Fuel System

Last updated 03-Jan-2012

Choke Control

There was a manual choke control for twin SU carbs, the North American single Zenith from 1975 on had a coolant operated automatic choke.

The manual choke had a round knob engraved with the letter 'C' until 1970. It looks like this choke did not 'twist to lock' but was just 'push-pull' and stayed out simply from some friction mechanism. From 1970 home market cars retained a round knob but now with a 'fan' symbol as well as the word 'LOCK' and an arrow showing the direction (clockwise) to turn the knob to lock the choke. At the same time North American MkII cars got a 'T-handle' choke knob this time with the word 'CHOKE' as well as 'LOCK' and the arrow. The 'fan' symbol is not very appropriate and neither is the word 'choke', as they really refer to fixed-jet carbs where mixture enrichment is performed by restricting the air supply for much the same fuel volume, whereas SU carbs add fuel to the same air volume. All (including V8) UK cars got the T-handle choke control with the change to rubber bumpers.

After many years use due to wear the choke control can fail to lock at all, or in some cases lock but suddenly release at inopportune moments. In some cases, with the 'twist to lock' type, this can be due to twisting of the cable inner tending to turn the choke knob in the anti-clockwise (i.e. unlocking) direction, and so if the inner is released from the carbs and turned in the appropriate direction the twist can be made to aid the locking action rather than oppose it. But mostly it is simply due to wear in the locking mechanism as indicated in the accompanying photos and descriptions (click the thumbnail on the left). Note these only apply to the later 'twist to lock' types, not the friction lock types although these also eventually suffer from a failure to lock.

On the 'twist to lock' types wear occurs on both the cable inner and a removable component (the 'wedge' in the accompanying pictures) of the outer. So by purchasing a new cable it is possible to fit the inner and the 'wedge' from the new cable to the old outer, leaving the run of the outer in position and just undoing the nut on the back of the dash to pull the outer forward to access the wedge, rather than removing the whole thing then having to thread the new cable (inner and outer) through the most advantageous path to get smooth operation. Of course if the old outer is damaged, or is stiff in operation because it is poorly routed, then you will have to remove and replace the whole thing anyway. May be advantageous to pull out the knob, put a spot of grease on the shaft, push it back in till the grease lines up with the wedge and twist it back and fore a few times to distribute it. Then pull the knob in and out a few times wiping the shaft each time to wipe off any excess or you will get grease on the handles of your handbag.

Added May 2011: John Tait in Australia found his new choke cable failed to lock after just 10 starts. Opening it up he found the locking wedge is made of plastic and had deformed!

Added June 2008

Chrome bumper cars had a curious arrangement at the carb end where the cable inner was fixed, and it was the movement of the outer sliding up and down the inner which operated the lever on the choke interconnecting shaft. It's quite a neat way of running the cable to avoid clutter above the carbs, but does mean there has to be space for the outer to move around without fouling anything or it can make the choke control stiff. For rubber bumper cars (and all V8s) the factory used the more conventional arrangement of fixed outer and moving inner. Seeing as how the chrome bumper type often seems to cause confusion, and someone has just asked me about it, I'll describe the carb end of just that type.

Added February 2009

But why not show the HIF as well?

Ethanol *added November 2009*

Ethanol is appearing in fuels in various concentrations, leading to questions as to its suitability for MGBs.

Update September 2011: Currently UK petrol can contain up to 5% ethanol without any additional labelling, anything more than 5% must be labelled "Not suitable for all vehicles: consult vehicle manufacturer before use" The Biofuel (Labelling) Regulations 2004. There is currently a proposal to increase the amount to 10% before labelling is required Targeted Consultation on Proposed Amendments to the Biofuel (Labelling) Regulations 2004. The FBHVC is on the case - see Bio Fuels and scroll down to PETROL.

- E5 has a 5% concentration and is becoming more common in Europe. It's said to be compatible with most vehicles, including all MGs, although certain Alfas, Audis, Fords, Lotus, Mazda, Peugeot, Subaru, Suzuki, Toyota and all Daewoo are not.
- E10 with a 10% concentration is available in countries like Australia and America but there are a lot more incompatibilities, for example no MG or Rover models are compatible.
  The main problems of E10 for carburettor equipped engines are:
  - The vapour pressure of fuel with ethanol will be greater (if the base fuel is not chemically adjusted) and probability of vapour lock or hot restartability problems will be increased.
  - As a solvent, ethanol attacks both the metallic and rubber based fuels lines, and other fuel system components.
  - Ethanol also has an affinity to water that can result in corrosion of fuel tanks and fuel lines. Rust resulting from this corrosion can ultimately block the fuel supply rendering the engine inoperable. Water in the fuel system can also result

in the engine hesitating and running roughly.

In addition there are the following problems for injection engines:

- The use of ethanol blended petrol in fuel injection systems will result in early deterioration of components such as injector seals, delivery pipes, and fuel pump and regulator.
- Mechanical fuel injection systems and earlier electronic systems may not be able to fully compensate for the lean-out effect of ethanol blended petrol, resulting in hesitation or flat-spots during acceleration.
- Difficulty in starting and engine hesitation after cold start can also result.

- E85 with an 85% concentration of ethanol and only 15% petrol or gasoline is widely available in Sweden and becoming available in America, Europe and elsewhere. Only cars with specially designed engine management and fuel handling systems should use E85. These cars have stainless or plastic lined tanks and lines and no aluminium, magnesium or rubber parts. Ethanol is more combustible than regular fuel and so spark arrestors and other precautions have to be taken to prevent vehicle fires and explosions. E85 vehicles should not use regular fuels as the higher compression needed to get the best out of E85 will result in catastrophic detonation.

Given the problems listed for E10 I don't think I want to use even E5 in my cars. *Update May 2010:* I understand UK fuels can contain up to 5% without labelling on the pumps, and even Shell V-Power may now contain it. Car warranties may state only E5 can be used and nothing higher. E10 becoming more common in Europe, and forces in America are pushing for E20.

Update July 2011: Amal Carbs states:

> For fuel blends containing less than 5% ethanol the concentration is low enough not to cause any significant effect. For 5% to 10% blend then some changes are recommended, (albeit that the USA has been subjected to this concentration for sometime without any known problems). For above 10% the effects of ethanol are known to cause problems and the necessary modification that would be required would extend beyond those of just our product content in a vehicle.

That leaves a question-mark over 5% (i.e. does it cause no significant effect or are some changes recommended?), and from what I've read a lot of people in America wouldn't agree that 10% doesn't cause any problems.

Frost Restoration are selling Ethomix additive at £12 per bottle. The advert mentions nothing about protection against ethanol, it seems to be a fuel system cleaner more than anything, but modern fuels don't need additional detergents. The data sheet linked from that page does mention that it protects against ethanol-based acids and corrosion, however the FAQ page includes:

> **What materials should be changed or avoided (or regularly checked)?**
>
> Zinc and galvanised materials, Brass, Copper, Lead / tin coated steel. (Aluminium), Buna-N (seals), Neoprene (seals), Urethane rubber, Acrylonitrile-butadiene hoses, Polybutene terephthalate, Polyurethane, Nylon 66, Fibreglass-reinforced polyester and epoxy resins, Shellac, Cork.

References:

- http://www.shell.com/static/au-en/downloads/e10/shell_e10_tds.pdf
- http://www.fcai.com.au/publications/all/2006/6/3/can-my-vehicle-operate-on-ethanol-blend-petrol-
- http://en.wikipedia.org/wiki/E85

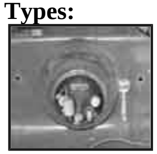
Fuel Filter *added September 2007*


A clear plastic fuel filter was fitted to all V8s, and 4-cylinder cars from various times according to year and market, and there is frequent concern about how empty or full these filters should be. From observations of my own V8 (my 73 roadster doesn't have one) and from others it matters not how full it is. I have seen mine virtually empty (as per the attached), and at other times virtually full i.e. pretty-well the inverse of this, and it seems to make no difference whatever to the running of the car either way. So if your car is running well ignore an empty fuel filter. If it **isn't** running well then seeing the filter empty or very nearly so is **not** a diagnosis of fuel starvation. The only way to verify that is to remove a delivery pipe from a carb and direct it into a container, turn on the ignition, and it should deliver **at least** one Imperial pint per minute (and in practice nearly two) steadily and consistently and with minimal bubbles.

Fuel Pumps *Added September 2008*

Types
Mounting
Venting
Testing and Diagnosis *Added December 2009*
NEW Schematics *Added August 2010*

Types:




The MGB always used the SU reciprocating type of pump, although there were variations over the years. Clausager describes these as 'high pressure type', they may well have been 'high pressure' in SU terms but in general terms they are low pressure of the order of 2psi or thereabouts. Many aftermarket pumps deliver considerably more pressure than this, which overwhelms the float valves in the SU carbs, and pressure regulators need to be fitted. Originally AUA 150, minor changes to AUB 182, then AUF 301, AUF 303, and AUF 305. The AUF 305 had two breathers whereas the previous types only had one. The MGC used AUF 303 and the V8 305. All these pumps used capacitor spark quenching to protect the points, and can be fitted to either polarity of MGB. These pumps can be identified by the plastic cover over the points having a stepped end. They also originally had blue 'SU' tape wrapped round the join of the cover and the pump body, but this could have been replaced with other colours.


In January 1977 pump AZX 1307 was used which had diode quenching instead of capacitor. Clausager states that this was to prevent points 'buzzing' but he means 'burning', it's either a mis-

print or illegible in the source material he used.
By this time all MGBs were negative ground of course, but the AZX 1307 is polarity sensitive and cannot be fitted to positive ground cars without modification, which involves reversing the diode connections, there are also positive ground versions. This type of pump has a cylindrical bulge in the end of the plastic cover, and the join is wrapped in black tape for negative ground pumps and red for positive. In theory connecting one of these pumps to the wrong polarity car could blow the diode and burn the wiring due to excess current, but I have read that they include a current limiting resistor to prevent this. I wouldn't like to try it, but if they do then it will be in circuit when the diode is the correct way round and so limiting the diodes effectiveness in any case. Which begs the question why bother with the diode, why not just have the resistor? There is apparently already a 'swamp resistor' wired in parallel with the coil which reduced points burning even before capacitor quenching was fitted. The only drawback I can think of is that the diode reduces the current the pump draws in normal use, but it can only be marginal. Current versions of these diode-protected pumps seem to be AZX1331 for negative ground and AZX1332 for positive. However SU Burlen only list AZX1307 and AZX1331, both of which are negative ground, and no positive ground version! I've also read that there is an even later version using a bi-directional transient voltage suppressor (TVS) which is like a pair of zener or avalanche diodes end to end which give spike quenching but in either direction of polarity so can be fitted to positive and negative cars. At least one web source quotes the AZX1332 as dual polarity, so the situation is very confusing. Diode protection may well reduce sparking at the points (there was none at all I could see on a pump I have just worked on) but over time they still seem to erode as much as my capacitor protected pump had when it finally stopped working from physical causes. In both cases I was able to reface the points with a sharpening stone, checked the clearances and the 'throw', and were working again and probably good for another 20 years or so.

