Braking System

Last updated 24-Nov-2011

Bleeding

For the original system with the single hydraulic circuit brakes should be bled starting with the longest run i.e. passenger rear then the next longest and so-on to the shortest i.e. drivers front. It may well be beneficial to release the handbrake while bleeding the rears, see below. Dual-systems, including the brake-failure shuttle switch, are outside my experience but I can't see how they can be pedal-bled very easily as the circuit **not** being bled will still pressurise and stop the pedal moving to the floor, which will greatly reduce pedal travel and hence the amount of fluid that can be pushed through the system that **is** being bled with each pump. It will also activate the brake failure pressure switch (earlier remote types) or need the switch to be unscrewed (later integral types). Continuous-flow bleeding as with a Gunson's EeziBleed should avoid both these issues, as well as making the job much easier on all systems. On both my cars I find that whilst the EeziBleed is perfectly adequate for the rear brakes, if the fronts have been dismantled and air has got into the system additional steps are needed, as using the Gunsons alone I get a 'long' pedal. This can be 'pumped up' but after only a few seconds that effect is lost and the next application results in a long pedal again, which can be a bit disconcerting! I get my assistant to press down hard on the pedal while I rapidly open and shut each caliper bleed nipple in turn. The much higher pressures, and hence flow when the bleed nipples are opened, seems to blast any remaining air out of the pipes. Thereafter the brakes have always been as expected. Note that on twin-circuit brake systems this may well cause the shuttle valve to move and light the brake warning lamp. If it is still lit after doing both sides then on the side **opposite** to the one you did last, get the assistant to apply medium pressure to the pedal, open the bleed nipple just a fraction letting a tiny dribble of fluid out, get the assistant to shout as soon as the warning light goes out, and rapidly close the nipple. If it doesn't go out try doing it on the side you bled last.

Added October 2009: Following me giving the above advice on a mailing list a medic pal told me he had to do exactly the same thing with an arterial pressure measuring system. They had to get all the air bubbles out of the external tubing or it wouldn't work. The system came with a low pressure and flow flushing feature which was never sufficient, so they had to add a syringe to give a much higher pressure and flow which was successful in blasting them out. A 'negative' pressure system (akin to the Mityvac which some recommend for brake and clutch bleeding) was also of no benefit. A 'continuous flow' system would sometimes work, but on a car would need many litres of brake fluid to work, or a very long length of tubing from nipple back to master. However this method can be used when bench-bleeding master cylinders by looping the outlet directly back into the filler. But bench

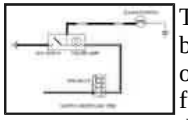
bleeding has own problems of mess and potential contamination and I've never bothered doing it.

Although I have never experienced this problem on multiple BL cars I'll mention it anyway. People from time to time ask why the bleed nipple on the rear cylinders isn't at the top like it is on the calipers, and why doesn't an air bubble get trapped in them and cause spongy brakes. The reason is that a caliper is self-adjusting for wear and the pistons gradually move further and further out so creating a larger and larger cavity behind the piston for air to gather in, and unless the bleed point is at the top it will never be fully removed by bleeding. Look at the diameter of a caliper piston and how far it can be pushed back in when you remove worn pads and you will see what I mean. By contrast slave pistons should always pushed all the way back in by the springs when the brakes are released and this leaves just a tiny channel round the backs of the pistons and not a cavity between the pistons to trap air. Normal bleeding will push air down and out of this tiny channel just like it will push an air-bubble downwards along a length of pipe. Adjustment for wear is on the separate adjuster at the top, of course, and doesn't affect the hydraulic system like it does with calipers. For this reason it seems that the handbrake should be released while bleeding the rears in order to allow the release springs to push the slave pistons right back but in 35 years I have never found this to be necessary. A couple of people have mentioned that they have only been able to get rid of a spongy pedal by forcing the rear shoes to be locked on by the adjuster as this is the only way to force the slave pistons fully in and so remove a larger space between the backs of the slave pistons which is trapping air. If that is the case I'd suspect weak or missing return springs, or possibly stiffness the handbrake cable or levers preventing the shoes from being pulled back by the springs, which **could** well leave a cavity that will trap air.

Brake Balance and Handbrake Warning

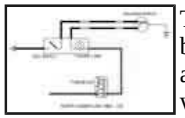
North American spec cars got the brake balance circuit with the dual-line braking system with the MkII in 1967, UK spec cars never did. North American cars got the handbrake warning circuit in 1976 and the UK in 1977.

There were three arrangements of the brake balance failure circuit - a simple circuit for 1968 where the test switch merely tested the warning lamp and 12v supply. From 1969 to 1975 there was a more comprehensive circuit where the test switch checked the wiring right back to and through the balance failure switch. From 1976 on there was another variation that integrated a handbrake warning but deleted the test switch. Non-servo dual line systems had a remote splitter manifold containing the balance switch, servo dual-line systems had the balance switch as part of the master cylinder assembly. The UK just had the one handbrake warning circuit.

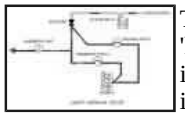


The 1968 circuit has a single black/white wire running from the balance failure switch to one side of the failure warning lamp, the other side of the lamp being connected to the purple (always on, fused) circuit. A black ground wire was connected to one side of the test switch, the other side of the switch being connected to the

same side of the lamp as the black/white wire. Balance failure results in a ground being connected to the black/white wire, which lights the lamp. The test switch merely connects a local ground to the warning lamp, the wiring to the balance failure switch could be disconnected but the test switch will still light the lamp.



The 1969-75 circuit has two black/white wires running from the balance failure switch to the warning/test panel, these two wires are linked together inside the switch. Both run back to the warning/test panel, one to one side of the lamp, the other to one side of the switch. The other side of the lamp is connected to the purple circuit as before, and the other side of the switch is connected to a local ground as before. Balance failure results in a ground being sent from the balance switch down both wires. One will light the lamp, the other does nothing. However with this circuit when the test switch is operated a ground is sent up one wire, though the link inside the balance switch, and back down the other to light the lamp. This proves the continuity of the wiring between the switch and failure lamp as well as the failure lamp and power supply as before. I have also heard from one source that fluid leakage through the switch will cause the internal link to fail, which means the test will fail. However whether this was a 'one-off' or a design feature hasn't been confirmed. If it **is** intentional it seems to imply that leakage through the switch was almost expected (it certainly does seem to happen by all accounts), in which case one would have thought they would make a better switch!



The 1976-on circuit is quite different, being integrated with a 'handbrake on' warning. The drawing of the brake balance switch implies that a) the warning light would be on all the time, and b) in the event of balance failure the green circuit fuse would blow! I think both of these rather unlikely, and so have drawn the switch as I think it actually is. *Update October 2009* The master/servo unit is identical for both pre 76 and 76 and on, and new ones from Moss at least are supplied with the later switch in the box but but not installed. For earlier cars with the white/black wiring the earlier switch must be used instead or the balance failure warning will not operate although the test circuit will. *End of update.* One thing of interest is that there is no longer a manual test switch that checks the continuity of the wiring right though the balance switch itself. However there is a part of the circuit that will light the warning lamp every time the engine is cranked, so testing at least the lamp and its 12v supply is OK, which saves one the bother of manually checking the circuit when one happens to think about it. But because the lamp also acts as the 'handbrake on' warning, and seeing as how on most occasions the handbrake will be on anyway when cranking the engine, the 'crank test' facility is almost entirely superfluous. Not only that but all it does is check the lamp and its local ground anyway, it doesn't even check the continuity of the wiring back to the balance switch on the master. Another example of interfering American legislators not really understanding what they were doing. **But the biggest problem with this circuit is that involves a diode, which if it goes short-circuit causes the starter to crank all the time, unless one has the presence of mind to drop the handbrake!**

The 4th circuit is the 1977-on UK spec 'handbrake on' warning,

very similar to the latest US circuit but without the brake balance switch even though it has the dual-circuit braking system. This also includes the 'crank test' diode which is even more superfluous (there being no brake balance warning system to 'test') but can still cause the 'continuous cranking' problem.

