Rear Axle

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The sectioned MGB at the British Motor Museum, Gaydon

The socket for the Salisbury/tube axle hub nut is 1 5/16" AF (same as for the crankshaft pulley nut). On wire-wheel cars this has to fit down inside the splined tube, which is about 1.87" ID. Some have reported difficulty in getting one to fit, but my 1/2" drive came off the shelf and is 1.73" OD so fits easily. Maybe the problem is with 3/4" drive or impact sockets.

Alignment *September 2014*

For as long as I can remember there have been questions about the position of the rear axle relative to the body, particularly the rear wings. It seems that it is very common for the rear tyre to be much closer to the left-hand wing outer panel than it is the right-hand wing outer panel, giving a difference in clearance of half an inch or more. I have only ever heard of one claim where it was the other way round. Both of my cars are closer to the left - including two different axles on the roadster, and it was a significant issue when I first put wire wheels on the roadster by changing the hubs on the existing stud wheel axle. This is because the offset in the wheels is very different, and the original axles were of different lengths to cater for this difference in wheel offset. Even though I fitted so-called conversion hubs at the rear, which are machined to allow the wheels to sit closer to the brake drums and hence give more clearance of the tyres to the arches than standard hubs on a stud wheel axle would, I still had very bad rubbing of the left tyre on left-hand bends.

I fitted harder springs, which raised the rear of the car so the wing went over the tyre on cornering rather than against the sidewall, but that gave an unpleasant ride over some surfaces, so in the end I swapped the axle for an original wire-wheel, which solved the problem. At least, it solved the problem until I fitted 175 tyres, now it has come back again slightly when fully laden. Note that originally the width of roadster tyres was 155, which are 10mm narrower each side of the centre. This problem should only affect chrome bumper 4-cylinder cars, rubber bumper cars and all V8s have a higher ride-height and the wing should clear the top of the tyre in all cases, unless the suspension has been lowered, of course.

Having an axle off-car I have been able to measure the spring pads relative to the brake drum faces, and they were equal to a millimetre or so. Nevertheless, some people have seen fit to cut off the pads and reweld them so that the tyres are positioned equally between the outer wing panels. **Note that this should definitely NOT be done unless you have established that they are incorrect i.e. at different spacings to begin with** For the axle to be out relative to the wings, the rear spring mounting points i.e. the chassis rails must be out. And if they are out, then the rear axle won't be tracking the front axle correctly, i.e. the car will be 'crabbing'. I really can't see how they can be out, unless the car has been in an accident. **If the rear axle is already in line with the front axle, then moving the spring pads to position**

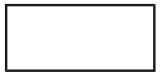
the tyres centrally with respect to the outer rear wing panels, will offset the rear axle and cause the car to crab.

To establish just what the cause is on my roadster, I decided to take a series of measurements, the most important of which would be diagonals from certain points on the front and rear axles - the question was, what points? I would need to drop verticals as it isn't possible to measure directly on the car. Wheels and tyres must be excluded as they could have run-out to a certain extent. I could take the wheels off, but that would mean supporting the car at four points, and would have to be under the suspension with the suspension at its normal working height. In the end I decided to leave the wheels on the car and take the measurements from the spinners, which are screwed onto the hubs of course, there would have to be something very wrong for there to be any run-out at that point, and hopefully the depths of the outside faces to the ends of the hubs is consistent! The next issue was the surface. Concrete or tarmac usually has too coarse a surface texture to be able to mark points to the millimetre, but I have my full-length ramps which have a very smooth painted steel surface. The steering wheel must be positioned in the straight-ahead position.

To drop a vertical I would either need a plumb-line, or a spirit level used in both the fore and aft and sideways directions. There is also the question of where to take the vertical from on the domed surface of the spinner. As it happens I don't have a suitable plumb-line, but I do have a level, and the width of the level is almost exactly the width of the domed surface of the spinner, such that it is easy to get the level centralised on the spinner. So that was the first vertical onto the surface of the ramps - the fore and aft vertical. I then used that to position the bottom of the level now turned through 90 degrees, and with the edge of the level resting against the middle of the spinner, slid the bottom of the level in and out relative to the centre of the car, to get the second vertical. Lines drawn through both those verticals should be directly under the centre of the face of the spinner where they cross. With all four corners done, it was time to take the measurements, and I decided to take the track out of interest, as well as the more important diagonals:

- Rear track 1510mm
- Front track 1514mm
- Right front to left rear 2767mm
- Left front to right rear 2765mm

4mm difference between the front and rear track (which is not strictly the track of course, as it is between spinner faces and not the centre of the treads) is irrelevant, the original disc wheels were 6mm different anyway. The crucial point is that the diagonals only being 2mm out indicates that the rear axle is almost exactly aligned with the front axle, nothing like the discrepancy indicated by the different clearances between the tyres and the rear wing outer panels.



