider drive, you need to obtain a spider drive pump, the same as the pump that came with the manual version. It may be possible use different drives & pumps than the one shown in this article, but the I haven't done it yet. The spider drive stuff is getting scarcer, so if you want to use a newer slot drive pump with the older spider drive cam, Mini Mania offers a special spider that connects a spider drive cam to a slot drive pump. David Vizard has a drawing of a pin-drive cam-to-slot-drive pump adapter in his large

authoritative book "Tuning The A-Series Engine".

The automatic pump situation is less complicated. I hear there have only been two automatic oil pumps: spider drive & slot drive.

It is unlikely you'll be able to use a used pump from a front drive car because they're usually shredded internally. I figure they're tore up by bits of steel ground off the first and reverse gears during bad shifting. I like to install lots of magnets in the manual transaxles I build. It also helps keep the differential from being chewed up. Consider buying two identical pumps so when the first one wears out you won't have to re-engineer the plate. Automatics don't have the problem and their pumps almost always look new inside. It's the small spline part of the spider drive that's destroyed: On an automatic, the splines are almost always very badly worn and occasionally worn all the way through, resulting in a car that will start but has no oil pressure anywhere. Unfortunately, a replacement pump shaft, part number 27H6907 (spider drive), can rarely be found by itself. You have to get a whole new pump. The price would probably be nearly the same anyhow.

If you have such a car and are frustrated that the rest of the pump is so perfect, it occurs to me you could grind or machine the oil pump's ruined input shaft to the slot drive shape and use a slot drive cam or the spider-to-slot adapter.

If the spider from your automatic is one of the later symmetrical ones that can be installed in either direction and its splines are only partly worn, you can turn it around to get "new" splines.

Pre-made oil pump spacer plates are available aftermarket for mixing & matching manual blocks & pumps. However, the outside diameter usually isn't near large enough to be a snug fit in the block for an automatic-to-manual conversion, and there'll be a massive oil leak from the pump pressure side to the sump. The store-bought 1/4 inch thick plate on the left is only 3.442 inches in diameter, and the 1/8 inch plate on the right is 3.495.

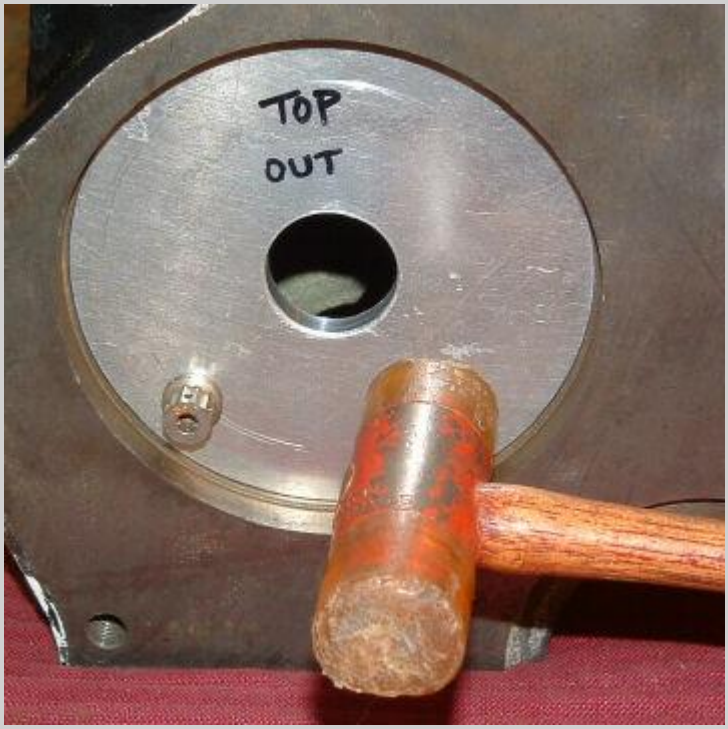
You will need to drill several holes in the spacer plate you're fabricating. For the holes that need to match the block, transfer screws make the job easy. Top left is an inexpensive set of blind-hole spotters, middle & right is a high-dollar set of Heimann transfer screws, and bottom left is an assortment of transfer screws and dowels fabricated on a lathe.

Install a transfer screw into one of the pump mounting holes.

The point of the transfer screw should be just above the pump mounting surface.

Write an orientation on the plate to prevent later mistakes. Push it into the block and tap on the area over the transfer screw to make a punch mark on the other side of the plate.