Fault Diagnosis:

US 1968 circuit: If the light doesn't work from either the test switch or the balance switch either the 12v supply from the purple circuit is missing or you have two or more faults like power supply, ground supply, bulb blown, switch(es) faulty. If it lights from the test switch but not the balance switch either the balance switch is faulty or the wiring between the two is faulty. To eliminate this last possibility disconnect the wiring from the switch and connect a known good ground to the wiring connector. If it lights from the balance switch but not the test switch either the ground supply to the switch is faulty or the switch itself.

US 1969-75 circuit: If the light doesn't come on from either the test switch or the balance switch either you have two or more faults like power supply, ground supply, bulb blown, switch(es) faulty, or there is a disconnection in the wiring between the balance switch and the warning/test panel. If connecting a known good ground to both black/whites at the switch/light panel doesn't light the lamp either the bulb is faulty, it isn't making good connection with the bulb holder, or there is no 12v supply to one side of the bulb. If that works but not if you ground both black/whites as the master then there is a break in at least one of the black/whites between the master and the switch/lamp panel. This could be at the multi-plug behind the dash (later cars) or a pair of single connectors in the black/whites (earlier cars). If that works, link the two black/whites in the plug that goes on the balance switch and try the test switch. If that works the balance switch is faulty or not being operated by the shuttle valve inside the master. If the test switch still doesn't light the lamp the switch itself could be faulty, or its ground supply, or there could be a break in its black/white between the test switch and the balance switch connector. Note that the balance switch will only light the warning lamp if it is attached to the master, or has an alternative ground provided to its body. It won't light the warning lamp if it is removed from the master, even though it has two wires on it. However when the balance switch is removed from the master cylinder, the **test** switch should light the warning lamp as long as the wiring is connected to the balance switch and the rest of the circuitry is correct.

US 1976-on circuit: This circuit works 'the other way round' to the earlier circuits by extending a 12v signal from the balance switch, handbrake switch or test diode to the warning lamp, which is backed by a local ground. If none of them causes the lamp to light either the bulb has blown, its local ground is faulty, or the green/orange wire to it has a disconnection. If the handbrake switch lights the lamp but cranking (handbrake down) and balance switch do not then there is probably a disconnection in the green/orange between test diode and handbrake switch. If the handbrake and cranking lights it but the balance switch does not then either the balance switch is faulty, the green orange between it and the test diode has a disconnection, or the green 12v supply to the balance switch is disconnected. If the balance switch lights it but either or both of cranking or handbrake do not, then in

the former case the test diode or its white/red connection to the starter relay is open-circuit, and in the latter the handbrake switch is faulty, incorrectly adjusted, its local harness disconnected, the green 12v supply to it disconnected, or something is preventing the handbrake from fully returning to the 'off' position.

UK 1977-on circuit: This circuit works 'the other way round' to the earlier circuits by extending a 12v signal from the handbrake switch or test diode to the warning lamp, which is backed by a local ground. If neither of then causes the lamp to light either the bulb has blown, its local ground is faulty, or the green/orange wire to it has a disconnection. If the handbrake switch lights the lamp but cranking (handbrake down) does not then there is probably a disconnection in the green/orange between test diode and handbrake switch. If the handbrake lights the lamp but cranking does not then the test diode or its white/red connection to the starter relay is open-circuit. If cranking lights it but the handbrake does not either the handbrake switch is faulty, incorrectly adjusted, its local harness disconnected, the green 12v supply to it disconnected, or something is preventing the handbrake from fully returning to the 'off' position.

NOTE: As referred to above both the US 76-on and UK 77-on circuits have a connection between the cranking and handbrake circuits that lights the brake warning light if cranking with the handbrake off (if the handbrake is on the light will be on anyway). Because the warning light also has the handbrake switch connected to it, which also feeds 12v to the light when the handbrake is on, a diode is necessary to ensure that current can only be fed one way - from the cranking circuit to the warning light - and not from the handbrake switch to the cranking circuit. **If this diode fails short-circuit turning on the ignition with the handbrake on will cause the starter to crank, and keep cranking even when the ignition is turned off again.** This is because even when the ignition is turned off current is still being fed in a self-perpetuating loop from the starter solenoid ignition boost circuit, back through the ballast resistance, the white fuse, the green circuit, through the handbrake switch onto the green/orange circuit, through the short-circuit diode on the white/red circuit, which keeps the starter relay and hence the starter solenoid operated. The only way to stop the cranking is to disconnect the battery or drop the handbrake. Obviously the latter is much simpler - if you can remember to do so in the heat of the moment! The diode is a cylindrical object (click the thumbnail for a picture) tucked high up behind the dashboard on the right-hand side in UK cars, and I think US cars have them in the same location. It has a male spade for a female connector on the white/red feed from the starter relay, and a female spade for a male connector on the green/orange wires to the brake switch and warning lamp. If your diode fails short as a temporary measure disconnect the white/red from the diode, as the connector on that wire is insulated. If you remove the green/orange and don't tape it up you are more than likely to blow the green-circuit fuse. The diode is labelled 'Pektron' with a diode symbol and 'A75-294'. Apparently these are still available from Volex Wiring Systems Tel. +44 (0)1942 685234 or Anixter Fastners Tel. +44 (0)1905 752100, but you can replace it with any 1 amp 100v diode, with suitable male and female connectors on tails, connected the right way round!! Diodes usually have the positive end marked with a white band or '+' sign, this end connects to the green/orange wires and so needs a

female spade connector.

Brake Hoses

As brake hoses deteriorate flaps of rubber can start to become detached inside the hose and act as a check-valve. This can either reduce braking effort on one side, or cause the caliper on one side to stick on. If slackening the bleed screw on the stuck side causes a spurt of fluid after which the disc can be rotated, then the hose should be replaced. If there is no spurt of fluid, or only one piston of the pair is sticking, then the caliper itself is suspect.

Should you fit steel braided hoses? "If they are good enough for aircraft they are good enough for my MGB" well, yes, but only if you are going to replace them on a routine basis like they are on aircraft - you can't see what is happening to the rubber under the stainless braiding! They may well give a harder pedal by not swelling under heavy braking, hardly a factor in road cars I would have said (and if you have silicone DOT5 brake fluid that is more compressible than any of the non-silicone types).