The faces of the spinners project beyond the outer surfaces of the rear wings at the highest point of the arch, by 2mm on the right, but by 8mm on the left. Therefore there is 6mm less clearance to the tyre on the left compared to the right. But that's not the whole story, as the profile of the wing below the trim strip at the highest point of the arch is also different between the two sides. On the right, the edge of the wing projects about 2mm beyond the face of trim strip, whereas on the left it projects 6mm further. Both rear half wings have been changed on the roadster, i.e. the join is under the trim strip, so the positioning of the rear wing panel above the trim strip should be the same as it came out of the factory. Measuring to the trim strips the spinner projects 16mm more on the left than the right, i.e. the clearance to the tyre is 16mm less that side. Whether the replacement panels had that different profile from manufacture, or whether it was the tyre rubbing on it when I first fitted the wire wheels has bowed it out - they did rub very badly on cornering, I don't know. In any event, there does seem to be a discrepancy between sides. I don't know exactly how many panels are joined together to get

from the chassis rails to the wing outer panels, but there are quite a few. At the very least there is the floor, inner arches, outer arches, and outer wing. But the tops of the wings are attached to the boot surround, which is attached to the bulkhead, which is attached to the floor. So even if the inner arches are correct, by the time you have gone through all the other panels and back to the floor, you could have collected quite a discrepancy.

I carried out a similar exercise at the front - just to the trim strips of course - and found the left spinner protruded 6mm more than the right, or half the discrepancy (to trim strips) as at the rear. A front tyre would have to be hugely out of line before it started fouling anything.

Axle Length

Axle location

The axles on original wire-wheel and Rostyle equipped cars differ in length, Banjo and Salisbury types also differ. The following dimensions were supplied by Larry Hoy (who got them from Kelvin, who ...) and are measured from brake-drum face to brake-drum face - at least that's what the source said. But my old steel wheel Salisbury axle measures a shade under 48.5" between the bearing cap outer faces, i.e. the machined faces the back-plate sits against. Between brake-drum faces would add about another 4".

Axle Type	Wheel Type	Length
Banjo	Wire	44.5"
	Steel	46.25"
Salisbury/Tube	Wire	47"
	Steel	48.5"

It's relatively easy to tell which you have on your car, by looking at the length of the axle tube between the U-bolt and the weld for the bearing housing at the end of the casing, as shown in this picture.

When swapping Tube-type or Salisbury axles also be aware of the year. From the 77 year on the casing had extra mounts for the rear anti-roll bar drop-links, and a further bracket for a different system of handbrake compensation. Probably not an issue if fitting a late axle to an earlier car, but it would be the other way round. If you change the axle type you will also need to replace the handbrake cable, as the wire-wheel one is correspondingly shorter.

Axle location It is purely the rear springs that locate the rear axle in the car, nothing else. Just in case you wondered how much it moves around under acceleration and cornering forces, have a look at this Healey video which has much the same leaf spring and lever arm damper arrangement: https://www.youtube.com/watch?v=tN-4LLAKlpw. Note that the movement is nothing to do with the lever-arm dampers, telescopics would make little if any difference. You would need a multi-link system to positively locate it against rotation about the half-shafts and sideways movement.

Banjo Axle Hub Nut *April 2014*

I've no experience with this type of axle but there have been periodic questions about the special octagonal nuts and how to remove them. Brown & Gammons, SC Car Parts and Moss USA sell box spanners for these nuts but there have been complaints about the quality of this type of socket and how easy it slips off. A couple of years ago on a forum someone was

making an improved spanner available which might be worth investigating. This nut has to be done up to 180 ft lb so a properly fitting socket is essential.

Bearings and Oilseals

Pinion oil seal

My experience is limited to the later Salisbury or 'tube type' axle and its wheel bearings and oil seals, but cross-sectional sketches of both types are shown here.

NEW *August 2016:* Occasionally questions are asked about whether there should be a gasket between the bearing cap and the axle casing on the Salisbury axle. None is shown in factory documentation, but people have said they have had leaks from the flange joint and have added a gasket or sealant. As far as I know the bearing cap is used to clamp the bearing outer into the axle casing, so there is no chance of it turning. If you add a gasket or goo at the flange then you will reduce this clamping force, and the bearing could turn in the housing. For the banjo axle at least this T-type site clearly states that there must be a clearance between the two halves of the flange (although in that case the bearing outer and its housing rotate with the hub), indeed a shim may need to be fitted between the bearing outer and the hub in order to obtain a clearance. If you have a leak from that flange then there must be something wrong with either the cap or casing. Try swapping the caps over, and if the leak stays with the cap then replace it. But if it stays with the axle end, then instead of adding a gasket or sealant between the cap and the casing, add them between the sides of the bearing outer and the casing and cap, which will increase the clamping force not reduce it. In fact I wouldn't use sealant anyway as excess could get squeezed into the bearing itself and restrict lubrication. I'd cut a gasket, which will need the half-shaft to be pulled to fit to the axle casing side.

I bought a used wire-wheel axle for rebuilding to replace the Rostyle axle with conversion hubs that I had been using for some years. The rebuilder insisted on having a stripped axle - no hubs, backplates, or even half-shafts - so I was faced with stripping the axle on the ground, i.e. I was not going to be able to use the weight of the car to lever against if I came up against any stubborn nuts and bolts. This concerned me a bit as when removing the hubs from the Rostyle axle some years ago I had to take it to a garage for them to use a five-foot breaker bar before they could undo the left-hand nut. Mind you, it didn't help that the mechanic thought it was a left-hand thread (all the hub nuts are right-hand threads as they are secured with split-pins, and in any case a left-hand thread would have been on the right-hand side) and managed to tighten it a bit first! In the event everything came off remarkably easily - except the bearings from the half-shafts.