It's nice to use a drill press to make straight holes, but since the plate isn't very thick, drilling it by hand should be fine. Be accurate with this first hole because it will serve as a datum for everything else. One way to keep the finished hole more concentric with the punch mark is to first drill a pilot hole with a small drill (1/32 for example) then drill the final hole. Make the finished hole just barely large enough to fit a 1/4 inch bolt. The remaining holes can be sloppier.



Install the plate with a short bolt and mark the other existing pump mounting holes in the block the same way. Drill the plate.

Since there are production oil pumps with only two and three mounting holes, I figure it's not critical to drill & tap the missing holes in the block, but I like to do it anyway. At least in all the blocks I've seen, all the bosses are still there. I believe the manual & automatic blocks have the same casting number. For an Austin America, the number is 12G1279. Install the pump & plate with 1-3/4 or 1-7/8 inch long bolts, (the automatic bolts are way too long), and mark the hole location(s) on the plate with a transfer punch. The holes through the pump are bigger than 1/4 inch to allow for production tolerances, and it took a 9/32 transfer punch to fit snugly in this pump. Remove & drill the plate then reinstall the plate and similarly mark the location on the block. Drill the block to the same depth (about 5/8 inch) as the original holes using a #3 drill then tap the hole 1/4-28.

Using an accurate gasket (compare it to the block), lay out the pump inlet & outlet holes on the plate. You can use an 11/16 blind hole spotter for the larger pump inlet hole, but not a 3/8 spotter for the smaller outlet hole because the factory didn't drill that hole in an automatic block.

If you have a handy bare manual block you could use a blind hole spotter to mark the location of the smaller hole, but at that point you might notice that all of these holes vary ≈.03 in their locations. An adapter plate you make for one block probably won't fit another block! I'd love to see the factory mechanical drawing for this area showing the nominal locations and the allowable errors.

Drill the marked hole for pressurized oil through the plate into the block. The diameter of this hole isn't critical: Make it no smaller than 3/8 inch and no larger than 7/16. The hole in a manual block is 3/8, so that's an excellent choice. The hole should be 21/32 inch deep into the block, measured from the plate to the point of the drilled hole, with the plate and a gasket bolted in place. It shouldn't intersect anything yet.

Then drill the pump inlet hole through the plate 11/16 to match the block.

Mark & drill a 5/16 or so oil drainback hole at the bottom of the plate. This hole was originally intended to allow oil seeping from the pump to return to the sump on longitudinal engines, since there's a sealed cover over the pump to protect the dry clutch. On transverse engine cars, it doesn't really matter because both sides communicate with the sump, but I like to do it anyway. You'd want to do it for sure if you were also converting a transverse automatic to a longitudinal manual, which I hear involves getting and line-boring a longitudinal rear main bearing cap that has provision for a rear main seal.

Instead of drilling a drainback hole in the adapter plate, you could cut & file a notch like the pumps have.

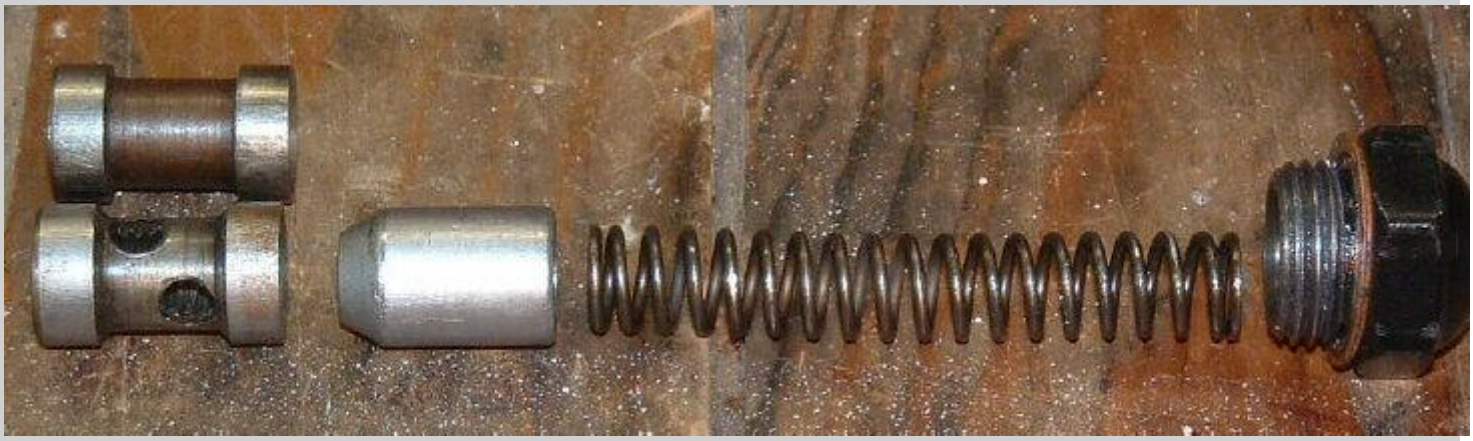
Observe the tiny hole in the back of the pump that goes into the pressure side of the pump. This hole lubricates the rear cam bearing and the oil pump drive. If you study a bare block, there's no pressurized oil drilling in the block from the rear (left side) oil galley to the rear cam bearing like there is for the other two bearings. So, you'll need to drill a matching hole in the adapter plate to let the oil spray through.