Brake Squeal

Brake squeal seems to have been a problem for the last 30 years. When I started getting it the word in the industry was that different asbestos was being used which had a lower wax content. Whatever, even anti-squeal shims and caliper piston cut-outs aren't guaranteed to cure it. I put a very thin smear of grease on every metal-to-metal contact point of pads/shoes, shims, pistons, calipers, back-plates etc of both front and rear brakes and it seems to do the trick. Just once when first fitting new pads seems to be enough, but at every service for the rears. This used to cause some amusement amongst my friends many years ago but now one can buy brake grease for this very purpose. Be very careful not to get any on the friction material discs or drums though. Generally successful for many years, I started getting one rear brake squealing on Bee which was very annoying on club runs with lots of short distances between turns. Greasing the shoes as above only worked for a short time and it came back. Eventually I swapped the shoes between the sides and the squeal went and hasn't returned so far after several years and thousands of miles.

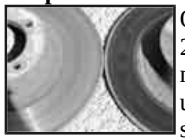
Calipers & Discs

When exercising and polishing the pistons solved a problem
And when it didn't *Added May 2009*

When I changed Keith's clutch a week ago I'd noticed the car pulling quite strongly to the right on braking, but hadn't realised his MOT was so close, and it failed on that and emissions. Pistons and seals are £40 for a full set but I really don't like fiddling with caliper internals (I'd opted to swap Vee's calipers outright when she had a similar problem), and complete calipers were £40 each (not bad considering the clutch slave was also $40). So we thought it worth trying to clean the pistons up a bit and exercising then in and out a bit. The inner piston on the right-hand caliper

was very stiff as was the outer piston on the left-hand. I took the pads out and although there was plenty of meat on three of them I noticed the material was crumbling away, something I hadn't seen before. The 4th pad had worn quite a bit more and at an angle. Also noticed the left-hand disc was pretty new whereas the right-hand looked original and noticeably thinner. One caliper may also have been changed previously as only the right-hand caliper had the cut-outs in the pistons. I wedged a block of wood between the disc and the fully retracted 'good' piston so I could lever the 'bad' piston in without distorting the disc too much. Pumped the 'bad' piston fully out, then dipped some coarse twine in brake fluid, wrapped it round the piston and pulled the string back and fore to scour the surface of the piston. Also dribbled a little fluid round the edge of the seal, then started working the piston in and out several times. Both 'bad' pistons noticeably lightened up to something much closer to the 'good' pistons. Cleaned off an excess brake fluid from the pistons and refitted the pads, using an old one from Bee that had plenty of meat on it in place of the badly worn one. On a test drive it was much better, but still pulled very slightly to the right under heavy braking when not holding the wheel. So I decided to clean the 'good' piston on the left-hand side as well. Might have been slightly improved after that, but still pulling very slightly. I know there is a limit of imbalance but had no idea how close it was to that limit, but Keith thought it worth a punt at a retest, and it was declared 'fine' so many of Keith's quids saved. Before that I also reset the carbs, which seemed very close in both balance and mixture, but I did weaken it by an 1/8th turn which showed as about 3.9%CO on my Gastester and 3.8% on the retest and also OK (limit being 4.5%). He does need new pads though, and the rear brakes looking at as the pedal is a bit 'long' for both our tastes, so that will probably be the next job.

Caliper and Disc Change *Added May 2009*



On the way home from the Yorvik Run we tanked up about 2/3rds the way home and after that Bee didn't feel right - pinking much more than she had been all weekend (none at all on the way up) and seemed to be holding back. In a town and some stop-starts on slight inclines although Bee would roll it wasn't as freely as normal, and I had a couple of whiffs of hot metal. One could be someone else, two is worth investigating, and I found the left front hub a bit warm, disc blued (used to smoke them) and smelly. Jacked up the wheel and found it was definitely dragging more than it should, although it loosened up when I banged on the side of the tyre, and the pistons weren't siezed. Took it steady the rest of the way home (40 miles or so) to find it as cool as the other side when we got back home. Next day jacked up both sides to compare and the left side is definitely dragging more after the brakes have been applied. Took the pads out that side and the edges are badly crumbled, and although I pump the pistons all the way out and all the way back in again, polish them and there is no corrosion, that side is still dragging after applying the brakes. As it looks like the dust seals are breaking up (bits of rubber sticking up) I decide to replace calipers, discs and pads both sides. Leacy are doing rebuilt exchange at £39 each, so half an hour sees both sides off, hose clips on hoping to reduce bleeding effort. With new discs, pads and lock-tabs the bill comes to £119, pretty reasonable I reckon and not worth the hassle fiddling with pistons and seals.

As I'm changing discs first job is to remove the hubs. Pull the

grease seals off, remove the split pin and nut. Pull the hub and disc forward and tip it outer face down and catch the outer bearing, shims and outer grease seal, put them in a safe place to keep them clean. Now for the struggle to undo the disc to hub bolts. I did this once before when swapping the discs over from Rostyle hubs to wire wheel, and it is tricky. Both are 9/16" but the nut really needs a long-reach socket as the wider diameter needed for the 1/2" drive fouls the edge of the taper the wheel sits against. But that is nothing compared to the bolt heads, which are recessed, and only have a very small clearance to a raised portion of the disc, and really need a thin-wall socket, a standard socket only goes about half way on. Although the new discs have more clearance it is still too tight. Add to that the problems of putting a lot of torque into the nuts and bolts to undo them, and you really need a jig of some kind to keep both sockets square to the nut/bolt, particularly the bolt, as well as press the bolt socket onto the head. Eventually I managed to get them all undone, changed and torqued back up again using a foot holding a tommy-bar on the bolt socket onto the ground, one hand pressing the bolt socket onto the head, and the other hand using a torque wrench as a breaker bar on the nut, 40-45ftlb. One of the old discs is about half the thickness of the new. The other is much closer, perhaps that had been replaced by a PO.

No grease came out of the bearings i.e. from excess heat but nevertheless I squeezed some more into the back of the inner bearing while it was still in the hub (retained by the grease seal) and pressed some into the outer bearing while it was still out. Reassembled it all, torqued up to the minimum of 40ftlb, and checked the endfloat was still OK. I found both split pin holes ready lined up so didn't need to tighten any further (maximum 70ftlb), fitted those, and the grease caps. I just used large pliers and wiggled to get these grease caps off, but have an idea of using a 1/4" UNF nut welded to a short length of tubing with a screwdriver or something to lever them off, and used as a drift to tap them back on.

Next the calipers go back on. Something to watch here is that unless the flex hose thread starts in exactly the same place on both old and new calipers then when the hose is tightened down the caliper won't be at the correct angle to attach to the swivel axle, and forcing it will put a twist in the hose. If you are replacing hoses as well this isn't an issue - you would fit the hose to the caliper first and then to the body bracket and pipe, but I've changed mine not that long ago. One of mine was as bad as it could be at 180 degrees out, the other not so bad at 90 degrees. Fortunately the other end of the flex hose is easy to get at, unlike the clutch! Support the caliper on a block, slacken the locknut on the hose, use one spanner on the fixed nut on the hose and another to slacken the nut on the end of the pipe, then carefully twist the hose relative to the pipe until the caliper lines up again. Unfortunately a little fluid seeps out, let's hope not to much air has got in. Tighten the nut between pipe and hose and loosely fit the caliper with its bolts and new locktab, turn the steering from lock to lock to make sure the hose clears the side of the damper mount, making any adjustments to the relationship between pipe and hose as required. Torque up the caliper bolts to 40-45ftlb and bend over the lock-tabs.