Updated April 2007. To remove the hub nuts: The socket for the rear (Salisbury/tube axle) hub nut is 1 5/16" AF (same as for the crankshaft/pulley nut). That converts to 33.34mm, but it has been reported that 33mm is snug but fits. Some people seem to have a problem in obtaining a socket for the rears that will fit inside the wire-wheel hub. Mine came off-the-shelf from Halfords, is a 1/2" drive non-impact type, and fits without difficulty. North Americans often talk in terms of having to obtain a 'thin walled' socket or grinding a standard one down, but then they also talk in terms of 3/4" drive and impact wrenches, maybe that makes the difference. My socket is 1.73" outside diameter, the ID of my hub is 1.863" and David Darby reports that his hub is 1.867" so there should be plenty of room. I wedged a 4-foot bar between two hub studs and rested the other end on the ground, in such a manner that when applying 'undo' force the bar wedged against the studs to stop the hub from turning. I put the 1 5/16" socket on the nut with its 'outer end' resting on a block of wood standing on the ground. Simply standing on a tommy-bar in the socket was enough to undo the nut, as the weight of the axle, my weight on the tommy-bar, the socket on the block of wood, and the 4'

bar, were all applying their forces down through the hard-standing, which wasn't going anywhere!

With the hub nut undone the next thing is to break the taper between the hub and half-shaft. I have some steel wedges so tapped two in between the back of the hub and the heads of two diagonally opposed back-plate bolts, and off the hubs popped. This has left two tiny little marks on the back of the hubs that I am not really concerned about, but others have written that by tapping on the back of the hub with a soft-metal mallet they achieved the same effect, and I can imagine without damage.

With the hub off I could remove the four bolts and nuts that held the backplates and bearing retaining caps to the axle casing. Amazingly, even though the axle had been on a car for many years, and had been stored outside for a considerable length of time since it had been removed from the car, all came off as if they had only just been put on.

The bearing inner is a tight press-fit on the half-shaft, and the outer is a slightly looser press-fit into the axle casing and the retainer cap, so the half-shaft complete with bearing has to drifted out of the axle in some way. I loosely refitted the hub and this time I **did** tap round the back of the hub with a mallet (the back-plate no longer being in the way) and the retainer and half-shaft came free. *Update July 2010:* Another more 'engineered' method is to get two long bolts with nuts - the 'pullers'. With the hub off put the threaded end of the bolts in opposite bolt holes in the end of the axle casing, heads facing outwards, with the nuts positioned on the bolts so that with the hub back on the half-shaft, and the hub nut on just a few threads, the heads of the 'puller' bolts are pressing against the back of the hub. Then when the hub nut is tightened, it pulls the bearing and half-shaft out of the axle casing.

Although the rebuilder was going to deal with the diff and its bearings I also wanted new outer bearings and oil seals of course. As I have said the bearings are a tight press-fit on the half-shaft, and although I have read of people putting the half-shaft in the freezer and the bearing in the oven, I didn't think my long-suffering other-half would stand for it, so I had arranged for someone else to press the new bearings on. The big mistake was to think that, everything else having gone so well, I could get the old bearings off myself. After beating on one for what seemed like hours I did manage to get it off, but that was more than enough for me so left the other one on for the press-operator to remove.

Two important things to be aware of:

Firstly, between the bearing and the hub there is a collar that slides onto (and off) the half-shaft fairly easily, but it is not obvious at first glance. This is the running surface for the oil seal. If yours show any sign of grooving, or in any case to be absolutely sure, replace them, they are not expensive.

Secondly between the bearing and the shoulder on the half-shaft it butts up to there is a spacer. This spacer is essential to ensure the bearing is the correct distance along the shaft, and hence the shaft and hub will be in correct relation to the diff and backplate. The spacer has a concave face and a flat face. The concave face butts up to the shoulder on the shaft, and the bearing butts up to the flat face. Why bother with a spacer and not just have the shaft machined so that the bearing can butt right up to it? Because the bearing is machined with a very tight external radius between its face and its internal diameter and the shoulder is machined with a larger internal radius. The concave face on the spacer has an even greater radius and this allows the faces on shaft, spacer and bearing to all butt together. If the spacer were not used these radii would interfere and the face of the bearing would not be right up against the shoulder. Why isn't the shaft machined with a tighter internal radius than the bearings external radius? Dunno - cost? 4th April 2004: Toby opines that a sharp radius on the half-shaft to match the bearing would lead to a weak point, cracking, and eventual failure of the half-shaft. The radius

makes it stronger and hence the spacer is required to join the dissimilar profiles. Sounds reasonable.

August 2014: To replace just the seals the hub is removed as before. Now I can't recall if the back-plate covers the oil seal or not, but if not then you may be able to use a pick to lever out the oil seal, or drill a small hole in the outer metal part of the seal, screw in a self-tapper, and use a slide-hammer to pull the seal. But if that doesn't work, or the seal is covered anyway, you will have to remove the back-plate. Remove the four bolts that go through the back-plate, axle end-cap and axle casing. Lift the back-plate out of the way - or clamp the flex hose and disconnect the pipe from the slave to remove the back-plate altogether. Now use a light hammer and drift to tap around the join between the end-cap and the axle casing to release the end-cap. The bearing is not quite fully pressed into the axle casing, a small portion is left exposed, and the end-cap is an interference fit over that. The half-shaft and bearing remains in the axle. While you are working on the right-side check the axle breather is present, and if you can unscrew it without breaking it check that it is clear. A blocked oil seal will result in oil being forced past the seals. Note that the top clips off the threaded part of the breather.