Update January 2010:

Further information indicates that the AX1331 now contains a blue metal-oxide varistor (MOV) i.e. offers dual polarity quenching, the box is labelled 'dual polarity', however the information sheet inside the box still states "All AZX pumps are polarity concious" i.e. it hasn't been updated since the substitution of the MOV for the previous diode.

There is always much talk about 'pointless' pumps in the MGB communities, i.e. electronics in the shape of a magnet and a Hall-effect transistor or reed switch in place of the points. There are SU versions with an 'EN' (electronic negative) after the earlier part number e.g. AZX1307EN or AZX1331EN, and 'EP' (electronic positive) e.g. AZX1308EP or AZX1332EP for positive. I have no idea what protection there is on these against reverse connection, there could be a diode in series with the 12v supply which would mean the pump would be protected and simply wouldn't work, or there could be no protection which means you could destroy the electronics. There is also a Moprod version of the SU (shown here), 'plug compatible' but plastic bodied and there have been reports of the bodies cracking if the unions are overtightened. The V8 came to me with one of these and although it worked fine for many thousands of miles, it then started 'short stroking' and causing fuel starvation. Even though the electrics end protrudes into the boot space on rubber

bumper cars and I was able to open it up in-situ while the problem was happening one day, I couldn't see what was wrong and nothing I did resolved it, I just had to wait until it decided to start working properly again which it did for several days, then it would happen again. After two or three bouts of this I decided to junk it and replace it with my refurbished roadster points/capacitor pump, and the V8 has been fine ever since. Therefore I would **never** recommend a Moprod pump, and would never countenance fitting an SU electronic to any of my cars. Once the electronics start playing up you are stuffed. With points, like ignition, you can usually sort them out by the roadside (like rapping the pump body with something) and get on your way. Points usually last 30k or more without attention, and usually give you warning rather than complete failure. It's true that they are difficult to access on chrome bumper cars, requiring pump removal, but access for cleaning or replacement is very easy on rubber bumper cars.

There are any number of after-market types, many of which require mangling of the mountings and/or connections to fit. Some of these make a loud chattering all the time regardless of engine requirements, and many output excess pressure that overwhelms the float valves and causes flooding unless a fuel regulator limited to about 2psi is fitted.

Mounting:

Chrome Bumper Rubber Bumper An Alternative Position in Chrome-bumper Cars

Chrome Bumper:

The pump is mounted by the right rear wheel under the car in a not terribly accessible position, particularly the points end in-situ which projects into part of the cage that holds the right-hand battery. It's not very easy to get at the points end either from below, or above if you remove the battery, the rubber bumper arrangement is much better. Having said that when my pump packed up on a run miles from home, and the only space available off the road was in a farm gateway on soft ground, I was able to change the pump with all four wheels still on the car and on the ground as I didn't trust working under the car with it jacked up on the soft ground. I was very lucky, I had an idea how the pump mounted having been interested enough to lie under the car when up on ramps simply looking up to see what was there. I was also lucky in that both unions came undone, and both nuts that attach the pump bracket to studs on the body shell, even the clamp nut and bolt came undone. But the biggest luck of all was that very little fuel ran out when I disconnected the unions. This a UK car with vented fuel filler cap, and the vent is spring-loaded to prevent fuel running-out if the car overturns. This allows a small negative pressure to develop in the tank after running for a while (I have always heard a slight 'gasp' when removing the cap to refuel whilst on a run) and that prevented fuel siphoning out of the tank, the pump being below the top of the fuel in most circumstances. A North American car with sealed filler cap and tank vented via the charcoal canister (or a faulty vented cap on other cars) would not allow such a vacuum to develop and so the supply hose would dribble unless the fuel level in the tank were very low. I was also carrying a new spare, which fitted right in and tightened up with no leaks, and the points weren't oxydised as I had previously tested the pump when I first had it (bought as a spare prior to a long run through France). While changing the pump I noticed the braided flexible hoses were pretty manky, and subsequently changed those in the garage. As the car hadn't been running before I started, and the seal provided by the vent in the cap isn't perfect, the small vacuum from previous running had dissipated, and I had fuel running out all the time I was changing the hoses!

The pump has 12v (white) and earth/ground (black) wires coming out of the rear harness, the 12v attaching to a spade on the electrics end, and the earth to a spade by the unions. The other end of the earth terminates with the reversing light and some number-plate light earths at a number-plate bolt.

Rubber Bumper:

As with the chrome bumper the pump is mounted near the right rear wheel. At first sight it is less accessible than on the chrome bumper as it is mounted quite a bit higher and the unions at least can only be accessed from immediately below, i.e. the car needs to be raised. However being this high it is above the top of the fuel tank, hence above fuel level, which means the unions can be worked on without fuel siphoning out of the tank. But the biggest advantage of the rubber bumper is that the points end protrudes into the boot, making cleaning/replacing/adjusting of these very much easier. A large purpose-moulded grommet (unfortunately NLA new) is pushed into a large hole in the front wall of the boot and the panel edge located in a groove in the grommet. The pump body is pushed into the grommet from under the car, and orientated so that the pump unions are pointing towards the middle of the car. A large worm-clip is fitted around the grommet clamping onto the pump body, which together with the panel edge in the groove of the grommet seals against water entry. Under the car an earth wire comes from the rear harness and attaches to a spade on the pump body near the unions, the other end of which terminates under a number-plate bolt as before. A steel braided fuel supply pipe from the tank connects to the lower pump union, and another feeding the carbs connects to the upper union.

In the boot the 12v supply wire is connected to the pump terminal. A metal box screws to the boot front wall to protect the pump and wiring from damage from heavy objects in the boot.

An Alternative Position in Chrome-bumper Cars by Peter Mayo: *Added November 2011:*
At the start of the long refurbishment of my 1970 GT one of my main objectives was to replace the two ageing 6 volt batteries with a single 12 volt system, this coupled with a new lightweight high torque starter motor would ensure better first time starting and a considerable saving in weight. Removing the old batteries and cleaning the metal frames I then cut and riveted aluminium sheet turning each holder into a box thus preventing the Ingress of water and road dirt, sprayed them both with grey primer and finished with colour match and drilled a new earth point. I looked at the now vacant offside battery box and realised that I could now fulfil a long held idea of re-locating the SU fuel pump from its awkward access under and forward of the offside rear wheel and install it in its new home. First job was to jack up the car and securely support it on axle stands, got to be safe when working under a car.

Removing the wheel to access the fuel tank fitting, I scraped away the dirt and underseal and cleaned the area, don’t want to get bits in the fuel tank. When using a large pair of adjustables to hold the

rectangular block tank fitting and a spanner to undo the nut remember when pulling down on the spanner to push up with the adjustables to reduce the danger of stressing or fracturing the tank. I got the nut loose without any problem or fuel loss and moved the pipe to one side. I intended to wrap and seal the pipe to prevent any sparks when cutting the pipe but it wasn’t necessary as the pipe didn’t have a sealed olive end so a flexible fitted fine.

Mounting the pump on the floor of its new location I used the original cut out in the side of the (ex) battery box as access to route the flexible pipes from tank to pump and from pump to carburettors. The pipe from the carbs to the pump will need the end cutting as it has a fixed olive but it is not a problem and the flex pipe fits straight on after the cut.

When mounting the pump I found the best access was afforded by a diagonal installation, which allow you to get to the points if fitted, the electrics and the banjos.

With the air delivery bottle uppermost and the banjos 45 degrees apart with the banjo feed to the carburettors at the top.

One last job to cut and fit foam insulation to cut out and possible noise. If you have an electronic, no points pump so much the better, it will stay cleaner and access to the flex pipes and electrics are good. Job finished. Battery access panel and rear seat installed. Car started..........................

NO NOISE WHATSOEVER.

Pump Vents: *Added December 2009:*

Originally the MGB pump seems to have had one vent - on the main body by the diaphragm. Subsequently a second vent was provided in the plastic cap on the electrical end. These vents are necessary to prevent the diaphragm pressurising the air space around the solenoid which would tend to restrict the movement of the diaphragm and hence pumping performance. On chrome bumper cars both (where provided) vents are connected by plastic tubing to Tee pieces (similar to screen washer Tees) in the boot - curiously the two tubes and Tees are of different sizes. One of the Tees sits in a hole on the shelf, the other is brought through a different hole and to a position further up to sit in a harness clip. Rubber bumper cars already have the electrical end of the pump inside the boot, so there is only one length of tubing brought into the boot from outside, this time though the vertical wall below the shelf, but again ending in a Tee sitting in the hole. In all case the arms of the Tee are left open. Even though the electrics end of the rubber bumper pump is already in the boot mine still has a short length of tubing under the metal cover, presumably to stop any debris or moisture dropping into the vertical port.

The port in the plastic cap has a little ball in it, which tends to act as a one-way valve. The purpose of this isn't clear, ordinarily as the solenoid operates it would tend to suck air in the body vent and push it out of the cap vent and the one-way valve will allow this. When the solenoid releases ordinarily air would flow the other way, but with the valve closed air from the diaphragm side of the solenoid will be pulled past the solenoid into the cap end. The effect of this is that as the pump repeatedly operates air is pumped through the pump body from the body vent to the cap vent. As air can apparently flow past the solenoid as it releases, presumably it can also flow the other way when it operates, so in theory only the body vent is required to allow air to flow in and out as the diaphragm itself actually moves - presumably what happened in a one-vent pump. Why they went to two isn't known. One could hypothesise that the two-vent pump moves air through the body of the pump so cooling the solenoid and coil. But as the pump is only energised for less than a second once every two or three seconds at most in normal use, it's difficut to imagine the pump getting very warm anyway. Different when you have run out of fuel of course, as the pump then chatters away like billy-oh, and for maybe half a minute or more while the float chamber empty before the engine cuts out.

There is a view that on chrome bumper cars the cap vent can be left without any tubing as air only flows out of it and the valve **should** prevent anything getting in. But as Abingdon saw fit to provide a second length of tubing and Tee from this into the boot it seems perverse to remove it. Even sillier is another view that says you can block off the cap vent with caulk, on the basis that the early pumps didn't have it!

My pointless Moprod (same system as the SU but different packaging) has no identifyable ports at all, so either it vents differently, or maybe they didn't think compressing of the air inside the pump was an issue. It's true my pump started short-stroking, which was why I replaced it, but only after many tens of thousands of miles including very cold and very hot weather, so I don't think that was the cause.