With the thicker discs and new pads, although the pistons are well

back into the calipers I have to press them back all the way before I can get the pads in, doing a trial fit first. When they fit I smear a little copper grease on the backs (no anti-squeal rubber on these I notice) and on the edges of the back-plate where it contacts the caliper and retaining springs. Note that the springs are 'handed' in that one pair of fingers is longer than the other, so they have to go round a certain way. The Leyland Workshop Manual shows the longer fingers facing towards each other, the Haynes drawing shows them the same length so is no help, and you can't tell from the photo!. I can't remember which way round I put mine but one way seemed more logical and a better fit than the other. Just bend the long end of the split pin back about 45 degrees, that is more than enough to keep them in. One tip when inserting them is to turn them so the short end of the pin is facing towards the pad, locate the long end over the spring, then rotate the pin 180 degrees and that will depress that side of the spring so you can push the pin across to the other hole. Then fit the long end of the pin in the other hole, rotate 180 degrees again, and that will compress the other side of the spring and allow you to push the pin through the second hole. Just a bit easier than trying to depress the spring on its own.

Now for bleeding. I've still got the hose clamps on, so I open the bleeder on the driver's side (easier to get at the air hose connection to a wheel), set up the EeziBleed, lower the air hose down through the engine compartment rather than draping it over the wing, slide a wheel with the pressure reduced to about 15psi partly under the body, and connect the air hose. There is some hissing which is air leaking from the EeziBleed bottle cap. This has always been a problem with mine, and overtightening causes the seal to pop out which leads to rapid deflation of the tyre, so I live with it. What **is important** is that you have a good seal where the EeziBleed cap attaches to the master. If this leaks fluid will completely fill and overflow the cylinder. Fit a drain hose to the caliper bleed nipple directed into a jam jar, and release the hose clamp. Pretty soon fluid comes out, a few tiny bubbles and that is all, so I close the nipple and release the air hose. Round to the other side, and this time I have to bleed a lot more fluid at as every couple of seconds a large bubble of air comes out. When none come out for a few seconds I close that nipple, although in the meantime I have had to top up the EeziBleed bottle with more fluid, which means disconnecting the air hose and reconnecting it again. Check the pedal and it is its usual after any brake work and that is a long pedal that pumps up, but goes long again when released for a few seconds. So get the Navigator installed in the car with pressing down as hard as she can on the pedal, while I open first one side then the other. Nothing comes out the drivers side, but two or three inches of air comes out of the passenger side, so we do that side again and this time it is OK. Check the pedal and it is as it should be. The passenger side was the one where the hose had to be rotated 180 degrees relative to the pipe, and it took a bit of fiddling to get the angle right going from lock to lock, so I suppose that let more air in than on the other side.

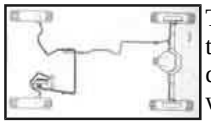
Wheels back on, go for a test drive on a beautifully sunny afternoon, and all is well.

Update March 2010: Oddly exactly the same thing happened to a pal the same year, but for health reasons he was unable to do the job himself and asked me, and

what with this last winter it's taken until now for the weather to be suitable for working outside. Interestingly his old discs had more clearance to the bolt heads even though the sides of the well were unmachined casting and a socket fitted right on for removal. I'd taken a large bench vice up with me to grip the discs while we were wrestling with the bolts and that worked well. But the new discs were the same as my new ones (same source) i.e. even though the very bottom of the sides of the well were machined it wasn't machined back as far as the casting surface so again I had problems getting a socket on the heads. I then had a brain-wave and remembered I had some old box-spanners inherited from my Dad (which I hadn't used since I got a socket set well over 40 years ago) and one of those fitted a treat. These fit better as they don't have a circular outer surface like a socket, and if you align a bolt head flat with the side of the disc the flat on the box-spanner fits into the space available. Other than that the only othr problem was I couldn't get the old brake hose (fortunately had already planned to replace those as well) out of the left-hand caliper and the new hoses didn't come with copper washers. Cost-cutting like this is ridiculous, but fortunately my pal is a horder like me and had a spare. Back home a bit of heat, Plus-gas and a couple of whacks with a hammer and chisel got it moving. Other than that the job went very well, starting at 10am done by 3:30, including greasing the kingpins and topping-up the dampers. Another brain-wave was that to stop fluid draining out of the master while the hoses are being replaced, rather than fiddling about putting polyethelene over the master filler (which never seems to work) is to wedge the brake pedal partly down. Once the piston has moved far enough to cover the bypass hole i.e. starts applying pressure no fluid can drain out of the reservoir. Unfortunately I didn't think of this until after bleeding, so it remains a theory to be tested. Bleeding went exactly the same as on my two cars - low pressure on an EeziBleed gets the main air out but leaves the pedal spongy, then applying heavy pressure to the pedal while each caliper nipple is rapidly opened and shut a couple of times blasts any remaining air out and after that the pedal is good. However on the test drive it was obvious something was still dragging, which proved to be both rear wheels. Whilst the car had been unused for six months, it had been in a nominally dry garage with the handbrake off, so they weren't rusted on. Unfortunately the ajusters were also very stiff, so nothing for it but to strip, clean, grease and rebuild both assemblies which was done in about an hour, so pretty good going. The worst side did show droplets of moisture on the outside of the slave cylinder which proved to be water, so I suspect the linings had absobed moisture and swollen to jam on to the drums. Free now, when the car starts to be used on a regular basis again they may well shrink back down so need readjusting.

NEW Dual-line Plumbing *Added September 2011*

A lister has queried the connection of the brake pipes to the dual-circuit master with servo as depicted by Moss (US and Europe) and Victoria British. This appears to show the rear circuit being connected to one of the ports nearest the driver, the right-hand front caliper being connected to the other port nearest the driver, and the left-hand front caliper being connected to the port nearest the front of the car. This is quite wrong, and could well throw your car into the nearest hedge or even worse oncoming traffic if you braked hard with a circuit failure.



The correct way is for both front calipers to be connected to the ports nearest the driver (it shouldn't really matter which way round, but Haynes shows the left caliper on top and the right caliper below for LHD) and for the rear circuit to be connected to the single port nearest the front of the car, as shown here (my colour) in Haynes, and applies to both LHD and RHD cars.

E-clip Fitting Tool

These can be a real pain to fit trying to keep them lined-up while pressing the tangs over the boss on the slave cylinder, only to have them ping off somewhere never to be seen again. I saw a feature in the MGOC magazine describing a tool to fit them, but at £15 I thought they were a bit pricey for all it seemed to be. I subsequently found a similar tool to a slightly different design at almost half the price of the MGOC item (since vanished), but by this time was intrigued enough to see if I could make one, even though fitting these clips isn't an every-day occurrence. After some thought and rooting around my stock of nuts bolts, washers and plumbing bits I assembled this tool which makes fitting the clips a doddle in seconds. See here for how I did it. Since then I've heard of people using circlips instead, which will be a lot easier to remove and refit. However unlike the E-clip there will be no spring pressure holding the slave firmly against the back-plate, so you may get rattles. Unless you use a crinkle washer?