Interesting that the rear cam bearing's oil isn't filtered, but I haven't yet seen the little hole get plugged or the bearing wear really badly. However, this could be a contributing reason the splines of the spider drive on an automatic engine are usually very badly worn.

You can mark the location of the rear cam bearing lube hole in the adapter plate by disassembling the pump, laying the front section accurately onto the plate, and drilling into the plate, with a bit that just fits through the pump's lube hole. In this case, a .046 inch drill bit. Then make the finished hole in the plate 5/32 or 3/16 inch.

Note that the location of this little hole varies with different pumps.

Here's what the adapter plate should look like with all the through-holes finished. There's a final hole to drill later, and it's going to be sideways half in the plate and half in the block.



Now for the obscure part of this conversion. There's a secret steel "spool" (far left) press-fitted into the cylinder block that forms the seat for the oil pressure regulating valve. In a manual block it also separates two otherwise intersecting oil passages: One passage comes from the outlet of the pump, connects with the drilling up to the external pipe that feeds the oil filter, then goes through the center of the spool to the oil pressure relief plunger. The other passage comes from the front (or right side) oil galley around the outside of the spool to the rear main bearing . In an automatic block, holes drilled sideways through the spool don't keep the two passages separate, and that situation has to be changed.

I won't go into all the details of how the automatic oiling differs from the manual, but the high pressure output of the big automatic oil pump first goes to the transmission, which needs as much as 180 PSI, then goes to the engine where the manual-type regulator keeps the pressure from going over about 60 PSI. The automatic spool has two big holes drilled in its side to fit in with this scheme. If you leave it in the block you're converting, it will create a connection from the pressurized unfiltered oil into what's supposed to be pressurized *filtered* oil. You'll have full oil pressure everywhere, but little oil will go through the filter and the engine will wear out quickly. In one case I heard of, the engine only lasted 1500 miles. Modern thin-shell crank bearings don't have the embeddability of older Babbitted or white metal bearings and they need a full-flow oil filter system, not a bypass system, especially one of very low flow due to the outlet being at nearly the same pressure as the inlet.

The manual spool is part number 2A797. I've never seen a part number for the automatic spool.

Aaron Anderson provided this photo from Kelly Mascher of Samoa of a cut up manual trans 998 block.

Note that the pressure regulating plunger from a manual transmission engine is often badly scratched by or even jammed by debris in the unfiltered oil. The factory Churchill 18G69 oil pump relief valve grinding-in tool will sometimes help work a stuck plunger free.

The plunger in an automatic engine has the advantage of living in filtered oil and is unlikely to be scratched up like the one in a manual motor. Save it!

Some engine builders like David Vizard suggest replacing the cylindrical plunger with a 9/16 ball bearing (and changing the spring to suit) because the ball is much less likely to get stuck. This setup was used on some production Cooper S engines, and the ball is part number BLS916 & the S spring is AEA536.

The oil pressure relief valve seat must be removed from the block. Conveniently, it is internally threaded 3/8-16 so you can use a slide hammer to get it out, or ...

... or you can use a piece of allthread with a thick washer and nut to extract it. Or you could use a series of shorter & shorter bolts with a thick washer.