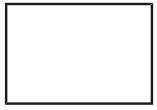
Update October 2007 Whilst reiterating this process to someone the question of wire wheel hubs and split-pins raised a question in my mind. On wire wheel hubs the split-pins and nuts are deep inside the hub tube. The hub tube has holes in the side to enable insertion/removal of these split pins, so logically the holes must line up with the holes in the end of the half-shaft. So this must be borne in mind when refitting the hub to the half-shaft, and a wire-wheel hub must be correctly orientated, whereas a disc-wheel hub can be fitted any-old how.

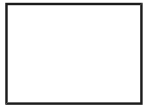
NEW **Pinion Oilseal** *August 2016:* If this leaks great care must be taken when removing and replacing the drive flange or you can destroy the pre-load on the collapsible spacer between the bearings. The WSM says to measure the torque required to turn the flange before removal, then on refitting tighten to obtain the same torque, or a minimum of 4 to 6 pound INCHES. Quite apart from the difficulty of measuring the torque (which needs a specialist wrench) it has been found in practice that this can often destroy the spacer. The advice is to carefully mark the relative positions of pinion shaft, flange and nut, refit the flange to the same position on the splines as before, and tighten the nut to the same position as before, taking great care not to go beyond your mark.

Breather

There is a plastic breather on top of both banjo and Salisbury axles, just to the left of the diff on the banjo and to the right of the diff casing on the Salisbury, and on top of the gearboxes. This is so that expansion and contraction of air and oil inside the axle and gearbox don't blow the seals, but has a indirect path to reduce the chances of water and dirt. It screws in (and out), if you find you don't have one and a new one doesn't screw in, it may be that the stub of an old breather is still in there. The square tang of file or similar should be able to remove it. Originally 1H 3364, although that part number is shown in the Parts Catalogue throughout production for all axles and for 4-cylinder gearboxes, the V8 gearbox part is shown as 21H 6060. In fact the V8 item is an improved version (shown here) and was subsequently used for all gearboxes and axles. At least - that's the theory, but Vee had the early type fitted to the axle, only noticed when I went to replace it as its cap was missing.

Cut-away Images





A couple of pictures from the 'divorce' MGB at Gaydon.

Differential *November 2016*

A superb explanation of how a differential works. You may wonder why you are watching a motor-cycle display team, skip the first two minutes to jump straight to why a differential is necessary in a car.

Not that long ago someone on one of the fora asked "Which wheel is used to drive the car forwards?" Personally I was amazed the question was even asked, even more amazed at how many times and how many explanations had to be used before everyone finally accepted that (on a car without limited slip or locked diff) both wheels are used - until one of them loses traction at which point neither will drive the car forwards. Some other aspects of a differential:

- If the engine is trying to accelerate the car but one wheel breaks traction, that wheel will suddenly start spinning twice as fast as if both wheels were turning, and the other wheel will not increase the speed of the car.
- With both wheels off the ground and the prop-shaft being turned, any difference in friction between the sides e.g. from the brakes will cause one wheel to rotate differently to the other. The wheel with more friction may turn slower, or intermittently, or not at all, but when moving both will rotate in the expected direction.
- With both wheels off the ground and the prop-shaft being turned, if you stop one wheel, the other wheel will rotate twice as fast compared to if both wheels were free to turn, but always in the expected direction.
- With both wheels off the ground, if you lock the prop-shaft and turn one wheel, the other wheel will always turn in the opposite direction at the same rate.
- If the prop-shaft and both wheels are free to turn, then turning one wheel could turn the prop-shaft (in the expected direction), or the other wheel (in the other direction), or a combination of both, depending on the relative friction in the prop-shaft and the other wheel.
- Likewise if you lock one wheel, turn the other, and the prop-shaft is free to turn it will turn in the expected direction.
- When the engine starts to accelerate the car one wheel is pressed down harder onto the ground than the other, This is because torque in the prop-shaft working against the grip of the tyres on the ground and the inertia of the car will try to rotate the axle about the centre-line of the car. Because of this if both wheels have equal grip and loading when the car is stationary, if one wheel breaks traction under acceleration, it will be the same wheel every time i.e. the lighter loaded wheel. At the same time the engine block will try to rotate relative to the car and in the opposite direction to the crankshaft - called 'torque induced roll'. It's barely noticeable in a car, but can be catastrophic in aircraft. Late versions of the Supermarine Spitfire with the more powerful engines had a throttle that could only be opened a certain amount on the ground, and full-throttle was only available above a certain height. If the throttle could suddenly be fully opened fully on

the ground the reaction to the inertia and 'back-pressure' from the prop could tip the aircraft over onto one wing-tip. When moving the effect causes 'torque steer' even at relatively low throttle openings. Torque steer can also be experienced on a car like the MGB if the axle U-bolts are not tight.

- The same forces will also try to rotate the axle about the axis of the half-shafts by pushing the drive flange downwards or upwards, by quite a surprising amount, see here. This is called 'axle tramp', and tries to change the shape of MGB (for example) rear springs from elliptical to 'S' shaped. They are also what tries to lift the front of the car under acceleration, as with dragsters.

Level/Drain Plugs

The ultimate solution?