Fluid *Added October 2009*

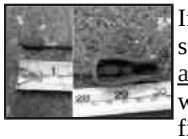
Someone on the MG Enthusiasts bulletin board asked about DOT5 brake fluid. Wanting to confirm to myself that this was in fact silicone fluid, I Googled it and the first (non-sponsored) result was an article from American Auto Club UK. Basically this says whilst it was originally used because it had a higher boiling point than DOT3/4 fluids and didn't absorb water, Super DOT4 developed since is preferable. Furthermore it says if you do convert **don't** flush you systems with spirits as they are known to cause system failure, but unless the system is completely clear of DOT3/4-contaminated sludge it will react with DOT5 to cause a gelatin-like crud which will attract more crud and block orifices, and you will never get the silicone of DOT5 out of the system in order to change back. So you are damned if you do and damned if you don't. It also says the American Military are the only major users of DOT5 now, and have asked the SAE for a way of changing back, and if they stop using it DOT5 will go the way of leaded fuel. There are any number of pages on Google (except from suppliers selling silicone-based fluid!) saying much the same thing. Halfords don't stock it anymore, just DOT4 in vanilla and Super flavours, and Haynes for my 2004 ZS180 specifies these and not DOT5 - I always knew not following the herd and changing to DOT5/silicone was the right thing to do :o). Confusingly the spec for Super DOT4 i.e. glycol-based like

DOT3/4 is DOT5.1, even though DOT 5 isn't compatible with it! Why the powers that bee didn't call it DOT4.1, or even DOT6, is a mystery. And ironically, even though silicone fluid doesn't absorb water, it doesn't mean there isn't any water in the braking system. What there is will just sit there as a lump of water alongside the fluid. It will still boil and kill the brakes, and it will still cause corrosion. In fact according to some sources silicone/filled systems need **more** frequent flushing than non-silicone. Silicone readily aerates (one source claims a trip from the shop to home on a motor-bike is enough to cause problems unless it stands overnight), which causes a spongy pedal, and it cannot be used with ABS as it gives inadequate lubrication to the ABS pump.

Updated December 2009: I see quite frequent references to Castrol LMA as being the best fluid to use. This is non-silicone and so theoretically compatible with DOT3, 4 and Super DOT4/DOT5.1 but not DOT5. It's said to have lower water absorbancy than DOT3 or 4, and a similar boiling point to DOT5 silicone and Super DOT4/DOT5.1, so after that it comes down to price and availability. Whilst Google has loads of references to LMA it is almost all club and list talk, no suppliers that I could see in the UK, and only a couple in the US.

Updated January 2010: DOT3 still seems to be available, however it has a significantly lower boiling point than even DOT4, let alone DOT5 and 5.1, additionally damages natural rubber seals, and still damages paintwork. It's advantage apparently being it is cheap! Given that most peoples usage is surely minute, I can't believe people would choose to buy it over DOT4 just to save a few pence. But then Wikipedia (yes, I know I know) claims most cars produced in the US as of 2006 use DOT3! And another update, apparently Super DOT4/DOT5.1 and Castol LMA are both harmful to paintwork.

Handbrake (See above for handbrake warning light on later cars) *Updated November 2009*



If replacing the handbrake cable be aware that the cable for a stud-wheel axle is longer than that for the wire-wheel axle as the axles themselves are different lengths. Also be aware that wire-wheel hubs, both original and special conversion hubs, can be fitted to a stud-wheel axle, and vice-versa, so going by the hubs/wheels alone is not necessarily the correct thing to do. An old stud-wheel cable I have (bear in mind this probably has stretched) measures almost exactly 30" from the tip of the nipple at the compensation lever end to the tip of the U-clip that attaches to the lever at the brake drum end. I looked into this following a question on the MG Enthusiasts BBS from J F Demerath who had a new cable, unlabelled, so he didn't know what axle it was for. His measures 28.5" i.e. 1.5" less than mine. That's a bigger difference than you might expect, given that the axles are 2" different, and in theory half that should be in this short cable and the other half in the long cable to keep the compensation lever on the diff case in about the same position. But mine is an old i.e. stretched cable and 1/2" of stretch isn't unreasonable, and his is new, so almost certainly a wire wheel axle cable.

Before fitting the new cable anchor the ends of the inner so as to pull it straight, this makes it easier to get plenty of grease into the sheath using the grease nipple and sliding the sheath up and down the inner, than waiting until it is on the car.

BL handbrakes were always dodgy if not given regular and comprehensive cleaning and lubrication. At each 3k service I completely dismantle the shoes and the actuation levers from the backplates and cables. With the cables off you can get plenty of free movement on the levers on the diff casing, make sure these are free and oil the pivots. Also make sure the cable at the handbrake end and the handbrake itself are free. If the cable sheath has a grease nipple pump some in and work the cable back and fore to distribute it in any case make sure the cable is not stiff or catching in the sheath, which indicates broken strands. Check the slave pistons move back and fore and there is no fluid inside the rubber boots. Ensure the pivot on each actuation lever is clean and free, work a little grease in to it and wipe off any excess. Screw the adjusters all the way in and remove, clean and grease the wedges and adjuster screw. Replace the screw, screw it all the way out the back of the backplate (minimum adjustment) then apply more grease to the threads that are in the open on the back (so when you screw the adjuster back in a ring of grease builds up protecting the threads from water ingress). Apply a thin smear of grease to every metal-to-metal contact point of shoes, actuators and backplates (you can see the rub marks). You don't want great gobs of it that will get on the drums and friction material, just a thin smear. Refit the shoes observing the correct orientation and spring orientation, reconnect the cables, and adjust as described in Rear Shoes .

One cause of poor handbrake operation is wear in the notches in the handbrake levers that the shoes sit in. The handbrake is most effective if the shoes contact the drum when the lever the cable attaches to is parallel to the back-plate. As parts wear - or if the wrong shoes have been fitted - the angle between the lever and the backplate increases so reducing its efficiency. In the case of worn handbrake levers the notches can be filled with weld and filed to the correct depth, but new levers are available and not expensive.

Once the rear shoes are correctly adjusted the handbrake lever itself can be adjusted using the nut under the tunnel at the front of the cable. I prefer to be able to pull it up one click without affecting the brakes so as to be sure they aren't dragging when it is fully down. This should give you about five clicks to full engagement. Cables stretch over time, in fact it is only because they spring a little when you pull them on that the handbrake works at all. Eventually they can stretch so much that there is no more adjustment on the nut and the lever starts going higher and higher before the handbrake holds the car. If the cable is obviously sound and has no broken strands or corrosion it is a waste to replace it, but in the UK at least eventually it will fail the MOT. My V8 got higher than I would have liked, I had reused the

cable I had taken off the roadster when I changed its axle to a wire-wheel type when the V8s developed some broken strands. Looking at the cable the short length of inner from the RH drum ends in a nipple by the diff casing. I removed the nut at the lever to give me plenty of play, then clamped a bracket around the inner between the compensator and the nipple effectively shortening that cable by an inch. This actually moves the end of the sheath to the right about an inch, which pulls an inch

of inner out of the sheath, so shortening the cable! I now have plenty of adjustment left at the nut by the lever. The bracket was actually off a handle-bar mirror from a motorbike and was used to clamp the mirror onto the rod that comes up from the handlebars. As such it was about 1/8" thick with turned-over edges so that even when clamped with a bolt the cable itself isn't clamped tight which could cut through strands, but the clearance is small enough to stop the nipple pulling through, you might get some idea by clicking on the image on the left. You could have a more 'engineered' solution using a thick plate about 1" square, drilling a hole off-set to one side and cutting a slot just big enough for the inner, off-set to the other side. Then a 1" square closing plate with a hole lined up with the hole in the other piece, and a bolt and nut to clamp the two together. It obviously needs to be secure since if the 'shortener' suddenly comes free the handbrake will effectively be fully off, with obvious results if parked on a hill.