Testing and Diagnosis: *Added December 2009:*
If you have an SU pump then listening for clicking when turning on the ignition but before starting the engine is a perfectly valid test. Depending on how hot the engine was when last switched off it may click just a couple of times (cold) or for several seconds (hot). But if you turn the engine on within a few minutes of turning it off it may not click at all especially when cold. Note that some after-market types chatter all the time, regardless of engine demand.

If it doesn't click at all after having left the ignition off for several hours or overnight then the pump or its electrical supply is probably faulty. If it clicks, then it should stop, and only make a single click once every 30 secs or longer. If it clicks more frequently than that then either the float valves are leaking and it will eventually overflow, which if you have a charcoal canister make take some time to appear on the ground, or the non-return valve in the pump inlet is leaking. If it continues to click rapidly then either you are out of fuel i.e the fuel level is below the pickup strainer, the pickup pipe is perforated above the fuel line, or a float valve or the non-return valve mentioned above are stuck open. If rapid clicking stops and starts while the ignition is on but the engine isn't running that implies either very marginal fuel level or the non-return valve intermittently sticking. Note that some after-market types output excess pressure which will overwhelm the float valves and cause flooding

unless a fuel regulator limited to 2psi is also installed.

If it clicks and stops as it should, then check delivery. Remove a fuel feed pipe from a carb (be aware it will spurt if the ignition has been on recently with SU and Moprod types), direct it into a container, and turn on the ignition. It should deliver **at least** one Imperial pint per minute, in practice closer to two, in a steady stream of pulses with minimal bubbles. Erratic pumping indicates pump or fuel level problems, lost of bubbles a leak on the tank side of the pump plumbing. Note that the delivery requirements apply to after-market types as well.

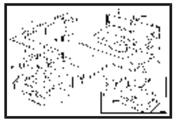
If all that is right then the only other thing running the engine is going to tell you is if there is a very intermittent problem with the pump or its electrical supply that only being operated for a long time may reveal.

Update January 2010: This source details a problem with a nearly new Burlen pump. It seems to have been caused by a misalignment between the moving and fixed contacts such that only one contact pip of the two each side was being used. On the face of it one should work as well as two (in fact much earlier SU pumps did only have one pip each side) except that physical erosion from the rubbing action as the contacts are closed and opened would occur at double the rate. I don't know how good MOV spark suppression is compared to diode (there seems to be no sparking with diode like there is with capacitor quenching) but if there **is** some sparking, and hence burning, maybe that is enough to cause a single contact to fail fairly rapidly. With two even if one burns and so no longer conducts, it will still be subject to the rubbing action while the other contact pair is still working, which would tend to wear any such burning off again.

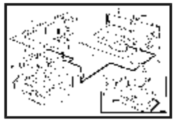
North American Emissions Plumbing

From February 1964 all MGBs had a positive ventilation system drawing in fresh air from the oil filler cap or charcoal canister (not closed-circuit as Clausager states, which involves drawing air in from between the throttle butterfly and the air filter, passing it through the crankcase, then returning it to a port on the inlet manifold i.e. down-stream of the throttle butterfly), passing it through the crankcase to a PCV valve on the inlet manifold i.e. making sure oil fumes were burnt instead of being vented to the atmosphere, replacing the hit-and-miss draft tube and air cleaner hose on earlier cars. In 1968 an air-pump was added to North American models to reduce exhaust emissions. In 1969 the crankcase breathing system on all cars was changed from using the troublesome PCV valve on the inlet manifold to using breather ports on the twin SU carbs. In 1970 (California) and 1971 (rest of North America) emissions plumbing was added to prevent vapours from the float chambers and tank being discharged to the environment, being trapped in a charcoal canister, fresh air being drawn through this to purge it before being passed through the crankcase. In 1973 an anti run-on valve was added to North American cars to deal with problems caused by lower octane fuels and weaker mixtures, and in 1975 the single Zenith/Stromberg replaced the twin SUs, also North American cars only.

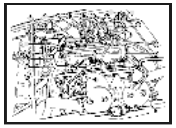
Click on the thumbnail for an enlarged schematic of the plumbing of twin SUs with emissions but without anti-runon



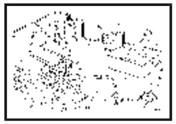
valve. This version prevents fumes from any expansion of air or petrol in the tank or float chamber from entering the atmosphere. The system also scavenges the crankcase burning any oil fumes and preventing condensation as before.



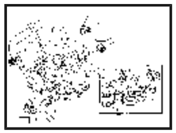
Twin SUs with anti-runon valve. Otherwise as above, the additional of the valve ensures there is no Dieseling when the engine is switched off. The leaner mixtures and lower grade fuels associated with emissions controlled cars made Dieseling more likely.



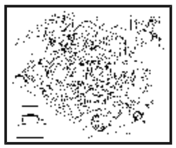
A general overview of the engine compartment plumbing SU carbs.



As above but with Zenith carb replacing twin SUs.



Detail of how the emissions pipes connect to the Zenith.



A general overview of the engine compartment plumbing Zenith carb.

My thanks to Mark Childers and Lawrie Alexander for their help in producing this section.

Removing the emissions plumbing *(Added August 2010)* Many people remove the emissions stuff, but apart from the air pump and gulp valve there is little to be gained by removing the charcoal canister other than space in the engine compartment. If you do, there are a number of things you should do as part of the job:

- Crankcase ventilation - this comes via the charcoal canister to the port on the rocker cover, and must be retained. You could seal the restricted port on the rocker cover and fit an earlier breathing oil filler cap, but that wouldn't be obvious and a non-breathing one could be fitted subsequently which would kill the ventilation. Much better to fit a small filter to the rocker cover port, then it is obvious.
- Tank ventilation - again this must not be sealed, unless a ventilated petrol filler cap is fitted, or you will get fuel starvation. You could just leave the hose open in the engine compartment, but that would emit fumes as the tank was filled and the fuel expanded. Neither should you simply disconnect the breather pipes in

the boot or that will fill with fumes. Probably the best solution is to fit a loop of hose to the tank breather port, going up into the space by the battery and back down again to about axle level.
- Carb float chamber ventilation - this must be left open to atmosphere otherwise the float valves will never rise to stop the pump, and fuel will be pumped straight into the inlet manifold and engine. Neither must the hoses simply be removed and the ports left open, as any fuel venting if (when?) the float valve fails can be poured straight onto a hot exhaust. Instead pipes or hoses must be fitted to take any leakage down past the exhaust to by the bottom of the crossmember by the front left-hand engine mount.
- Inlet manifold ports - none of these must be left open to atmosphere or it will cause a significant vacuum leak. If you are not happy plugging the port itself (which must be done in such a way that the 'plug' can't be sucked into the engine) then replace it with a blanking plug and sealing washer.

Octane Ratings

Briefly 'octane' is a number which indicates the grade or combustibility of petrol. As well as being ignited by a spark e.g. from a spark plug in an engine (which initiates a rapid but steady burn), fuel can also ignite if it is compressed enough which heats it up (which causes a sudden explosion). The octane number indicates how much a particular grade of fuel will resist this compressive explosion - the lower the number the more likely, the higher the number the less likely. A sudden explosion is very bad in a petrol combustion engine, it can cause serious damage to the engine (by contrast a Diesel engine is designed to cope with the sudden explosion which happens when fuel is injected into the hot, compressed air in the cylinder). High compression petrol engines need a high octane fuel, but lower compression engines can run on a lower octane. Higher octane costs more to produce than lower octane and consequently is more expensive at the pumps, but generally delivers more performance when used in an engine that is designed to take advantage of it. Using high octane in an engine designed for low octane gives no performance benefits. However using a low octane fuel in a high compression engine will cause pre-ignition or detonation under load (similar to the sudden explosion referred to above) known as 'pinking' or 'pinging' from the sound it makes, which can damage the engine.

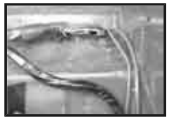
There are various way of measuring and specifying octane: The UK uses RON (Research Octane Number), there is also MON (Motor Octane Number) measured in a different way, and America uses a composite of these two (RON+MON)/2 which is known as PON (Pump Octane Number). Taking just one example 99 RON is 90.75 MON and 94.9 PON.

The MGB was designed to run on '4-star leaded' in the UK which equated at the time to 98 or 99 RON. Now leaded is no longer commonly available (for health reasons, although it still is from some UK specialist garages) unleaded at 95 RON is the universally available fuel in the UK with many (but not all) stations also stocking Super Unleaded at 97 RON. There is also Shell V-Power at 99 RON (replacing Optimax at 98 RON), and Greenergy from some Tesco outlets also at 99 RON. BP Ultimate 102 (102 RON) is available from some outlets but at about 2 to 3 times the price of 95 or 97 octane! Whilst the MGB will run on 95 RON the ignition typically has to be retarded by 3 degrees or so to control pinking, but this reduces the performance of the engine, increases running temperatures, and increases fuel consumption. Some eras of MGB engine seem to be very prone to pinking (my 73 is and I have noticed it on others of a similar vintage), probably due to features of the cylinder head design. Even when 4-star was still available I had problems with pinking if the timing was advanced even slightly from specification. By choice I have always used Optimax when available, have just started using V-Power, but can't say that the change from 98 to 99 has made it any less likely to 'pink'.

Further reading:

Probably all you would want to know about Octane from Thor Racing
'Fuel grading systems' from 'Mad Mole'
'Definition of octane rating' from Wikipedia
See also 'Unleaded' below.

Pump Fusing



I have seen at least three cars where the white wire to the fuel pump has been damaged, if not destroyed, as a result of a short to ground in or near to the pump. You might be lucky and get away with just a slightly damaged but useable loom. Or you might have to run in a new wire to the pump, or you could lose the whole car to a fire. So fusing the pump would seem to be a good idea.

On most (if not all) models the fuel pump wire is in the rear harness that that runs under the floor and connects to the main harness in a mass of connectors by the fusebox on the RH inner wing. It is a simple matter to pull the white wire from the rear harness out of the bullet connector in the main harness, make up an in-line fuse with two short wires terminating in bullets, plug one wire into the existing bullet connector in the main harness, and with a new single bullet connector connect up to the pump wire in the rear harness.

Note that for North American cars with the gearlever manual switch the inertia switch feeds both the fuel pump and the overdrive. There is a double connector, possibly by the junction of the firewall and RH inner wing as before, where there is a white from the inertia switch, a white to the fuel pump, and a white/brown to the overdrive switch. To just fuse the fuel pump insert it in the white wire going to the pump. But while you are at it you could fuse both the fuel pump and the overdrive it you insert it in the white from the inertia switch. If the inertia switch has spade connectors you could insert it here (using male and female spades on the in-line fuse instead of bullets).