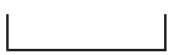
Quite why the drain plugs for sump, gearbox and axle have to be so different is beyond me and the original reasons probably lost in the mists of time. For the axle one could say that because the drain plug is virtually flush with the axle casing there is no loss of ground clearance and no chance of the head of the plug getting ripped off or damaged by grounding. So why do the gearbox and sump have protruding heads? And having decided to have a protruding head, why does the gearbox have a tapered plug with a hex head of smaller diameter than the plug, which means it protrudes further than the sump plug, which has a lower profile, head wider than the threaded portion, and less protrusion as a result? And why do the axle plugs have to have a square tapered drive hole, which makes it more likely for a tool to slip out than if the drive hole had parallel sides? Yes, I know the plug is tapered, but I can't see that having a parallel sided drive hole would make that much difference, and would avoid the need for a special tool with no other uses.

And a removal tool is the object of this section. For 17 years with Bee, and 14 years with Vee, at least once a year I have been able to remove the level plugs using nothing more than the 1/2" drive of a socket wrench, which admittedly only just fits in to the top of the drive hole, but pressing it in with one hand while I turn it with the other has always done the job. However this year I could not shift Vee's to check the level, I must have had two Weetabix or an extra portion of spinach the last time I tightened it.

I could have bought one of those multi-headed wrenches, but eight of the nine heads would have been no use to me, and it is a large lump of metal to add to the already crowded tool-box, so I reckoned I could come up with a socket-set attachment which would be much smaller.

It occurred to me that a bolt with its threaded portion as large as the widest part of the tapered drive hole could be ground down to fit the taper, and with a socket to fit the head of the bolt away you go. The drive hole (in one of my plugs at any rate) is 0.37" deep, 0.55" wide at the top of the hole, and 0.45" wide at the bottom. The largest bolt I could find in my box of bits was slightly smaller than ideal, as the peaks of the thread were only slightly larger than the widest part of the taper, whereas ideally you would use a bolt where the **troughs** of the threads would be slightly larger. But it was worth a go. I cut down the bolt so that the threaded portion was just longer than the depth of the drive hole, then just ground the taper bit by bit by eye. As I went I tapped a spare plug (make sure you clean out all the gunge from the hole first) onto the bolt which showed the high spots by leaving rusty marks on the shiny bolt. When the same marks started appearing on the cut end of the bolt it showed it was bottoming in the hole.

At that point I decided to try removing Vee's level plug, but immediately noticed that the head of the bolt went all the way into the socket of course,



which meant the socket was hard up against the diff cover and my modified bolt wasn't being pressed into the level plug drive hole. This was easily resolved by dropping a suitably sized nut into the socket first, so the head of the bolt sat neatly at the end of the socket, and I could press the bolt into the plug as I turned it. The drain plug came undone without further ado - a result.

The nut doesn't have to be the same as the bolt of course, anything larger than the 1/2" drive hole in the socket and smaller than the bolt head will do, as it is only a spacer. In hindsight I could have dropped the bolt into the socket then cut it down to leave the required amount sticking out, then tapered that part. But rather than cut up another bolt I decided to weld the nut I had used as a spacer (which was pretty chewed-up anyway) onto the back of the bolt head. This was fine depth-wise, but it wobbled about a bit in the socket. I found a bit of thread which I had cut off another bolt for another project goodness knows when (yes, I even keep bits like this rather than throwing them away, remember "If you haven't found a use for something yet, you haven't kept it long enough") which just fitted nicely into the square drive hole in the socket **and** the nut I had chosen to use as a spacer, so welded that in as well, then cut it down to a stub that still allowed the 1/2" drive of the wrench to fit all the way into the socket. Again in hindsight, I could probably just have welded this length of thread onto the head of the bolt and it would have acted as a spacer (instead of the nut) as well as a stabiliser, but there you go. The only socket I had that would fit the bolt was 24mm Metric, whereas the bolt is probably Imperial at exactly 15/16" AF. Subsequently I discovered the bolt was only slightly larger than my largest Imperial socket - 1/2" Whitworth - so I ground the head down slightly to fit that, as I don't usually carry Metric sockets with me.

The thing to remember is that it is only a relatively soft bolt, not a hardened tool, so I won't use it to tighten the plug, or I could be back to square-one again and not be able to remove it. So I used the 1/2" drive of the socket wrench on its own (as I have always done) to tighten the plug, knowing that the adapter I have made should always be able to remove it, being able to apply more leverage than the 1/2" drive on its own.

Other possible starting-points for making a tool such as this are:

- An parallel-sided drain plug key like one of these that you grind a taper onto. However the only square-drive ones I have seen are 11mm, which is way too short. There are 17mm hex-drive items which are big enough, but would require more work grinding a square taper on to them, and both use 3/8" drive anyway. Fine if you have one, but I don't. A 1/2" to 3/8" drive **expanding** adapter (although I have only found reducers) might help, but then you might be exceeding the space available between the back of the diff cover and the tank.
- A short 1/2" drive extension (like these) with the appropriate taper ground into the male end. However the shortest single I have seen are 3" which probably exceeds the space available, although there are 2" available as part of a set. Whilst you are wrecking the item (as far as its original purpose goes) you could cut it down to the minimum length i.e. leaving just 1/2" of male stub on the end of the female part and grinding the taper into that, but the section between the female and male ends is only 1/2" diameter **round** bar, and you need at least 0.7" of round bar to grind down to a square taper to fit the plugs.
- I then found this 50mm 1/2" drive wobble extension which is just 2" long overall and because it is a wobble extension already has a taper, and so may well do a good job without any modification, **and** be available for its original function as well. *Update February 2008* I purchased one of these at Stoneleigh this year but unfortunately the way the 'wobble' feature differs to the plug taper it just turns out of the hole, so that is a dead-end.