Update August 2007: Bob Howard has written to me saying that it is possible for the handbrake levers inside the drums to be fitted to the wrong sides (they are handed and marked with a small 'L' or 'R' along with the part number) and on the wrong sides it results in the cable being much too long. So if you have recently had both sides disassembled, and the handbrake doesn't work on reassembly, check this first, see also below.

Update July 2008: Toni Kavcic has written to me from Slovenia with a couple of

'Gotchas' that tripped him up. He had problems with his handbrake for many years and no-one seemed able to sort it out, until he spotted something in my photos showing shoe orientation. The short lever that operates the rear shoe and goes out through the back-plate to the handbrake cable must be **below** the long lever that goes forward to the front shoe. This makes the lever handed (as Bob Howard found above), and if fitted to the wrong sides they will be the other way up. Toni discovered his had been on the wrong sides all along, and correcting this solved his long-standing problem. The other problem concerned replacement levers. Although the holes and notches were in the correct places the long lever came back too far such that it fouled the rear shoe and held them too far apart to get the drum on. Toni had to remove 5-6mm of material to correct it.

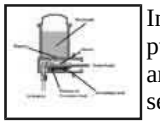
I've also just been through the rear shoes on a friends 78 and whilst I could see some numbers on his handbrake levers I didn't notice any L and R marking (neither did I compare the numbers with those in the Parts Catalogue, but I don't think they were the parts numbers). His were on the correct sides, but one shoe each side was orientated incorrectly - see Rear Shoes for the correct orientation. I also noticed a completely different handbrake cable and compensation arrangement. Both my 73 and 75 have a quite complex and expensive system of levers and bushes mounted on the diff cover. The 78 has nothing more than a square piece of rubber bolted between a flange near the left-hand end of the axle and a bracket on the end of the cable outer. The cable inner carries on to the left-hand shoes, and a metal rod goes from the cable bracket to the right-hand shoes. Not only is this extremely cheap, but apart from the rubber eventually breaking there is nothing to go wrong, and the rubber experiences very little stress and movement anyway. This probably came in with 77

models. The downside is that if you put an early axle on a late car it won't have the bracket for the handbrake cable. You could jury-rig a bracket for the rubber flap, other than that it will mean replacing the cable and obtaining the compensation levers if they didn't come with the axle. If you are going the other way you should just be able to transfer the compensation levers over from your axle to the replacement, and cut off or just leave the bracket and rubber piece. *End of update.*

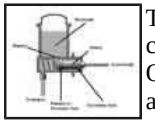
Update September 2008: Malcolm Craig wrote seeking clarification of the  handbrake levers issue as my photo and description shows them as being upside down according to the Leyland Workshop Manual and other sources such as the Moss US web site. His were as per the manual, and his handbrake cable seemed to be too long. He also said that his didn't have L & R markings either, and although they had numbers stamped it was the same number on both levers i.e. not the part number. Subsequently he fitted his levers to the other sides, i.e. the same sides as my photo, and it solved his problems. Closer examination of the manuals and Moss web sites shows that the Leyland Workshop Manual and Moss US only show the banjo axle. The Leyland Parts Catalogue and Moss Europe shows both the banjo and Salisbury/tube axles, and this is where it starts to make sense. The Moss banjo drawings show the same orientation as the workshop manual, and the Salisbury/tube axle drawings show them the other way up i.e. the same as the photo of my Salisbury/tube axle (however to confuse things even further the Parts Catalogue shows the left-hand levers with the right-hand brake parts!). At the moment I am unable to confirm whether the orientation shown for the banjo **is** different to the Salisbury/tube axle, but seeing as the Parts Catalogue and Moss Europe drawings agree with both the banjo drawing in the manual and with my photo of the Salisbury/tube axle, I could well be so. However! Just when things do seem to be making sense, the Parts Catalogue shows both early and late handbrake levers for the banjo axle, and the same early and late levers (the 17H prefix for the later right-hand lever is a misprint, it should be 37H as for the later left-hand) for the Salisbury axle, implying they are interchangeable. So does that mean both have to be one way up on the banjo and the other way up on the Salisbury? Or the early ones have to be one way up on both axles and the late ones the other way up on both axles? Or some other combination? Or are the drawings for the banjo incorrect and they should **all** have the short lever underneath? Who knows? Ste Brown on the MG Enthusists BB is adamant that the early set are for banjo only and must be as per the workshop manual, and the later set are for Salisbury only which we know must be the other way up. All I can say for sure at the moment is that the later levers on the Salisbury axle must have the short levers underneath the long levers.

Master Cylinders *Added November 2009*

Typical problems on single-circuit systems can be the pedal sinking if constant pressure is applied, and on both single- and dual-circuit systems fluid leaking down the pedal or the brakes binding-on. The first is caused by a faulty primary or pressure seal on the piston, the second by a faulty secondary seal, and the third by a maladjusted brake light switch or incorrect master cylinder push-rod.



Initial movement of the piston by the brake pedal pushes fluid up into the reservoir via the bypass hole and doesn't apply the brakes. As soon as the primary seal covers the bypass hole further movement of the piston pressurises the fluid in the lines and applies the brakes. As the primary seal continues moving forward and clears the bypass hole fluid is free to run into the space behind it from the reservoir, the secondary seal prevents fluid leaking out the back of the and down the pedal. If the primary seal is faulty pressurised fluid can leak back past it into the space between the two seals, and back into the reservoir, which cases the pedal to sink, a ripped primary seal may develop no pressure at all and the pedal will go straight to the floor (which can also be caused by air in the hydraulics). If the secondary seal is faulty, fluid, even though it is not under pressure, will leak back towards the pedal linkage and run down the pedal.



The final problem occurs when something prevents the piston coming back far enough for the primary seal to clear the bypass hole. Ordinarily simply withdrawing the piston will release the pressure, and any expansion or contraction of the fluid in the calipers, slaves or pipes from heating or cooling while the brakes are released flows via the master cylinder and the bypass hole to or from the reservoir as appropriate. The problem comes when the piston hasn't come back far enough for the primary seal to clear the bypass hole. If the fluid should heat up and expand while the brakes are released it can't flow into the reservoir as it should, so the fluid pressurises applying the brakes. This can be caused by the mechanical brake light switch (on the pedal cover or by the pedals, not the hydraulically operated switch screwed into the brake pipe manifold) being screwed in too far, or if a master push-rod that is too long has been used. A similar thing can happen if a brake hose starts delaminating and acting as a one-way valve, although that will only affect one caliper or both rear brakes. The two problems can be discriminated between as follows: If both calipers are binding on, and slackening a caliper bleed nipple either side releases both calipers, then it is a master problem. If only one front is binding, and slackening that bleed nipple releases it but not the other, then it is the brake hose feeding that caliper that is at fault. With dual-circuit systems diagnosing the rears is a little more difficult as only one hose feeds both slave cylinders.