Personally I would use a standard 17amp rated/35 amp blow fuse in the circuit simply because there are (or should be!) a couple of spares of that rating in the main fusebox. That rating may seem higher than required for the pump but the purpose of the fuse (like all in the MGB bar certain North American models) is to protect the wiring and that rating is fine.

This arrangement had an unexpected benefit out in my V8 one day when I had a major fuel overflow from one carb, and I really couldn't countenance driving home

with fuel pouring out of the overflow. Then I had the idea of cross-connecting the overdrive and pump fuses so I could use the OD switch to turn the pump on and off! While driving along I'd turn it on for two or three seconds then turn it off again, then continue driving until I felt it start to splutter from fuel starvation, then turn the pump on again for a few seconds and so on.

Running-on

My attempts to control Running-on

The Problem or to save time you can skip straight to
The Solution
An alternative solution
Yet another alternative

The Problem

Running-on, or Dieseling, is characterised as a very rough shuddering and shaking when the ignition is turned off was a progressive issue during the production life of the MGB due to increasingly stringent emissions regulations. It seems to have been more of an issue in North America and the factory fitted an anti-runon valve for that market from 1973, the UK never had one as standard. It should be noted that North American cars can suffer from a completely different kind of running-on which is characterised by completely normal idling for several seconds, as if the ignition hadn't been turned off at all. This is caused by a fault (or faults) in the emissions systems on those cars, see below.

Running-on was always a bit of an issue on my 73 roadster, but livable-with as long as the idle speed wasn't set too high. With the demise of 4-star Leaded I tried LRP (which doesn't give the protection against valve seat recession offered by 4-Star Leaded or Unleaded with a suitable additive) and Super Unleaded (same octane as 4-Star Leaded) with Castrol Valvemaster and neither of these seemed to offer any change in running-on, either better or worse. Standard Unleaded with Castrol Valvemaster Plus gave diabolical running on and pinking on hills and is unusable in my engine.

I decided to fit the MGOC anti-runon valve (note, the MGOC valve has been shown as 'not available' for some time at the time of writing. It does seem to be available from Moss Europe, but very expensive at £58, there may be a much cheaper option). When testing it I was concerned that disconnecting the valve while the engine was running didn't stop the engine, even though I could hear the valve had opened and was dumping copious amounts of air into the manifold, although it did make the engine run faster and roughly. On the road with Super Unleaded and standard Castrol additive it might, just might, have reduced running-on a little, but it certainly didn't eliminate it.

However Super Unleaded is not always available, and with a weeks touring of the Scottish Highlands coming up I bought a bottle of Castrol Valvemaster Plus (valve seat recession protection plus octane booster). Sure enough, I couldn't find any Super Unleaded anywhere we stopped throughout Scotland, so switched to the Plus additive. Immediately the running-on was much, much worse and so was pinking on hills. "Fat lot of good that valve is", I thought, and not cheap at 50 quid. . My initial reaction was to demand my money back, but that would still leave me with the problem.

So whilst touring I pondered some alternatives: Now the North American system uses a 3-port valve as part of the emissions system and when it operates it applies manifold vacuum to the float chamber overflow, which has the effect of sucking the fuel out of the carb jets and instantly stops the engine - a pretty neat piece of lateral thinking, IMHO. Could I get hold of a North American valve? Could I use the MGOC valve to perform the same function as the NA valve? Would I have to rig up a second valve to close off the bottom of the overflow pipes in order to develop enough vacuum to suck the fuel out of the jets? Could I get away with some Gunsons Carbalancer-like ball-valve where the vacuum lifted the ball and blocked off the pipe? Would a fuel overflow do the same thing and negate the purpose of the overflow pipe? Could I pinch the bottom of the pipes a bit and develop enough vacuum that way, whilst still leaving enough of a hole for fuel to escape? Despite so many unknowns I thought it was worth a punt.

I rigged up the MGOC valve as described below. Once fully installed, and after a motorway thrash in warm weather followed by a crawl through some town traffic, I revved the engine to 2500rpm and switched off. You may have some idea what revving the engine above idle **at all** does for Dieseling in a car that suffers from it, let alone 2500 rpm, but in this case the engine just cut and ran down perfectly without a single of Dieseling. For the sake of a fivers-worth of bits and an afternoons work it works better than ever I could have hoped.

August 2001: (sigh) not as successful as I had first hoped. In fact if switched off at idle speed it still runs-on even though it does not if revved - presumably the higher vacuum when decelerating from 2k or so makes the difference. I have had a switch in the petrol pump lead for some time as a primitive immobiliser but have now moved it to the anti-runon valve circuit. Switching this off cause the engine to cut after a second or so, then I turn off the ignition. Makes for an even more effective immobiliser - the car apparently has spark and fuel and even if it starts it cuts out again a second later - most confusing!

November 2001: Shell have launched Optimax at a claimed 98 octane. My first try at half a tank and unboosted Valvemaster (mixed 50/50 with standard unleaded and boosted Valvemaster) immediately reduced running-on to its former level with 4-star leaded, possibly a bit less, my anti-runon valve is still connected as before. I note that the MGOC claim boosted Valvemaster raises octane by two points, which is more than Shell state, and others claiming to be in the know say it is not technically possible to raise it by more than one. MGOC also say that "Optimax is not an option". I query this and they revise it to "not an economical option". Well excuse me but anything that causes the amount of pinking and running-on I was getting with standard unleaded is no

option at all.

July 2002: Determined to solve this I have been thinking of installing the North American anti-runon system. Bought the valve (which are available new from the MGOC, cheaper than their own option too) to see just what it did. Since one of the problems with my current system is that fuel is sucked out of the carb overflows and dumped straight in the inlet manifold, which is why the engine continues to run after a fashion if I activate the valve with the ignition still on and also still Diesels, so I may need the charcoal canister or equivalent as well to stop the fuel getting to the manifold. But then I would need to rearrange the engine breathing so the canister can be purged during normal running which would mean butchering the rocker cover. Where do I stop? Then I suddenly realised that the North American system has a restrictor in the pipe on top of the rocker cover, whereas I'm using full manifold vacuum. Fashion a simple hose clamp as a restrictor as described below and 'lo and behold' it seems to work.

The Solution


I drilled holes near the tops of the overflow pipes and soldered a short length of copper tubing to each to make a T then linked these with two short lengths of 6mm hose and a T-piece, and piped this to the inlet of the MGOC valve. Ran the engine, disconnected the valve but left the ignition on - and the engine instantly died - and this was with the bottom of the overflow pipes open to the atmosphere and not restricted in any way! This intrigued me as to just how little suction was necessary to stop the engine so I removed the hose from the valve and just sucked on it with my Mk.I mouth. I was amazed to find just how little suction I had to apply to stop the engine. It must be sucking the fuel out of the jets since the UK overflow pipes are open to atmosphere so cannot be affecting any other part of the carbs. There also seems to be no chance of sucking fuel up into the new pipes due to the very small volume of fuel in the jets - the level in the float chambers rises by this amount and thereafter you can hear and feel air coming down the jets and bubbling up through the float chamber (could be different if the float valve is stuck open e.g. with grit, though, and is full and overflowing).

More ingenuity required to obtain/fabricate a set of reducers to get down from the 1" or so of the MGOC valve inlet to the 6mm of my new T-piece. The hoses that go between the overflow pipes sit neatly out of sight under the carb flange between air cleaners and the U-brackets they bolt up to, and the hose to the valve comes up from the T-piece, between the carbs, then round the back of the rear carb to the MGOC valve which is screwed to the bulkhead between the heater and the remote servo (LHS of bulkhead).

Amazingly, too much vacuum is developed even with the bottoms of the overflow pipes open to the atmosphere and some fuel is sucked through the valve and dumped into the inlet manifold, which allows the engine to continue to run albeit roughly so I fashion a hose clamp to control the vacuum. I can tighten the clamp so the hose is fully restricted and it disables the anti-runon valve altogether, or I can loosen it so the engine continues to run after the valve is opened. But there is a position in between the two where it cuts out cleanly.

A couple of things to watch out for are to check the outside diameter of your intended hoses fits in the space between air-cleaner and U-brackets without being pinched. Also I found it easy to route the hose to the valve such that it doesn't interfere with either throttle or choke linkages, or reduce access to jets, clamps and adjustment screws by a significant amount.

Several months and thousands of miles down the road there may have been a slight cough on one or two occasions, but other than that it has stopped as clean as a whistle under many different conditions.

An alternative solution *August 2010*

Sometime after installing the above (which incidentally is still working perfectly and has needed no further alterations or adjustments) someone mentioned plumbing the MGOC valve straight into the inlet manifold may be a better solution to being teed into the servo hose, as perhaps it is the restriction of the one-way servo valve that is limiting its effectiveness. I've been pondering this for some time, and wondering how I could mount the valve direct to the inlet manifold.

Recently I happened to notice that the PCV valve used on earlier engines used a short length of hose to attach it to an adapter screwed into the manifold - previously I had thought the valve screwed in directly. The adapters have a large bore, no one-way valve like the servo adapter, and my inlet manifold has a large blanking plug at the front end ... are they the same size? Going against the edict "If it isn't broken don't fix it", and having found the original filter off the end of the valve which wasn't needed in Solution 1 ("If you haven't found a use for something yet you haven't kept it long enough") I splash out six quid or so on adapter 12H1405 and sealing washer. Lo and Behold it screws straight into the manifold in place of the large blanking plug. However it has about twice the thread of the blanking plug, and extends down into the inlet manifold, so I remove nearly half, maybe not necessary but I didn't want to restrict the flow of vacuum. The port for the hose is quite a bit bigger than that on the valve, and I would either need to get larger diameter hose to fit that and then pad out the valve port to fit the hose, or ... do something else.

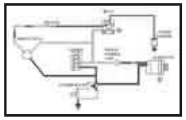
I have some copper pipe that fits really snugly into passage through the adapter, and is a reasonable fit to the valve hose. So I cut off the adapter port, press the copper pipe all the way through the adapter, cut that to the same length as the original port, and solder it in place for sealing as much as anything else. I tap a centre punch into the open end of the copper pipe, which swages it out a little

into a flange to make a snugger fit into the hose. The hose is cut to literally just long enough to push onto the adapter and the valve, i.e. the ends of the two are practically touching. The valve is a tight fit into the hose so doesn't need a clamp, and I have a spring clip which just goes over the hose to clamp it onto the adapter port.