Many of the stock manual spools are not internally threaded, they're smooth, so if you want to take the spool out of a junk manual block and use it, you might have to bandsaw the block apart like I did once or cut threads in the spool. Or, to get a proper spool, you could perhaps weld or sleeve

I once tried using a Snap-on #41-12 5/16 blind bearing puller (top) to remove an unthreaded manual spool, but the spool was too tight. The 5/16 internal hole is too small for a tool like this to apply enough force and all I did was bend the end of the tool. At the bottom is my slide hammer adapter

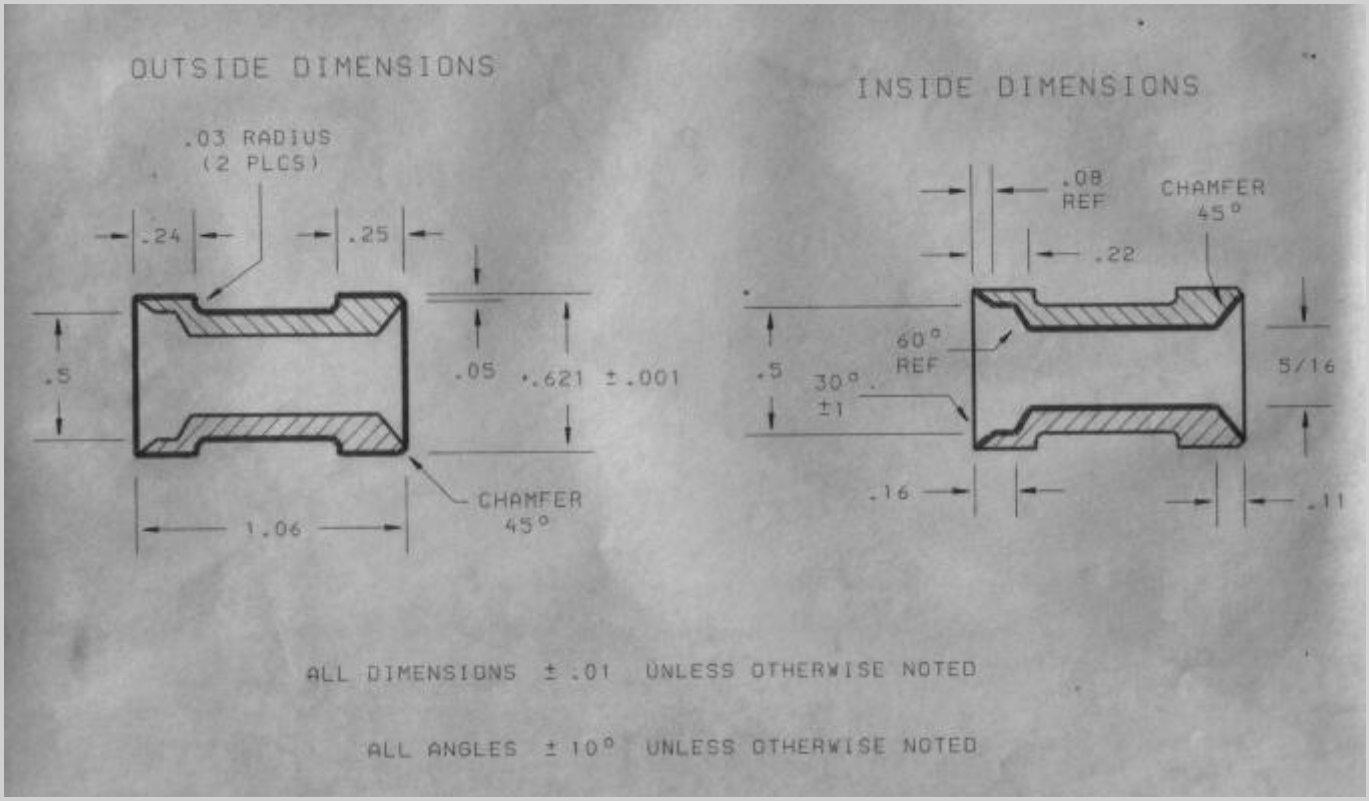
the automatic spool, or buy a manual one if your parts suppliers have any in stock. It seems to be rare and is not always shown in parts catalogs.

One possible low-cost low-tech way to convert an automatic spool to manual might be to slip or press in a ~5/8 inch long piece of hardware or hobby store 5/16 O.D. thinwall brass tubing and lock it in place by putting spots of solder on the tube through the side holes in the spool. The I.D. will be reduced .030 inch, but it might actually flow better because you're covering up the un-hydrodynamic 3/8-16 threads. This would complicate getting it back out, but the brass tubing should offer little resistance to a tap.