The above drawings have been adapted from a description of how a split braking system master works, click on a red arrow to see it operates. The movement of the pistons isn't as consistent as they show in practice though, only while both circuits have yet to develop any pressure i.e. are taking up free play in their respective circuits. On an MGB the front calipers come off the piston nearest the pedal (which I'll call the first piston), and the rear slaves off the furthest (the second piston). As soon as pressure develops in one circuit the pistons will move differently. For example if it develops in the first circuit first both pistons will start to move at the same pace until pressure develops in the second circuit. If it develops in the second circuit first then the second piston will stop moving and only the first piston will continue to move, until that circuit also develops pressure. The free play in a caliper is usually less than in a slave, which ordinarily would mean they would start to develop fluid pressure first, but they are a larger diameter than the slaves which

means they need more fluid to travel a given distance. I don't understand why there is a double bypass hole shown in front of the first piston, as the seal would have to pass both holes before it would start developing pressure. It's possible it should be shown **behind** the seal as in the second piston, so fluid expansion and contraction can freely occur in between the two seals on each piston when the brakes are released, as well as in the calipers/slaves and pipes.

In the MGB system both circuits develop the same pressure, this is so the pressure failure warning device (North American cars only) has equal pressure both sides, unless one of the circuits has a leak. In the event of unbalanced pressure (which could be a caused by a siezed secondary piston as well as a leak in either circuit) a shuttle valve is pushed to one side or the other from its normal central position, which operates a switch and lights a warning lamp. The shuttle valve remains offset and the warning light lit (while the ignition is on) until the fault has been repaired and the shuttle valve centralised again. The pads/discs and shoes/drums require different mechanical pressures for correct brake bias, which is always significantly more at the front than the rear, and that comes from the relative diameters of the caliper and slave pistons. The need for this brake bias towards the front comes about from what happens when you apply the brakes in a moving vehicle, as well as from static weight difference front to rear. Weight effectively moves forwards under braking, putting more pressure on the front tyres and reducing it on the rears, and you can see this in the way the suspension moves under heavy braking. This means that even in a car with almost exact 50:50 **static** weight balance front to rear, you have to apply much less retardation to the rear wheels than the fronts, or the rears will lock and cause most people to lose control. You should always be able to lock the fronts on dry tarmac, but not be able to lock the rears on wet tarmac. Ice is another matter! Front wheel drive cars with a much heavier bias of static weight to the front of the car require even more bias towards the front brakes. Competition vehicles often have adjustable brake bias which can be adjusted on the move from inside the cabin to cope with changing conditions. Some French cars have a dynamic bias controlled from the rear suspension - the more the rear suspension rises under braking the lower the hydraulic pressure applied to the rear brakes. Fine on dry tarmac, but a liability on ice I would have thought where the suspension will move little if at all, and lots of complicated stuff to go wrong - so probably a Citroen!

The animation when there is a leak in one circuit is similarly incorrect. It shows the second piston not moving until the first piston has reached it, but in fact both pistons will start to move as before, i.e. the first piston at about twice the rate of the second. The second piston will stop when its circuit has taken up all its free play, and the first piston will keep going until it reaches the second piston. Only then will any significant pressure be developed in the second circuit to slow the vehicle. If the leak is in the second circuit again both pistons will initially move as shown in the first animation, then when the first circuit has taken up all its free play the second piston will start moving as fast as the first, until it reaches the end of the cylinder. Again only then will sufficient pressure develop in the first circuit to slow the vehicle. A leak in either circuit results in a noticeable increase in pedal travel before any back-pressure is felt. Unfortunately because both calipers are on one circuit and the rear brakes on the other in the MGB, it means that if the front circuit

fails only the rear brakes will be operative which means pretty minimal braking - try stopping from a normal speed with just the handbrake! If it's the rear circuit that has failed it's quite possible you will only notice from the warning light (where fitted) and a slightly longer pedal travel, as 80% or 90% of normal braking effort will be available. More modern systems use diagonal circuits where one front is linked with the opposite rear, or even dual circuit calipers, but I'd expect a tendency to pull to one side with both these systems. And what happens with ABS when any one, two or three wheels can end up unbraked is anyone's guess.

MOT Test (UK)

Had the roadster tested today (July 2008) and for the brake test was asked the strange question "How much does the car weigh?". Apparently they now use a computerised system where they have to select the vehicle from a list to do the test, but vehicles of advanced years or rarity aren't on the list and in these cases they have to input the weight manually. I could remember it at about 2200lb, but it has to be input in kilos. In the end the tester selected another vehicle! The curious thing is that this system has been in use for about 12 months, but it didn't crop up when the V8 was tested just two months ago in May. I emailed the MGOC and they replied that they often get phone calls from people at testing stations asking what the weight is (you would think they would put a note to that effect in the magazine ...).

Updated September 2008: Briefly the weights from the Workshop Manual are as follows:

Mk1 Roadster	871kg
Mk1 GT	993kg
CB Roadster 68-71	1044kg
CB Roadster 71-74	1085kg
CB GT 68-71	1088kg
CB GT 71-74	1110kg
CB V8	1107kg
RB roadster	1100kg
RB GT	1133kg
RB V8	1146kg

Note the Mk1 figures are quoted as being 'unladen' but the others as 'kerbside weights with a full tank of petrol and all options and accessories' so in practice most Mk2 and later cars will weigh a bit less ... depending on what you carry by way of tools! But it isn't critical, just another Government requirement to record pointless information. The full weight information including front/rear split and with other loadings can be found here.

Rear Cylinders

The rear brake cylinders on the 4-cylinder GT are of a larger bore than for the roadster - 7/8" (GWC 1122) as opposed to 0.8" (GWC 1103, applicable to both

Banjo and Salisbury/tube-type axles). This gives more braking effect without locking using the additional rear weight of the GT. They differ externally in the position of the locating peg, and hence the back-plates are also different from GT to roadster. However note that the V8 GT wheel cylinders are the same as the **roadster**, hence they also have roadster back-plates. Presumably this takes account of the more powerful front brakes and wider tyres of the V8 giving more retardation, more weight transfer, and hence a greater chance of locking than the 4-cylinder GT. Note that weight transfer and hence the likelyhood of locking is dependant on the grip between the tyre and the road, not how powerful the brakes are - assuming they are at least powerful enough to lock the wheels. In fact making the front brakes more powerful with the same tyre to road grip without changing anything at the rear can be counter-productive, since a lower pedal pressure for maximum retardation i.e. just short of locking the front wheels means the back brakes aren't doing as much as before, hence the overall stopping distance could **increase**.

Update August 2007: Richard Atkinson has contacted me to say that the GT originally had the same wheel cylinders as the roadster, only changing to the larger item in May 1968 at chassis number 142735 for wire wheel cars, 148083 for disc wheel cars, and this is confirmed by both the Parts catalogue and Clausager. In Richard's case even though he ordered the correct items for his 66, i.e. the Roadster items, they did not fit his back-plates. So either his backplates had been modified to accept only the later GT items, or the backplates and possibly the whole axle had been changed at some point. This picture from Richard shows the GT item with the locating peg slightly further away from the fluid port, whereas the roadster item has it noticeably closer.