The original 12v wire reaches to the new location, so I just have to extend the earth wire back to the tapping where the valve mounted previously. While trying to remove the valve and it's short length of hose from the Tee in the servo hose I break the spigot off, which is a bummer ("If it isn't broke ...") for if I have to put the valve back in that position again, I'll have to get another tee. In the meantime a bolt with some tape around the threads is a push fit into what's left of the spigot, and more tape round the outside makes a seal against a vacuum leak. Turn the ignition on and off a couple of times to check the electrical connectivity (the valve clicks on and off), and fire it up. Engine starts and runs normally, so probably no vacuum leaks. First test is to turn the valve off with the ignition still on, obviously masses of air rushing into the inlet manifold, and whilst the engine still runs (unlike in solution 1 above) it does so very badly and much worse than it did as originally, so hopefully more effective. A run round the lanes on the first warm and sunny day for a couple of weeks reveals no problems, and switching off no Dieselling. However I'll have to use the car a lot more before I can declare it as effective as solution 1 above, but if it is then it is an easier option for others to try than Solution 1 - The Plumber's Nightmare. *September 2010:* After several short, medium and long runs there is no sign of running-on, so plumbing in directly to the inlet manifold is definitely an option. However it still allows the engine to be started with choke, and run albeit with a weak mixture despite the open port into the inlet manifold, whereas my original solution also acts as a very effective immobiliser, so I will be returning it to that version - when I have replaced the plastic Tee I broke when disconnecting it from the servo hose!

Yet another alternative *November 2010*

Herb Adler wrote to me from Australia about his need for an anti-runon valve to prevent his engine trying to exit the car while the bonnet was still closed. He obtained a couple of vacuum solenoids from a scrapyard (for a sight less than the aftermarket valve that I have, currently £58 from Moss Europe!). However they operate 'the other way round' to the aftermarket valves in that they are normally closed, and have to be powered to open the valve on engine switch-off to apply vacuum to the carbs. Easy enough to use a relay controlled by the ignition with a normally closed contact, but that leaves the solenoid powered all the time the car is unattended which is not good. The factory overcomes this by feeding an earth to the valve from a normally-open oil pressure switch (**not** the same as the normally closed oil pressure warning light switches), so once the engine stops and oil pressure bleeds away the valve releases again. You can retro-fit this of course, but there may be another way. Or two.



Option 1 is for cars with an Accessories position on the ignition switch (1968 (UK) or 1969 (North America) onwards) and uses a relay with a normally closed contact (i.e. it has 87a terminal as well as an 87), operated and released with the ignition. Turning the ignition switch from Run to Accessories will release the relay, and it's normally closed contact will now connect power from the Accessories circuit to the solenoid to open the valve and apply vacuum to the carbs. Turning the ignition switch from Accessories to Off will release the solenoid again. In this case once the ignition switch has been turned fully off both relay and solenoid will be released, so you will have to remember to pause in the Accessories position while the engine comes to a halt. Cars from 71 to 74 have a fused Accessories circuit (green/pink) feeding the heater fan, wipers and electric washers so this can be used to feed the relay contact. Outside those years your own fuse off the white/green would be advisable.

There are a couple of other options that make use of the fact that while the engine is running, and the alternator (or dynamo) is charging, there is 12v on the indicator wire from the alternator or dynamo control box to the ignition warning light, which disappears when the engine has come to a halt. It's theoretically possible to use this via a relay to operate the solenoid when the ignition is first turned off with a running engine, then when the engine stops and the alternator stops charging the solenoid will release again. However on alternators this involves connection to the electronic voltage regulator and I'm not sure how that will be able to stand up to the additional load of the relay or solenoid or the fact that both are inductive and can generate a pulse of high-voltage back-emf which could damage the regulator. Because of that I'm unwilling to give details of how it could be done. However this method could be used safely if you are prepared to delve into electronics a bit deeper and either use an isolation circuit between the indicator wire and the relay or solenoid, or indeed devise a timer circuit to avoid connection to the indicator wire altogether.

Non-Dieseling (normal running) runon in North American cars

This type of running-on is not the shuddering, Dieseling kind but completely normal running as if the ignition had not been turned off at all. Believe it or not this is caused by a failure in the anti-runon valve or emissions plumbing, in conjunction with a design defect in the wiring of the ignition relay. When Abingdon provided the relay on North American cars they did it in such a way that the relay remains operated when the ignition is switched off, which maintains power to the ignition. But the anti-runon system is so good at stopping the engine no-one realised at the time. The problem was caused by (sensibly) moving all the heavy electrical loads to the relay contacts, but they left the ignition warning light connected to the white which goes to the relay winding. When the ignition is turned off current flows from the alternator through the warning light and the relay, which is enough to keep the relay operated. No-one realised this at the time because the anti-runon system cuts the supply of fuel through the carbs instantly stopping combustion. So it is lack of fuel that stops these engines, not lack of sparks. If the valve fails to operate, or any of the emissions hoses develop air leaks or certain of them get blocked the

engine continues to run normally.

Note: If any of the system leading from the charcoal canister to the fuel tank gets blocked the engine will tend to stall from fuel starvation after a short period of running. This is because these systems have a sealed petrol filler cap and the only way fuel can be replaced by air as the fuel level drops is by drawing air via the canister. If this path is blocked a vacuum builds in the tank that eventually overcomes the pumps ability to deliver fuel to the carbs.

When the ignition relay was fitted to UK cars the wiring problem was discovered immediately because these cars don't have the anti-runon valve and emissions plumbing, so cutting the ignition is the only way of stopping these engines. The problem was fixed on these cars by moving the ignition warning light wire from the relay winding to the contact, and normal operation was resumed. However for some reason they also moved the coil feed, heated rear window, turn signals and heater fan from the contact back to the winding, which as well as also stopping the problem rather destroys the reason for installing the relay in the first place! Either change would have done the trick, why they did both I don't know, but moving the warning light on its own would have made far more sense. *Update August 2010:* Apparently the original fix **was** to move just the warning light wire, but subsequently there had been problems with the ignition relays sticking on, which left all the ignition circuits running, flattening the battery, and was obviously a fire risk. So the factory moved the ignition, heater fan, indicators, GT heated rear window and tach back to the ignition switch, but powered via a separate in-line fuse. This still left the washers, wipers, brake lights, reversing lights, fuel and temp gauges, handbrake warning and seat-belt warning circuits powered in the event of the relay sticking on, and some of those at least would still be draining the battery, but it does remove the worst circuits I suppose. However since those 'worst' circuits are also the ones that take the most current, it rather removes the need for a relay in the first place! *end of update*. As far as I know the same correction was never applied to North American cars, which as long as the valve and plumbing remained sound continued to switch off normally. However, with time and distance electrical failures can occur and hoses get clogged or leak, causing this not uncommon failure to switch off, so now read on.

The North American anti-runon valve

Valve Schematic

The North American valve only operates for a very short time as the ignition is switched off. The ignition switch has a special contact that is closed when the ignition is off and open when the ignition is on. This contact has a slate (grey) wire feeding 12v to an in-line fuse. The other side of the fuse has a slate/pink wire going to one side of the valve, and the other side of the valve has a slate/yellow wire going to an oil pressure switch which supplies the ground for the valve. *Update August 2010:* Note this is a special switch with a normally **open** contact that **closes** with oil pressure, it is not the more common type with a normally closed contact that lights an oil pressure warning lamp. If you install the wrong switch the anti-runon system will not function as it should, but more importantly the valve will be energised all the time the ignition is off which may overheat it *end of update*. With the engine running and the ignition on there is no 12v supply to the valve but there is oil pressure so there is a ground going to the valve. As the ignition is switched off 12v is sent to the valve, and as the engine is still running and there is still oil pressure, the oil pressure switch is still supplying a ground to the valve. So the valve operates and cuts off the supply of fuel by applying manifold vacuum to the vent ports of the carb(s) which sucks the fuel out of the jets instantly stopping combustion. When the engine stops and the oil pressure dies away the oil-pressure switch opens, removing the ground from the valve which releases. You may hear a click a couple of seconds after switch-off. So when the car is being driven the valve has a ground but not 12v, and when the car is parked it has 12v but not a ground. When you first start cranking it has neither 12v nor a ground, only during switch-off does it have both 12v and ground. But the valve will only do its job if the emissions plumbing is complete and has no blockages or leaks (see above). The valve can be tested as follows: With the ignition switch off, remove the wire from the oil pressure switch and briefly tap it on and off a good ground. You should hear the valve click as it operates and releases. If it does not, check the in-line fuse, 12v supply from the ignition switch, and continuity of the wiring and valve. *(Corrected 25th August 2003 thanks Patrick Callan of Connecticut.) Update August 2010:* If the valve is clicking OK, then either there is an internal mechanical defect, or there is a leak or blockage in one of the emissions hoses or charcoal canister. If you remove the emissions kit (although there is little benefit in removing anything other than the air-pump and gulp valve, except freeing up some space in the engine compartment) and encounter this running-on problem then the easist fix is to separate the two white/brown wires at the fusebox, find out which one feeds the coil, connect that one to the **white** wire on the ignition relay, and put the other one back on the fusebox.

SU Carbs

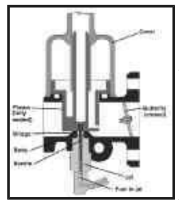
Return Springs, cables and linkages

Done properly, and not fiddled with afterwards, SUs will keep their tune for many thousands of miles. A superb quote that I have seen attributed to Lawrie Alexander of British Sportscar Center is "90% of the problems with SUs are due to Lucas electrics" i.e. the ignition system. Before setting-up the carbs it is essential that the valve clearances, plug gaps, points gap/dwell and timing including operation of the centrifugal and vacuum advance mechanisms are correct and any defects causing erratic or rough running are fixed.

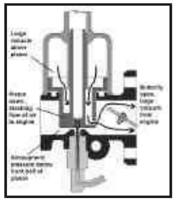
Theory: I'm not going into the theory of carburation in general, just the specifics of the SU, but the job of the carburetor is to feed a mixture of air and atomised fuel into the engine, in appropriate quantities and volumes for the conditions, so as to achieve good combustion and so best performance and economy. These conditions vary

according to how fast the driver wants go, whether the engine is hot or cold, accelerating or steady speed etc. Too much fuel in the air (or too little air for the fuel) - a rich mixture - will result in sluggish performance, fouled plugs, poor economy, and in extreme cases can wash the oil off the cylinder walls causing rapid engine wear. Too little fuel in the air (or too much air for the fuel) - a weak mixture - will cause hesitant running and miss-firing, poor performance, overheating, and paradoxically poor economy just like a rich mixture.