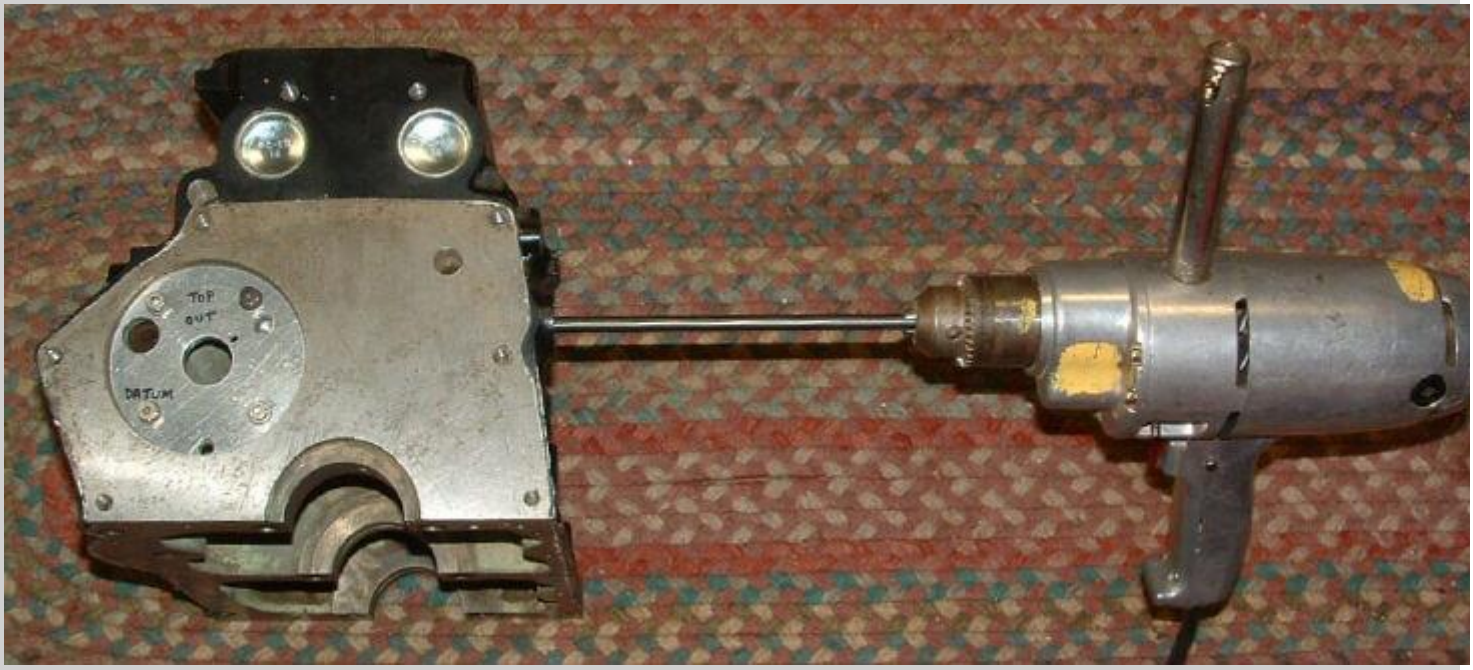
A friend and I once had a mess of replacement spools machined up. If you'd like to buy one or several, send me an e-mail. (roygbvgw at earthlink dot net) They are threaded 3/8-16 internally like the automatic spools for easy installation & removal. Years ago, I sold a handful to Mini Mania, now in Nevada City, California. Seven Enterprises, now in Auburn, California, also offers a new spool.

We also have some spools that were accidentally made from brass, without the internal threads, if that strikes your fancy.

made from a 3-inch long 3/8-16 bolt heliarced to a 5/8-18 nut.



If you want to machine your own spool(s), here's a mechanical drawing.



With the adapter plate and a gasket securely bolted down, drill the last "hole" in the adapter plate. In the automatic block, the 5/16 passage at the pressure regulating plunger is only drilled deep enough to intersect the angled oil passage up to the front (right side) oil galley. You need to drill deeper, deep enough to intersect the shallow hole you drilled in the plate & block at the oil pump outlet. In the photo above, I'm using a 12 inch long 5/16 drill bit, but you can use one as short as 6 inches.