June 2011: Servicing Vee last year I couldn't undo the level plug so this year was determined to do so as leaving the level unchecked for any longer isn't a good idea. In the end I had to chisel it round, tapping on opposite corners of the square recess, and eventually it started to turn but not without fracturing one of the sides off. I have a spare from Bee's old axle so that isn't a problem, but the whole thing is a pain and I start wondering if there is a hex-head plug that would fit, like the gearbox drain/level/filler plug! The two hex plugs on the rubber bumper gearbox are the same part number, as are the two square recess axle plugs. Asking on the usual mail lists got me nowhere, but Googling the part numbers threw up an MGA thread which stated that early MGA gearboxes had the square recess plugs, later had the hex headed, the two were interchangeable (the poster recommended using the earlier square recess plugs on the later gearbox "to save carrying two tools". Goodness knows why, you check the level a couple of times a year, it's much easier to use a spanner on the hex head, you are hardly going to take your 3/4" spanner out of your toolbox, whereas being able to leave the multi-headed 'dog bone' tool in the garage makes more sense), and it quoted the same part numbers as for the MGB items. So on the face of it a straight swap, so at the moment I have an enquiry out for a used item or two rather than buy new (2K5380, MGOC seem the cheapest of the usual suspects).

In the meantime I have welded the stub of a cut-down 3/4" AF bolt to the mangled plug as a possible alternative, and will get under the car sometime to see if it fits the side of Vee's gearbox to confirm whether the threads are the same or not.

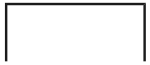
And they are not, comparing the two plugs! The gearbox is significantly larger diameter, even if the thread profile is the same, dimensions as below:

Plug	Thread tip		Thread root	
	Max dia	Min dia	Max dia	Min dia
Axle level	0.814	0.804	0.752	0.737
Gearbox level	0.906	0.883	0.845	0.821

However being tapered it's quite possible that the smaller diameter would eventually tighten into the larger hole, as long as there are enough threads in the hole, and this is maybe why the writer of the MGA thread got away with using axle plugs in the gearbox (although how many threads are actually engaged is debatable). If the hole in the axle back-plate were deep enough, and the axle plug normally sat a long way in, then it's possible that the gearbox plug may also start to screw in to the axle, although again the question is how many threads would be engaged. Sure enough the axle plug does eventually tighten in the gearbox hole, but ends-up being recessed, so you don't know how many threads are engaged, and more importantly if there is enough clearance to rotating parts inside. As an aside the gearbox level plug only screws into the gearbox casing 13 flats to fully tightened, i.e. barely more than two threads engaged.

All this means there is no chance of the gearbox plug screwing into the axle without the back-plate being rethreaded, so it's back to plan A.

May 2016:



However some time after going through the above process I heard about plugs with a hex socket i.e. that an Allen key would fit. At the time I didn't

follow it up, but a comment about these from Willy Scott of the MGCC Caledonian Centre set me off. Several of the usual suspects do show plugs with hex sockets, although some say they are for both drain and level and some just for level. They all quote part number 6K499 (which is the original part number for both drain and level, banjo axle and Salisbury) and yet more suppliers quote this part but don't show the socket so they could be the original tapered square type, you would have to check before purchase. The MGOC one at least takes a 3/8" Allen or hex key.

Lubricants

It's important to use the correct oil in the rear axle of both the 4-cylinder and the V8, which is different to the oil used in the V8 gearbox. There is more information on the differences here, but if nothing else you need one labelled 'GL5'. Some GL4 oils **are** suitable for the rear axle, but they need to contain statements to the effect that they are 'extreme pressure' or 'mild extreme pressure' and are suitable for hypoid axles. Banjo axles take 2 1/4 Imperial pints, 1.28 Litres, 2.75 US pints. Salisbury axles take 1.5 Imperial pints, 0.85 Litre, 2 US pints.

Oil Change

For what oil to use see Lubrication.

Immediately before changing the oil take the car for a run of 10 miles or so to warm things up and make it run out better. Before you drain the oil **make sure** you can undo the level filler plug. You can live without changing the oil for a bit while you ponder how to shift it, but not if you have drained it and then find you can't refill it! Hopefully the drain plug will come undone (see above for suitable tools), but if not it isn't the end of the world as you could take the rear cover off instead, albeit at the expense buying/time making a new gasket. Leave the oil to drain while doing something else, like draining the gearbox.