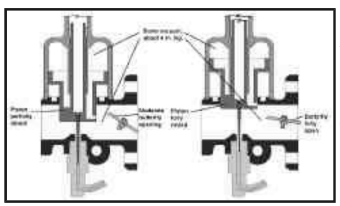
The SU carb is brilliantly simple in its design, with very little to go wrong. However the later HIF (which stands for 'Horizontal Integral Float', by the way) is a bit more complex than the earlier HS, which I *think* stands for 'Horizontal Side float'. Why not HSF then? Who knows? The 'Horizontal' in both cases refers to the direction of air flow into the engine, as opposed to the 'down-draft', or 'semi down-draught' you might see applied to some other designs of carb. Visual identification is simple - on the HIF the float chamber is contained within the main body of the carb and actually surrounds the bottom of the jet whereas on the HS the float chamber is to one side of the main body of the carb and has an external pipe connecting it to the jet. Whilst technically the HIF is an improvement over the HS, for a number of reasons there is no good reason to convert to HIFs if you already have HSs, and if you are converting to SUs from Zenith/Stromberg or an aftermarket conversion and have the choice of HSs or HIFs HSs would be marginally preferable for their simplicity. The diagrams below are of an HS unless otherwise indicated click on a thumbnail for a full-size image in a different window.



Put simply the SU carb consists of a butterfly valve on the engine side of the carb connected to the throttle pedal and this controls the volume of air being pulled through the carb and into the combustion chambers. However there is another independent 'valve' in the air passage, and this is the large piston which is on the air-cleaner side of the carb. The piston is relatively free to rise and fall depending on how much the butterfly is open or closed as will be seen later. Attached to the bottom of the piston is a tapered needle projecting downwards into the open end of a tube (the jet) containing liquid fuel, the height of which is controlled by a float and valve in the float chamber (not shown). With the butterfly mostly closed i.e. at idle the piston will be at the lower end of its travel so it is blocking most of the air passage through the carb. Also the widest part of the needle is in the jet so blocking most of its opening, and therefore little fuel is being mixed with the air, but the ratio of air to fuel (given correct adjustment of the carb) will be correct. With the butterfly fully open the piston will be fully raised allowing the maximum amount of air to flow through the carb, the needle will have its narrowest portion in the end of the jet, so unblocking most of its opening, and the maximum amount of fuel is being mixed with the air, but again the ratio of air to fuel will be correct. Generally this state of affairs will be obtained for any throttle butterfly opening, and hence any vertical position of the piston in the air passage and the needle in the jet. If you look through the carb it is not the same diameter all the way through. Across the top of the jet there is a raised portion the width of the carb - the bridge. This restricts the diameter of the carb throat at that point, which has the effect of speeding the airflow over it and hence over the top of the jet (Bernoulli's Principle). This lowers the air pressure above the jet which is what causes fuel to be drawn up into the airflow to produce the mixture. So as well as the thickness of the needle in the jet controlling how much fuel is drawn up, the speed of the air flowing past the jet is also having the same effect. In steady state conditions although the **volume** of air increases as the butterfly opens and the piston rises, the **speed** of the air across the top of the jet remains much the same. However as the piston rises the narrowing needle allows more fuel to be drawn up from the jet even though the speed of the airflow is much the same. Later on we will see what happens when the speed of the airflow increases for the same needle position in one case, and the size of the jet orifice is increased for a constant volume and speed of airflow in another case.

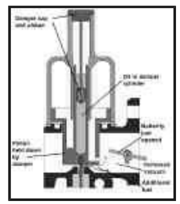


So how does opening the butterfly cause the piston to rise, and the needle with it? With the engine at idle the butterfly is mostly closed and the piston is mostly lowered. But far from 'idling' in the usual sense of the term i.e. doing nothing, the engine is acting like a large vacuum pump due to the action of the pistons in the cylinders. On the engine side of the butterfly i.e. in the inlet manifold there will be quite a large vacuum, which is measured in inches of mercury (in. Hg.), and can be up to 18 or 20 in. Hg. However between the butterfly and the piston there will only be a few in. Hg., and on the air cleaner side of the piston the air will be virtually at atmospheric pressure i.e. 0 in. Hg. Now consider the instant the driver opens the throttle a significant amount, say to accelerate away from traffic lights. The butterfly opens, but with the piston still mostly closed the large vacuum that existed on the engine side of the butterfly is now present between the butterfly and the piston. The piston has a couple of holes on the butterfly side near its base with passages to the space above the piston and its large skirt. Although there is a gap between the edge of the skirt and the inside face of the piston cover it is a very small gap, so virtually all the vacuum is applied to the whole of the upper surface of the piston skirt. Now below the piston skirt, on the butterfly side of the piston, there is also this large vacuum, so this part of the skirt has equal pressure either side of it i.e. there is no tendency for it to rise or fall. But on the air cleaner side of the piston the air below the skirt is at atmospheric pressure i.e. much higher than that above that part of the skirt. The effect of this is to force the piston upwards. This increases the air flow into the engine and raises the needle out of the jet, which increases the fuel flow into the engine, so more mixture in the cylinders, a bigger bang when the plugs fire, and the engine accelerates the car.

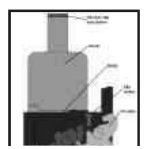


So how does the piston know how far to rise? As the piston rises it 'unblocks' the flow of air into the space between the butterfly and the piston, which reduces the vacuum there and above the piston. This reduces the difference in air pressure above and below the piston, which reduces the force causing it to rise. The piston will continue to rise, and continue to reduce the vacuum above the piston, until it reaches the point where the air pressure both sides of the piston and skirt are largely equal again. It will stabilise at a point where the vacuum between the butterfly and piston, and hence above the piston, are more or less at the same level it was before accelerating. It is this feature that causes this type of carburetor to be called a 'constant depression' or 'constant vacuum' carburetor i.e. no matter how big the throttle opening is under steady state conditions the vacuum between butterfly and piston will always be much the same. If you manually raise the piston further

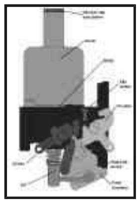
than it wants to go, the vacuum between the piston and the butterfly and above the skirt reduces, and when released the piston will fall back to its previous level. Similarly if the piston is manually pushed down the vacuum between piston and butterfly and above the skirt increases trying to pull it back up again, and when released the piston will rise back to its former level, and the amount of vacuum between butterfly and piston will be maintained. That is generally the case, but in practise there is a physically large but quite weak coil spring between the top of the piston and the outer cover pressing down on the piston and so restricting its rise somewhat. This is another feature to ensure the correct balance of air to fuel across the range of throttle opening, and means that a progressively larger vacuum is required the higher the piston rises. However the difference in vacuum between idle and full throttle piston heights is relatively small compared to the up to 20 in. Hg or so available in the inlet manifold. The spring strength, carb throat diameter, needle shape and jet size are all chosen to give the correct mixture across the operating range of the carb in that particular application. For a larger or smaller engine, single or multiple carbs, with or without supercharger, etc. the carb throat size, needle shape, jet size, spring strength etc. will all be chosen to give the correct results for that application. You can't just bolt on a bigger carb without doing anything else and expect your car to go faster, indeed it will probably perform worse. Likewise if you make changes to engine capacity, breathing, valve timing etc. you probably won't get the best out of them unless you change the carb parameters as well. What changes to make under what circumstances is a huge subject.



That is basically it. However whenever the throttle is suddenly opened the volume of air passing through the carb is able to increase faster than the volume of fuel can increase coming out of the jet. This has the effect of weakening the mixture, which causes the engine stumble when accelerating. To counteract this on top of the large piston there is a cylinder filled with oil - the damper cylinder. Attached to the outer cover there is a small damper piston sitting in this oil. As the large piston tries to rise the damper cylinder also rises, and because the damper piston is fixed this has the effect of forcing the damper piston further into the cylinder. As the lower end of the cylinder is sealed, and oil is not compressible, the only way the large piston can rise is for oil to be forced past the damper piston. The dimensions of both damper cylinder and damper piston are carefully set to that the oil flows past at a known rate, and hence controls the rise or the large piston. This damps or slows down the rise of the large piston, so that for a short time (a couple of seconds or so) the increased vacuum between butterfly and large piston causes the air flow across the top of the jet to increase in speed, which sucks more fuel out of the jet relative to the **volume** of air that is flowing even though the needle hasn't yet moved, so enrichening the mixture to avoid the stumble. But when the throttle butterfly is closed there is no such need to control the movement of the large piston, so the damper piston is designed to be ineffective when the large piston is falling, so it falls immediately.



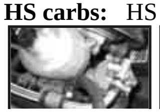
Another occasion when the ratio of air to fuel has to be altered from the norm is on starting from cold. When everything is cold the fuel doesn't atomise as well and so doesn't combust as well inside the engine, so again you get the effects of a weak mixture and indeed the engine may not start at all. To counteract this we have a choke. Well, it is called a choke but that is a hangover from earlier carbs where the air flow through the carb throat was manually restricted or 'choked' as a way of richening the mixture. In both types of SU carb it is done by increasing the amount of fuel for a given amount of air (rather than reducing the amount of air for a given amount of fuel as in the other design of carb) and so is an enrichment device rather than a choke. But no matter, 'choke' is the generic term, so that is what we shall use. The HS and HIF types differ in how they enrich. The HS has a very simple mechanism for lowering the jet relative to the needle, so increasing the size of the outlet, which allows a given speed of air passing over the end of the jet to draw out a greater quantity of fuel, so enriching the mixture. In the HIF there is a separate valve which opens and adds more fuel to the air stream via separate passages in the carb body. Both types allow the amount of enrichment to be continuously varied i.e. they are not a simple on/off switch. As mentioned before a mixture that is too rich causes a number of problems so you should endeavour to have the minimum amount of enrichment for smooth running. In practice every car is different and you will have to learn how much yours needs under various conditions. As well as varying from car to car it also various according to the ambient temperature and how long the engine has been switched off. Even though the temperature gauge may show fully cold if the engine has only been off for a couple of hours, as opposed to overnight, it may restart with no choke or only minimal choke, you will have to learn. For example my roadster needs full choke to start from fully cold then immediately pushed in about half-way, then gradually pushed in further as the engine warms up. By contrast the V8 needs full choke to start and for the first few seconds, then gradually pushing back in as the engine warms. Also it is better to drive off immediately after starting and not let the engine warm through idling, unless you have to defrost windows etc.



Another feature of the choke control on the MGB is that when correctly adjusted the first 1/4" of movement actually only increases the idle speed - the fast idle - and doesn't enrich the mixture. This is very useful if you are scraping frost, once it will idle at that amount of choke, even though you may have to add more choke once you drive off. In both carbs the choke control turns a 'snail' or tapered cam which is sitting under the fast idle adjustment screw. As the cam is turned its effective diameter under the screw increases and gradually lifts the screw, which opens the butterfly a little more than the normal idle setting. Again the amount of choke to fast-idle is a matter of balance - too much fast idle will cause the engine to race before you have enriched the mixture sufficiently for slow running, which makes for difficult slow running in traffic. Insufficient fast idle may cause the engine to tend to stall even though the mixture is enriched, so you apply more choke until the idle speed is suitable, by which time the engine is over-choked causing the aforementioned problems of plug fouling and oil dilution.