Rear Shoes

As well as the springs and handbrake levers each shoe has a steady pin, spring and washer attaching it to the backplate. Rather than trying to press and turn the washer at the same time in order to disconnect it from the pin (and stop the spring from flying away at the same time), I press down on the washer with a pair of pliers with one hand while reaching round the back of the backplate with the other hand to turn the pin with my fingers. Same goes for refitting.

Each shoe has the friction material bonded or riveted offset to one end of the back-plate. The 'empty' portion of the back-plate denotes its leading edge, that is, the end which a point on the drum will pass first when the car is travelling forward. Thus the front shoe has its leading edge or 'empty' portion uppermost and the back shoe has it at the bottom as indicated in these images (click to enlarge).

Early cars have two pull-off springs, later cars have three. The spring with the single coil goes behind the shoes at the top in the two circular holes. The spring with two coils of the same diameter as the upper spring also goes behind the shoes but at the bottom,

again in the two circular holes. The third spring (where fitted) has two larger diameter coils and goes in front of the shoes in the holes in the handbrake levers. All the springs can be fitted either way round, but only one way is correct, when fitted incorrectly they will either foul the back-plate or the slave cylinder.

Updated July and September 2008: Note also the correct orientation of the

handbrake levers, the short lever operating the rear shoe and going through the back-plate must be **below** the long lever that operates the front shoe on Salisbury/tube axles as per this photograph. This makes the levers handed, and so capable of being fitted to the wrong sides. This will severely limit the effectiveness of the handbrake. Note that banjo axles have the short lever **above** the long levers. This is how the drawings in the Leyland Workshop Manual and Haynes show them, but they only show the banjo axle and not the Salisbury/tube axle.

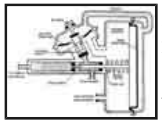
Something to watch out for on replacement levers is the length of the long lever. If it project rearwards too far as in this example it fouls the rear shoe, hold it out further than it should be, and you can't get the drum back on. *End of update.*

Added April 2009

One useful tip is to cut a slot in the end of the adjuster with a hacksaw, then you can use a screwdriver from the front to fully remove it for cleaning and greasing and refitting instead of groping round the back with a spanner and only being able to turn it 1/4 or 1/2 turn at a time. Cleaned and lubricated regularly (at least once per year) the adjuster should never be siezed or even stiff. I remove mine completely, clean it, then smear copper grease into the threads and screw it fully back in. Then I smear some more copper grease on the exposed threads at the back, which not only protects them from corrosion, but also as you screw the adjuster back out again to adjust the shoes the grease on the back forms a 'collar' which prevents water and corrosion working its way into the threads.

Screw in the adjusters until the shoes just rub on the drums, at this point I pump the brakes and pull on the handbrake a couple of times then strike the drums with a mallet to ensure the shoes are centralised. Experience will tell you how much to pull up your adjusters, after a short run they should be barely warm and definitely not hot. Cars seem to vary, for example my V8 has to have the adjusters one flat looser than the roadster or they overheat. After all that, assuming sound friction material and drums, you should be able to lock both rears with the handbrake on a roadster, possibly not with a GT with its heavier weight (although the slave cylinders compensate for the greater weight the handbrake doesn't). Finally adjust the screw at the handbrake end of the cable. The first click should not add any retardation, that way you know the brakes are fully off when the lever is fully down. The 2nd click should start to add retardation and should be fully on in five or six clicks.

Brake Servo/Booster *Added December 2009*



Ever wondered how it worked? Maybe this description of the remote servo will help, click the thumbnail. Originally the remote servo was an option, which means that braking performance **without** the servo must be adequate at least, and in fact this servo only gives light assistance. I've driven V8s (on which it was standard) with and without this servo operational and even though the first time I drove one without and was looking for the difference, I was amazed at how little it was, and after a couple of test prods I didn't notice it at all in normal driving. I believe the later integral servo does give more assistance, and the master cylinder diameter was reduced to give less pedal travel for the same overall retardation. This means that if the **integral** servo is not functioning the effects are much greater and significantly higher pedal pressures will be required for 'normal' levels of retardation.

For the purposes of the UK MOT if a servo is fitted it must be functional, there are a couple of ways you can check it. Firstly, turn off the engine with the footbrake released, then try the footbrake. Initially the pedal should feel pretty much as normal, accompanied by some clicking and wheezing from the servo as it is operated and released. But after the third or so operation the wheezing should reduce to nothing as the vacuum in the servo is 'emptied', and the pedal won't go down as far. This shows that the servo, and the non-return valve in the vacuum port on the inlet manifold, are functioning as they should. The second test is performed after the first, and involves pressing the pedal down hard as you start the engine. You **should** feel the pedal go down a bit further as vacuum is applied to the servo again. If the first test results in no wheezing, and the pedal seems higher than in normal driving, but the second test works, then the non-return valve in the vacuum port of the manifold is probably stuck open.

Other problems can be:

- The most serious is when the seal round the push-rod fails, allowing fluid from the cylinder to be sucked into the engine via the vacuum chamber and vacuum pipe. This will empty the master cylinder, the first thing you know about it being when you suddenly don't have any brakes! A fluid level warning system is available from TE Electronics.
- A leak in the vacuum hose or main diaphragm, which will cause a gross vacuum leak into the manifold with the consequent effect on mixture and running, as well as both tests failing. Note the hose is special vacuum hose to resist collapsing under vacuum, not standard hose as for, say, cooling and heater systems.
- A sticking air-valve piston causing the brakes to stick on. This happens on Bee in very warm weather when we are following a route on a run i.e. slower speeds, but not more normal speeds i.e 50-70mph when presumably the engine compartment is cooler. It happened on a pal's V8 touring Ireland, and got so bad we opted to disconnect the hose from the servo and seal it with the pointy end of a spark plug clamped with a hose clip (that's when I had the opportunity to try one without the servo). One recommendation has been to put a dab of silicone grease on the air-valve piston. Mine had brake fluid on it, so I didn't think that was it. Someone else has said that the servo should be turned so that the air-valve assembly points downwards rather than upwards to keep fluid round the piston, but again as mine had fluid round out I idn't think that was it either. Yet another person reckoned he had tried both those without effect, so removed the piston and polished the bore with fine wet-and-dry and that did the trick. It does seem more likely i.e. jamming due to differential expansion in higher temperatures.
- The servo can also be the cause of difficult bleeding. The 'correct' mounting position on an MGB is with the cylinder feeding the outlet horizontal and the air-valve assembly facing upwards and slightly forwards. However this can allow a small amount of air to get trapped under the air-valve piston, as well as a larger amount in the cylinder. This latter is because the outlet is drilled concentric with the cylinder and not at its upper edge like a bleed port is in the calipers and clutch slave. The effect would be much worse if there was any tendency for the cylinder to be tilted downwards, either due to the mounting brackets used or the attitude of the car. This is where mounting the servo with the air-valve assembly pointing downwards may help, and angling the cylinder upwards towards the outlet. I have seen fitting instructions for an after-market Powertune/Lockheed servo which is outwardly identical to the MGB unit, but shows a totally different mounting arrangement.

V8 Pads

Pads for factory V8 calipers are handed. Not right to left but inner and outer. The pad almost fits in the 'wrong' half of the caliper but not quite, and it is very annoying when you buy a set, get them and home and start to fit them, then discover you have three inners and one outer as has happened to me.