When the dripping has slowed down refit the drain plug and remove the filler plug. On a rubber bumper car if you support the rear of the car by the rear spring front hangers, and let the axle hang down on the rebound straps, the axle should come low enough for you to be able to use squeezy bottles with nozzles the oil comes in - that was certainly the case on the V8. If you have the rear of the car supported with axle stands under the axle the filler will be up behind the tank and much more of a fiddle to fill. However the chrome bumper is just that bit higher relative to the tank and in order to get the last bits out of the bottle I had to fold over the nozzle while I positioned the bottle upside-down above the handbrake cables, then unfold the nozzle as I fed it into the filler hole. If you have both front and rear of the car raised, so it is pretty level, you can get the more or less the correct amount in going by the level at the filler hole. It can take cold oil some time to flow into all the crevices and find its correct level, so I then replaced the filler plug loosely, and ran the engine in gear for a moment or two to distribute the oil, then checked the level and topped up again. **MAKE SURE** the car is supported safely at all times, don't be underneath it with the engine running, and make sure there is some run-off room in front of the car. After that I took it for a run for a few miles and checked again, and it needed a bit more. After standing overnight I checked the level again cold just to be sure but it was fine. Finally check both drain and level plugs are tight, but not overtightened. After the next decent run check the level and plugs again to give you confidence there are no leaks, then you should be fine to leave it the normal service intervals.

Remove and Refit *September 1999*

Bee came to me with a stud-wheel axle that I had fitted conversion hubs and wires to, but the rear tyres were fouling the outer arches on cornering on heavy cornering particularly when touring fully laden. Rubber-bumper roadster springs cured that, but led to the back-end breaking away in the wet sooner than normal, and a very choppy ride over some surfaces. As time and miles went by the axle started grinding and clonking so I decided to replace it with a reconditioned wire axle and revert to the original springs, and renew the prop-shaft UJs at the same time. Picked up a used axle and had it reconditioned earlier in the year through Clive Wheatley. The crown-wheel and pinion were shot, but fortunately Clive keeps good used sets when he is converting axles to V8 spec so I had one of those. Early afternoon on day 1 saw everything off the car (except the handbrake cable) with the short brake pipe being the only part that was damaged during removal. I couldn't split the exhaust so I decided to work with it in-situ as I didn't want to have to mess with the manifold end of the car at the same time. Wasn't too difficult - removed the back-plates in-situ then slid the axle sideways on a trolley jack till it cleared the pipe, then lowered it and removed it from the rear as normal. The propshaft UJs were a bit of a pig to get out but the new ones went back in OK - make sure the yokes stay in the same orientation. "Replacement being the reverse of removal" I supported the new axle on ramps and trolley jack as well as having a large bundle of dust sheets under the nose while I manoeuvred it into position - bumping the pinion flange on the concrete could have destroyed the pre-load. Everything went back together as easily as it had come apart - then it came time to change the handbrake cable. I just could not shift the nut and bolt that secures the bracket to the corner of the battery box (the smallest nut and bolt of the whole job), so I had to drill it out. As it is right next to the fuel pump I had to slacken its clamp and slide it clear and remove the battery. Clamped the nut with an adjustable wrench to stop it spinning and put a small jack underneath so I could bear down on the bolt head from above. Slowed me up by about an hour but it saved destroying the bracket. When I came to re-assemble the handbrake end of the cable the trunnion was missing. I presumed it had dropped out and rolled somewhere, but searched high and low to no avail, so I made one out of an old kingpin bolt ("If you haven't found a use for something yet you haven't kept it long enough"). Slightly smaller diameter than the real thing but it would do till I could get the proper item. Later on when I had finished and was clearing up I found it lying at the bottom of my 'parts washer' - it was just a 10-minute job to replace my make-shift part, which is now on my shelf of miscellaneous bits ("It you haven't found a use ...").

Rebound Straps *Added October 2009*

Vitally important to take the shock of unloading the suspension off the top of a yump instead of it being the lever-arm dampers. And whilst the dampers taking the weight of the axle when the body is supported may be OK, you wouldn't want to be under there when one or both of them suddenly parted and the axle dropped that extra bit. When removing the rear dampers prior exchanging them I noticed the V8 straps were a bit ratty, but they were on the car when I bought it and have done 15 years and 75k in addition to anything they had done before. After replacing each damper I tackled the strap that side. Note that various different straps, pedestals and drop-links were used for CB and RB, 4-cylinder and V8, see Suspension and Steering, Rear Lever-arm Dampers.

The usual problem is that the nuts (9/16") have rusted to the pin welded to the axle, and the end of the pin is sheared off. Whilst replacement pins are available and can be replaced it is probably an axle-off job to grind the old one out and weld the new in. If there is a stub of thread left then you could drill through it and fit a split-pin, it's not taking any force, just stops the strap working its way off the pin. The same problem is likely at the top but that is a through bolt and nut (1/2") so is easier to deal with if it shears.

With the car supported on axle stands at the front spring hangers and a jack lifting the axle just enough to take the tension off the old rubbers, I gave the upper and lower nuts a couple of applications of Plus-Gas, and for the bottom nut used a ring-spanner so I could see if the pin was turning as well as the nut. When this happens it has a quite distinctive 'springy' feel to it, so you need to sit back and apply a bit more PlusGas, or a little heat, rather than snap it off. Working the nut back and fore a fraction rather than just turning it may also help to free it. This 'springy' feel of a stud or bolt in the process of shearing is very different to the 'crack' that often accompanies the first time a nut has moved in years. Both sides came undone relatively easily, as did the top bolts and nuts.

With the rubbers off you will see a spacer tube pressed in to the upper hole of the old strap, this can be pressed out in a large bench vice with a suitable socket larger than the tube one side and a bolt or small socket just slightly smaller than the tube on the other. Both mine had corroded, so I filed the corrosion off the outside with a rasp to make refitting to the new rubber easier. I used Waxoyl inside the hole and the new strap and on the outside of the tube and the vice to press them in.