Ports: There is often confusion about which hose goes on which port of SUs. If you get the inlet and vent hoses reversed for example, the carb will flood petrol out of one of the ports and/or the jet.

HS carbs: HS carbs are a mirror image of each other, each with its own fuel

inlet and vent/overflow ports. The main fuel feed pipe has a T-piece which feeds the rear carb from a side tapping, the straight-through tapping

feeding the front carb. From October 1969 and the 18GG/GH/GJ/GK engines the carbs also had a crankcase ventilation port which removed the need for a separate PCV valve. These are joined together by a Y-piece and connected to the front tappet chest cover port. Click on the thumbnails to see which port is which but basically the fuel inlet ports point straight across the car to the rocker cover, and the vent/overflow ports are the same size pointing straight across the car in the opposite direction i.e. to the left-hand wing. The ventilation ports are larger and point diagonally upwards, towards the front of the car on the front carb and the rear of the car on the rear carb.

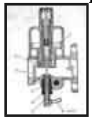
The vent/overflow ports are connected with a short length of rubber hose to two individual steel pipes which carry any overflow safely down past the exhaust. Bee came to me with them just dangling, so I looked closely at a concourse winner of the same year (and colour!) which had them retained by one of the rear engine mount to chassis bracket bolts, so that is how I fixed Bee's. However this means that as the engine rocks the carb end of the pipes moves up and down, but the clipped part stays still, which stresses the short piece of rubber hose connecting them to the carbs. Subsequent research has shown that these run side-by-side behind the engine mount, and are attached with a clip to a bracket (AHH7382, NLA). It looks like this bracket mounted to the side of the block, with a stud, washers and nut for 18G and GA without the aperture for the mechanical fuel pump, and under one of the bolts used for the mechanical fuel pump blanking plate on 18GB and later engines. Early cars needed the bracket to clear the non-positive crankcase ventilation hose that was secured to the rear-most tapped hole for the mechanical fuel pump, but as that was deleted in Feb 64 it would seem that the vent/overflow clip could have been secured direct to the same point from then on, as was the case with rubber bumper cars, but this bracket seems to have been used as long as HS carbs were used, i.e. until the introduction of the 18V engine in 1971 for export cars, and until November 1973 for UK cars.

HIF carbs: HIF carbs are **mostly** a mirror image of each other, except for the

fuel feed arrangements. The fuel feed pipe connects to the front (4-cylinder) or left-hand (V8) carb only, which as well as feeding the float valve in that carb goes straight through the carb body to an 'outlet' port on the other side. A short (very short in the case of the V8) length of rubber hose goes straight across from that port on the front/left-hand carb to a mirror-image inlet port on the rear/right-hand carb. There is a matching outlet drilling on the other side of the rear/right-hand carb, presumably for triple carb setups, but it is plugged on MGB carbs. The crankcase ventilation ports are connected individually via a flame/oil traps to the associated rocker cover. Click on the thumbnails for details of which port is which, but basically the fuel inlet and outlet ports are at the back of the carbs pointing straight across the car, with the inlet on the left-hand carb immediately above its mixture screw, and the blanked-off outlet port of the right-hand carb the same. The vent/overflow ports are immediately in front of those, also pointing straight across the car, and the same size as the fuel inlet/outlet ports. The crankcase ventilation ports are in front of those, are larger, and pointing diagonally upwards as well as across the car. On 4-cylinder chrome bumper cars the vent/overflow ports and crankcase ventilation ports are plumbed similar to HS carbs, but the former are held by a retaining clip bolted to a stud on the engine restraint bracket. On 4-cylinder rubber bumper cars the pipes are clipped to one of the studs for the mechanical fuel pump blanking plate on the block. The V8 has hoses from the vent/overflow ports going being the carbs to a T-piece behind the right-hand carb, then a single down-pipe clipped to a bolt on the bell-housing.

NEW **Damper Oil-level** *December 2011* Some confusion over this, and the manuals



don't help. HS drawings show the oil level being **below** the top of the oil reservoir, whereas HIF drawings in the same manuals show it **above**. I have seen a claim that it has to be above so the outside of the reservoir is lubricated where it moves up and down again against the cover, but if HSs didn't need it why do HIFs? If you **do** try to keep it above, then you will be continually topping-up, and some people do say they have to keep topping-up. I have maintained my HIFs below, the same as my HSs, for around 90k with no ill-effects so far. All I do is unscrew the plastic cap, lift it up, and press it down again. If I can feel the resistance of the oil before the plastic cap reaches the cover, then I have enough, and the distance before tells me how much 'reserve' I have left. I don't have to top up from one year's end to the next. The oil only needs to reach the **bottom** of the damper piston in the oil reservoir to do its job, not the top, so to maintain it much above that is overkill.

There is currently a long thread on a BBS about plugs oiling, and oil pooling on top of pistons, and after many posts the person who started it all said he has just noticed that there is oil in the throat of the carbs, while they have been sitting on the bench, and wondering whether it could be from the carb damper, saying he did top up the dampers recently. At the moment we don't know to what level he filled them, and if they are HSs or HIFs, but there is another possible cause of **complete** draining of the oil from an HIF, rather than just what is above the top of the reservoir. And that is that while the reservoir on HSs seems to be blind-drilled, that on HIFs seems to be through-drilled, then plugged. If the plug is faulty or gets dislodged somehow, then that carb could drain completely.

Setting-up: Note that in the UK MGBs first registered before 1st August 1975 the emissions test simply comprises a visual inspection for excessive smoke. Cars first registered on or after 1st August 1975 will fail if they emit more than 4.5%CO or more 1200ppm hydrocarbons. But note that if it can be shown the car is fitted with an earlier engine it only has to pass the visual test.

The basic requirement for good twin SU set-up is that the carbs should be matched - and that means matching springs, needles, jets, air flow and mixture. Springs, needles and jets should always be replaced in pairs. If you have non-standard parts in the inlet/combustion/exhaust area you may benefit from a different needle to standard, see SU Needles. While the earlier metal floats can be adjusted to give the same fuel height in the float bowl, it looks like the later plastic ones cannot easily be, except by placing washers between the needle valve and the housing. (The float height on HSs is supposed to be such that, with the float chamber lid upside down, the float should just rest on a 1/8" to 3/16" round bar placed across the middle of the lid parallel to the

hinge pin). These notes assume that the jet is already centred and the needle correctly installed.

Tip: The float valve can sometimes stick in the closed position, particularly if the car is not used for some time. Running the engine will empty that float chamber which will cause poor idle and running. Rapping the top of the (HS) float chamber with the handle of a screwdriver can often free the valve.

Tip: The opposite effect is dirt in the float valve that stops it closing when the float chamber is full and it overflows. Disconnect the fuel pump and run the engine until the float chambers empty and the engine stops. Reconnect the fuel pump and the resulting rush of fuel into the float chambers will usually clear the dirt away. If it happens again immediately either the float could be punctured and full of fuel so it doesn't float, or the valve could be worn. If it happens frequently change the in-line filter (if fitted) or investigate the causes of dirty fuel e.g. internally corroded fuel tank. Check the float height after replacing the float valve, or float.

Tip: Many HIFs, and possibly some SUs, have a 'poppet valve' in the butterfly which opens under conditions of high manifold vacuum i.e. the overrun. This was an emissions measure which simulates opening the throttle slightly until the manifold vacuum drops closer to its normal value at idle. This valve can stick open and cause a high idle, sometimes only during certain circumstances e.g. warming up and be OK the rest of the time. One of my V8 carbs was doing this so I soldered them shut, which needs minimal dismantling to perform. Some recommend replacing the butterfly with the solid item, which has the same effect plus removes a small obstruction from the throat of the carb, but needs much more dismantling and it can be fiddly to get the new butterfly to seat properly in the throat, which leads me onto my next tip.

Tip: A high idle that cannot be brought down to normal by use of the fast idle screws is **not** being caused by a vacuum leak. A vacuum leak only lets in air, whereas the engine needs fuel to run. Therefore, if the engine is still running when the idle screws are backed right off, there is some other problem causing one or both butterflies to be partially open. This could be one or more of the following:

- Maladjusted fast idle screws holding the butterfly open, see below for correct adjustment.
- No slack in the throttle cable i.e. the throttle pedal stop is causing the cable to hold the butterflies open. There should be 20 thou free play between the finger on the throttle interconnecting spindle and the choke spindle.
- Maladjusted throttle interconnecting clamps and spindle - one carb fully closed is holding the other one slightly open. Go through the full set-up sequence below.
- Butterfly poppet not seating - solder it closed or fit a plain butterfly.
- Butterfly not seating properly - check the carb throat seat is clean and reseat the butterfly.

I repeat: With both idle screws fully backed off both butterflies should be fully closed, and this is more than enough to cause the engine to stall.

The main adjustments - the detailed info relates to the HS but the principles apply equally to the HIF:

- Remove the air filters slacken the throttle and choke bar clamps, two on each bar, and back off the fast idle screws that bear on the choke cams.
- Screw each jet up until it is flush with the bridge, then screw it down 12 flats (two turns) to give the basic start-point for the mixture.
- Start and run the engine up to temperature, adjust the idle screws to give a reasonable idle speed.
- Using a tube to listen to the hiss in each intake, or by using a balance meter such as Gunsons, independently adjust each idle speed screw so you get the same hiss or meter indication in both carbs while still retaining a reasonable idle speed.
- On each carb in turn adjust the jet height to give the correct mixture for your spec. For non-emissions HSs this is checked with the piston lifting pin which, when lifted 1/32", should cause the engine speed to momentarily increase then settle back down. If the speed stays up the mixture is too rich, if the engine speed immediately falls the mixture is too weak. Each carb should be adjusted independently so that it gives the correct, and more importantly the same, results. After adjusting each carb the other should be rechecked as they are interdependent. NB: Emissions controlled cars have various CO readings, but this method should not be used until the carbs are balanced for air flow and mixture, and then only by adjusting both carbs by the same amount in the same direction.
- Recheck the air balance again, adjusting idle screws independently as before if required.
- The throttle spindle clamps should be set such that there is a small amount of free play in the throttle cable and interconnecting spindle before the butterflies start to open. There is a lever on the throttle spindle that rests on the underside (HS, above on HIF) of the choke spindle when the throttle is closed. Insert a .012" feeler gauge between the lever and the choke spindle, lightly press down on the part of the clamp that engages with the throttle cam and tighten each nut. Check afterwards to ensure that the slight play described above exists, and also that there is about 1/32" end-float on the interconnecting spindle.
- Run the engine at 1500 rpm and check that the air balance is still correct. If it is not the throttle spindle clamp(s) will have to be readjusted. Persevere with this, it is important to get both air balance and clearances right. If you find this difficult to set your throttle spindles/bushes may be worn i.e. can be waggled up and down or from side to side.
- The choke operates in two phases - opening the throttle slightly first (fast idle), then enrichening the mixture. Make sure the choke cable is routed such that it has a clear run when the choke knob is out, otherwise stiff operation can result. Also check that when the choke knob is half way out the operating lever clamped to the choke spindle makes an angle of 90 degrees with the cable, again to avoid stiff operation. The choke cable clamp screw should be adjusted such that the choke knob can be pulled out 1/4" before the jets start to move i.e. before richening occurs. See here for how the chrome bumper 4-cylinder choke cable attaches at the carb end, it is unusual in that it has a fixed inner and moving outer.
- Tighten the choke clamp screws such that both jets start to move at the same time as the choke is operated i.e. after the fast idle movement has taken place.
- Independently adjust the fast idle screws such that as the choke is operated both