The drill lines up better in the hole with the spool in place. If you're modding a disassembled block, just sliding the new spool into the area the plunger rides without pressing it into the tight section where it normally lives will do the job. With an assembled engine, you'll want to press the new spool into position so drilling swarf won't get into downstream oil passages that are harder to clean.

If you're planning on a maximum overbore for big pistons, you might want to bias the hole to the outside of the block. David Vizard says this is one of two oil drillings that might be uncovered when boring the block for the largest oversizes. See the lubrication chapter of his big book mentioned previously. See Kevin Green's conversion procedure mentioned at the beginning of this article for more info too.

If you're converting an assembled engine, you

The special tool I use is made from an oil

can limit the drill chips to more easily cleaned areas by temporarily lining the passage with a sleeve.

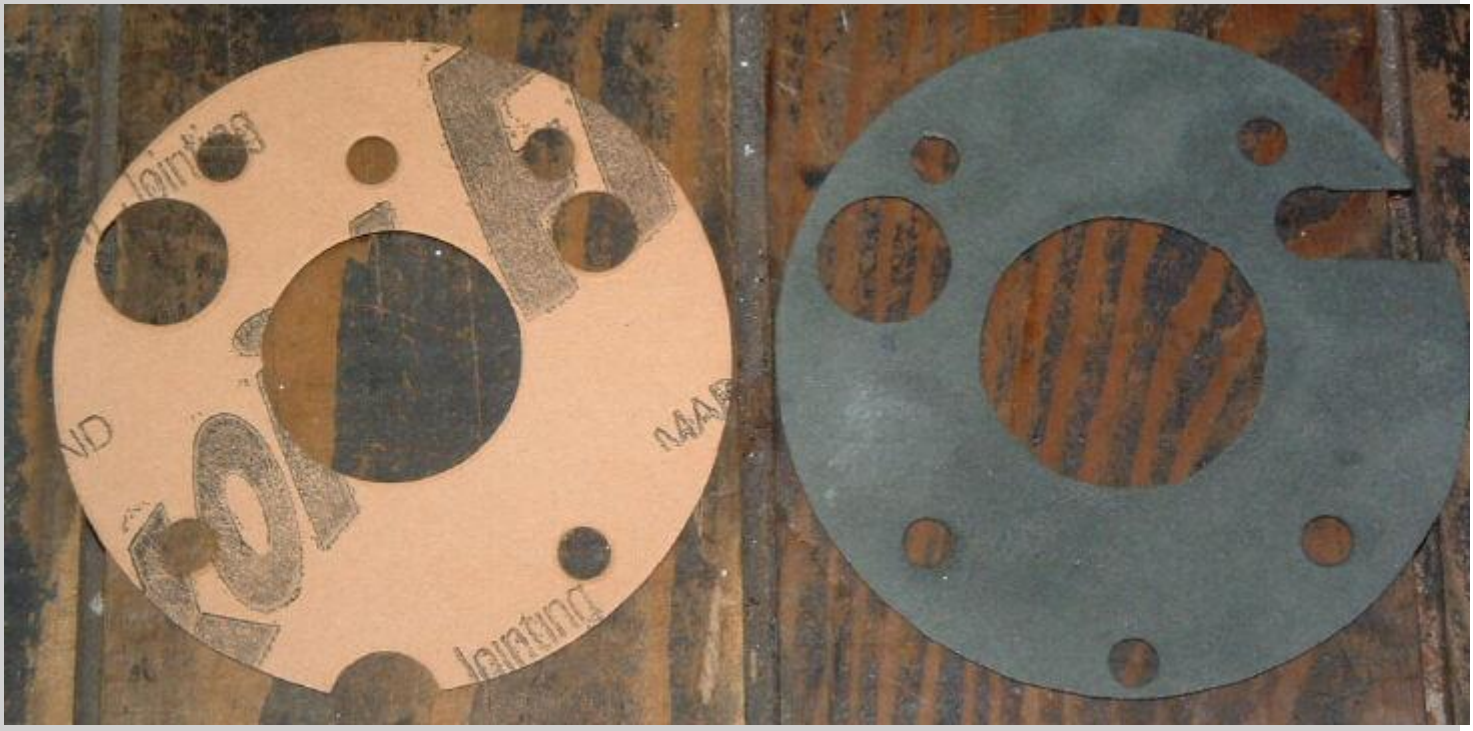
pressure relief plunger pressed onto an aluminum rod and the whole assembly rifle drilled 11/32. It can also be used to hammer in the new spool.