Similarly the axle pins showed some corrosion, again scraped off to make fitting of the straps to them easier, as did a daub of Waxoyl inside the strap holes and on the outside of the pins as before. Slid them on to the axle pins, and fed them up into the bracket under the chassis rail. One side went up easily and the holes aligned so I could reinsert the bolt, but the other didn't. A quick scrape up there with a screwdriver soon sorted that. Refit large washer, spring washer and nut at the bottom, and spring washer and nut at the top and job done.

Updated October 2010:

There have been some complaints about the quality of these straps in the past, in some cases they are little more than rubber bands that simply stretch to the limit of damper movement if not snap and so are useless. I measured just over an inch of stretch in mine from just starting to take the weight of the axle to fully taking it, and about an inch and a half from the same start position with the straps **removed** i.e. to the limit of damper movement. So they are only just holding the weight when gently applied, and could well hit the damper limit with the weight applied suddenly i.e. coming off the top of a hump. The old ones (yes, the ratty old ones) only dropped about 5/16" so a very significant difference. There is obviously cord reinforcement in the originals, but none visible in the replacements, that just look like plain rubber.

Some time later Michael Beswick said that with new straps just bought taking the weight of the axle, one reduced its width at the centre to about 2/3rds of its original, and with the other the hole for the axle pin ended up elongating to about 3-times the original diameter. Not only does this indicate a lot of stretch, but the two reacting significantly different doesn't bode well for consistency. A call to the vendor elicited nothing more than "they are all the same and we all get them from the same supplier", but they seem significantly worse than my Leacy items bought for the V8 less than 12 months ago. He also found that his axle was dropping 1 1/2" with the straps fastened, so was probably hitting the damper stop right away. We discussed some alternatives, and I found this B&Q lashing strap which looked to be a possibility, but would need an industrial-strength sewing-machine to close the loop with square and diagonal stitching if you didn't want to use the ratchet clamp. But Mike had the idea of polypropylene parcel strapping as he knew someone with the tool to fasten the closure and form a loop, to reinforce the rubber strap. He had some made, and was kind enough to send me two sets for the CB roadster and RB V8 which are different lengths.

As the roadster has decent original style I've kept those back, but have fitted them to the V8. As these are an open loop when the springs compress and the rubber strap curves the reinforcer could open enough to come off the axle pin, so we have fitted a nylon cable tie around the two so the reinforcer forms the same curve and shouldn't come off.

Update February 2012: Mike Grundy wrote asking if I had had any success getting proper replacements, he's recently had two sets from the MGOC and another from Moss Europe for his 73 BGT but all failed as soon as they were asked to take the weight of the axle (both suppliers say they have now withdrawn them from sale). I offered to get a pair of the reinforcers sent to him, but he said he is going to see if this American supplier of webbing straps for the MGB axle will send to the UK first.

Update May 2012: Latest info from Mike Grundy and progress on two fronts:

> "Two things of interest regarding my previous email on axle straps. Firstly, Moss Europe have been very proactive in addressing their problem with axle straps. A short while ago they sent me two replacement axles straps as samples for testing from their recently re-manufactured batch. Both straps fitted OK, but were about 1 inch too long. I guess this is because they sent me rubber bumper spec, not chrome axle. There is still evidence of some stretching when under load and one sample had the webbing showing through the rubber. Note that the original straps didn't stretch at all. I've yet to subject these to a sufficiently rigorous road test as the weather hasn't been too good here.
>
> "Second,,, I tried emailing Strapping Lad in America but didn't get a reply. As this is all too common with a lot of suppliers I decided to speculate and place an order. The total cost including shipping was $30 US which is just under £20. That's expensive for axle rebound straps but if they're are as good as they look they may well be worth it as there is no rubber to perish. Russell Koester, the owner of Strapping Lad, emailed within an hour of placing the order to thank me and let me know that the straps would be made and posted that same day. They arrived as promised 7 days later. Examination of the straps reveals very high quality webbing material and excellent machine sewing, overlocked and double stitched with strengthening along the diagonals. I've yet to fit them, as the Moss straps are still under test, but feel confident that they will more than do the job. One of my colleagues said it looks like you could hang the car from the axle on those!!"

U-bolts *Added September 2010*

These clamp the axle and the springs together between two metal plates, but with rubber pads against the plates. This means that tightening is a very gradual process as the rubber compresses rather than a rapidly increasing in an all-metal joint, and there is no torque value specified. Also especially when new rubber is used the rubber deforms under pressure over time reducing the clamping force. In extreme cases the axle can actually move about relative to the spring as the throttle is applied and released, causing 'rear wheel steering' i.e. a noticeable change in direction despite the steering wheel not having moved.

Whilst under the V8 doing something with the axle rebound straps I noticed an orange staining where the axle butted up against the spring, and that immediately said to me the two had been moving relative to each other and the occasional wet weather I drive in had washed out the resultant particles and rusted them. Sure enough I could tighten all of them several turns. I'd changed the springs in 2007, and the rebound straps in 2009. I'm pretty sure I checked the U-bolts some time after fitting the springs, and didn't alter them when I did the rebound rubbers nor notice this staining then, but I noticed it straight away this time. So it

shows that these need checking several times, say at the annual service, until one year you find they are still tight from last year.