On the later automatic blocks, the location of the new manual trans oil filter head (right, with its longer mounting hardware) is covered with a blank steel block-off plate (left). The oil passage in the block is already drilled (except on the very last Rover Minis) and is a dead-end sludge trap, so if you're converting an assembled engine, be prepared to clean out some gunk when you remove the plate.

Save the block-off plate and install it whenever you want to keep stray dirt out of the passage when the filter head & filter aren't on.

Here's what the finished cylinder block should look like.

Here's what the finished adapter plate should look like. The new surface finish is due to wet sanding the plate with 500 grit paper on a granite surface plate.



I like to make my own gasket (right) to go between the plate and the block. I make it a larger outside diameter, 3-9/16 inches, than the stock gasket (left) diameter of 3-7/16 inches. That way there's less leakage between the plate and block where the pressurized oil passes fully into the block. You could probably achieve the same with a stock gasket and a little bit of sealing compound.

If you use a stock gasket between the plate and block, cut out the area where the oil galley is half in the plate and half in the block, as shown on the right.

Use a second, completely stock gasket between the pump and the plate.

Make sure the large central holes in the gaskets are big enough to not cover the rear cam bearing oil spray

hole in the pump.

On the automatic cars, the dipstick is in the transfer gear cast aluminum housing instead of in the block. Some of the automatic blocks have the oil dipstick tube hole drilled & plugged, others it's not drilled at all. Knock the plug out or drill the boss with a 7/16 drill and chamfer the top edge.

I don't think the dipsticks are the same between the automatic and manual. They are a different part number.

You are now ready to assemble the engine. If you are replacing the cam bearings and have a manual set with the wider rear bearing (top right) and don't want to buy a set of automatic bearings (bottom left) to suit the style of conversion here, I figure you can bore the I.D. of the adapter plate the same size as the rear cam bearing bore in the block (~1.498 inches) and install the new wide cam bearing in both the block and plate. To keep the oil pump centered, you could machine a large ring to fit between the block and pump, center it by eyeball or by gauging when you install the pump, or push an O-ring in between the bore in the block and the O.D. of the pump. An advantage to this method is when years later you have to replace a worn-out pump with a new one that isn't identical in the snout area, you won't have to re-engineer the centering described in this article.

None of my catalogs list the bearings sets by manual / automatic. Instead, the set with a narrow rear bearing is listed (28G133 / BHM1211 / VPC956) as for blocks with tappet chest covers and the set with a wide rear bearing (8G2392 / BHM1210 / VPC989) is listed as for blocks without tappet chest covers .

Be sure to grease the inside of the pump before you install it the final time. Unlike most other engine designs, this pump is above the oil level in the sump and it can have trouble priming when the engine is first started.

I notice that a high quality C-AEG411 MS London Sureflow pump I have has sealing

compound between the two halves, presumably to keep priming oil from leaking out. I'm thinking of doing this to lesser pumps. The very nice $150 Titan competition pump is O-ringed.

Thanks to Sac EDM (Sacramento Electrical Discharge Machining & Waterjet in Rancho Cordova, California) for their assistance in this project. If you'd like to make one or one thousand adapter plates, check them out.

In this article I've mentioned a few times the existence of casting bosses that you can drill. While you have a 1300 engine apart, you can drill & tap your block & head for the extra Cooper S studs. However, I don't know how much it gains you: From the little work I've done with high performance small bore and nitrous oxide-injected big bore engines, I find that the head gasket tends to leak first at the ends on 9-stud small bore engines and at the front (right or spark plug) side on 9-stud big bore engines. Adding studs to a big bore engine might not gain you anything.

After you've converted an automatic block to manual, can you convert it back to automatic? I think so, though I've never done it. Plugging the hole drilled through the block from the pressure regulator to the output of the pump, plugging the dipstick hole, and swopping the oil pressure regulator seat spool ought to do it.

Remember long ago when drag racers were putting manual clutches in place of the torque converter on automatic transmissions? Here are some parts to put a manual transaxle clutch onto a Mini BMC/AP automatic transaxle.

For more privateer info on the BMC 1100 & 1300 series of cars, including considerable material on the automatic transmission, check out Todd Miller's Austin America website and its technical advice page.

End

Source: http://home.earthlink.net/~roygmisc1/convert1/convert1.html