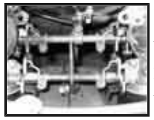
throttle butterflies start to open at the same time, and gives the correct fast idle speed (e.g. 1000rpm when the engine is hot) when the choke knob is in its 'fast idle' position.
- Adjust the idle screws **by the same amount and in the same direction** to obtain the required idle speed.
- The throttle pedal should reach the stop on the floor just as the butterflies reach fully open - the butterflies and cable should not act as the throttle stop. Adjust this with the cable clamp on the throttle spindle. Take up any free play in the throttle pedal with the bolt located near the pedal hinge, but not so much that it moves the throttle spindle off its stop (the underside of the choke spindle).
- Check the oil-level in the piston damper. The most sensible way to do this is to unscrew the damper cap lift it up, and press it down again. If you feel the resistance of the oil before the damper cap reaches the dashpot cover you have enough oil. If you try and maintain the oil level at the recommended top-up position of 1/2" above the top of the hollow rod you will be forever topping up which will wear out the damper cap threads and the damper cap will shoot up out of the dashpot cover under hard acceleration. The correct top-up oil is engine oil of whatever grade is correct for your local climatic conditions, e.g. 20W/50 for temperate climates. When you do have to top it up there is no point in filling it to above the top of the hollow rod as any oil above this point is rapidly drawn into the engine, hence the frequent topping-up if you try and maintain it at this level.

Important: Once the carbs are correctly set up only ever make further adjustments to both carbs by the same amount and in the same direction. Once you start adjusting the carbs independently you will have to go through the above set up to get them balanced again.

See also Tuning with a Vacuum Gauge from . The faulting techniques are perfectly valid but IMHO when setting-up carbs the way the engine idle speed alters tells you just as much as the vacuum gauge. Although the author of this page implies that they also use the vacuum gauge to adjust timing, they don't say how they do it! See also http://www.iwemalpg.com/Vacuum_gauge.htm which has information on using a vacuum gauge for fault diagnosis.

Return Springs, cables and linkages: There has been a lot of discussion recently as to how many return springs were fitted to the SU carbs, and in particular whether the choke has one. The Parts Catalogue up to September 1976 for car numbers 101 to 332032 lists one 'Spring-cable return' in the list of parts for the choke and two 'Spring-return' in the list of parts for the throttle i.e. three springs in total. For car number 332033 on it lists one 'Spring-choke return' and two 'Spring-throttle return' i.e. again three springs in total. The September 76 on Parts catalogue for non-North American cars lists **three** 'Spring-throttle return' and one 'Spring-choke return' i.e. **four** in total. The fourth spring on the throttle cable itself was only added for the 77 model year and on, maybe there had been complaints of sticking throttles. In all cases Part Number AEC 2075 is quoted, and they are in addition to the return springs fitted over the actual carb spindles.

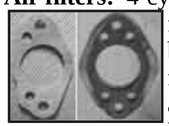
For completeness both Catalogues show one 'Spring-throttle return' with the Zenith carb, the 76-on catalogue also lists one 'Spring-throttle return' with the **pedal** parts but the earlier Catalogue doesn't.



Mine (HSs) originally had four springs the fourth one being on the throttle cable. But this is hooked over the pin of the cable clamp and not inserted into a specific mounting point, as is the case for the other three springs. The attachment points on the heat shield may give some clue the Parts Catalogue for up to September 76 shows it with three tags sticking out with holes in (confirmed by various owners) which also goes to support three springs, but my 73 UK roadster with 48G Gold Seal engine heat shield only has one tag, and four holes on the bottom edge making five potential attachment points in all! However two of them are not holes but slots, so it is possible these have been added later with a hacksaw rather than a drill, which could reduce the original holes to three. But having said that, the slots are actually more logical places to attach the two throttle springs as they have a better alignment. The Parts Catalogue for September 76 on shows four tags, although whilst three are of the same size and look in about the right positions for springs on the linkages the fourth is larger and right off the rear so maybe for something else entirely. My throttle has always tended to be a bit jerky on small movements, lubricating the old cable and even replacing with a complete new inner and outer making no difference. I have temporarily disconnected the fourth spring and on a short drive it does seem to be smoother. The pedal return pressure doesn't seem to have been lightened to any significant degree, so hopefully there will be no increased risk of sticking. Time will tell.

However on a friends UK 78 (HIF) whilst there are holes on the choke quadrants and the throttle lever for 3 springs I can't see anywhere to hook a spring on either of the throttle cams. Neither is there a hole in the choke lever for a spring. There is only one hole either side in the flange on the heat-shield, assuming these are for the choke springs that leaves nowhere for throttle cam springs. However there are two holes and one tab with a hole in the centre, which suggests two of those could be for the throttle and choke levers as on HSs, leaving the two outer holes for throttle cam springs again as on the HSs, but as I say nowhere obvious on the cams to attach them. Confusing.

Air filters: 4-cylinder cars have a gasket between the air-filter box and the carb



flange. All the ones I have seen have been handed in that they must be fitted to the right way up so as the auxiliary holes in the two flanges are clear (holes uppermost), and not blocked which apparently affect carb operation. This is frequently mentioned as a likely cause of carb problems. While doing the clutch change on a friend's 78 I found these gaskets, which have holes in both upper and lower positions, and so cannot be fitted the wrong way round. However! You still have to fit the base-plate for the air-cleaner the right way round or the holes will be blocked whichever gasket you use or how you install it! It wasn't obvious from the running of the car that they were blocked, but Keith's car failed it's emissions test this year having passed just a year earlier, done very little mileage since, no changes other than a new choke cable (which **was** fully releasing the choke) even during the clutch change apart from having the air-filters removed. When I went to setup the carbs for air-balance and mixture I found the filter bases upside down, hence the auxiliary ports were blocked.

In the end the balance and mixture were just about spot-on, only the balance under choke was out, which wouldn't have affected the emissions test anyway, so I can only assume I put the filters on the wrong carbs hence the bases upside down, and that was enough to affect the reading. Putting the air-filters the right way round (and hence fitting the bases the right-way round) and a precautionary weakening of the mixture by just 1/8th turn to show 3.8% on my Gastester passed the retest at almost the same figure.

Originally the air-filter cans were clearly handed and as long as you kept them, the bases, bolts and gaskets together as two assemblies you are unlikely to get them on the wrong carbs. But at some point they seem to have been modified so the cans are identical, so if you keep them together but mixed up and fit them to the wrong carbs you **will** get the bases upside down. The Parts Catalogue shows different part numbers for the front and rear cans for all years, but you can definitely fit the later ones on the wrong carbs and it isn't immediately obvious. Originally common to all markets they changed for the 72 model year (from straight intakes to curved?) to three different sets for UK, North America, and the rest of the world (export cars changed to HIF the previous year so it wasn't to do with that). UK changed to use the 'rest of the world' set in November 73 with the 18V 779/780 engines and all twin carb engines had those to the end.

Tank *Added August 2009*

Originally wedge-shaped with flat top, curved bottom and rounded off front and rear, with separate end-plates, 10 Imperial gallons capacity, attached to the body with longitudinal straps under the tank. In March 65 it was replaced with a bowl-like pressing with separate top of increased capacity of 12.7 Imperial gallons, attached to the boot floor with a series of studs and bolts and nuts around the top edge flange. Both types had separate fuel outlet and sender ports on the right-hand side, a vented fuel filler cap (until Oct 69 for North America), and a drain plug until Jan 74.

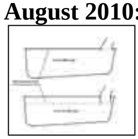
To prevent fuel and fumes leakage from Oct 69 cars for North America had tanks with an internal expansion chamber, an additional breather port at the top connected via a separation chamber to a charcoal canister in the engine compartment, and a non-vented fuel filler cap. The internal expansion chamber is a can with no bottom and a bleed valve at the top leading into the main tank. When pumping fuel air can only escape from the expansion chamber very slowly, so the fuel level inside is initially much lower than in the rest of the tank even if the tank is filled right to the very top of the filler. Over time air bleeds out of the expansion chamber slowly so the fuel level in it rises, lowering the fuel level in the main tank, so that even with heat expansion there should be no chance of the fuel overflowing out of the filler. This reduces the usable capacity back down to 10 Imperial gallons. With a sealed fuel filler cap any expansion that does occur expels air (and petrol vapours) from the breather port, through the separation tank and into the charcoal filter which traps the fumes, subsequently drawn off and burnt via the crankcase breather system.

From 1975 North American cars had exhaust catalysts and so were restricted to unleaded fuel, which necessitated a reduced diameter filler pipe with different filler cap to suit, and an 'UNLEADED ONLY' label adjacent, and on the fuel gauge.

In August 76 all cars had a modified tank with combined sender and fuel feed port. In late 77 California required a modified filler tube and connection, which was soon commonised on all cars.


It's often asked whether tanks were internally baffled to prevent fuel sloshing about or not. With my 73 and 75 cars even through the fuel gauge is very slow-acting it doesn't take much of a curve for the gauge to rise on left-handers and fall on right-handers. On the earlier Jaeger 'fast-acting' gauges this would have meant the needle swinging from side to side all the time, and is something I remember from my Mini days in the 60s. Certainly on the 'cut-away' GT at Gaydon the tank **is** baffled, as can be seen here, into three compartments, although the interconnecting holes seem to be much larger than would be required to allow unrestricted tank filling. It can also be seen that the pick-up has a cylindrical strainer about in the centre of the tank, which will reduce the chances of fuel starvation in bends with low fuel levels. The strainer is a vertical cylinder a couple of inches tall, so as soon as the fuel level drops below the **top** it will start sucking in air and spluttering to a halt will shortly follow as the carb float chambers empty as well, with the pump chattering away ten to the dozen in the meantime. This cut-away was produced for the 1969 Turin motor show, so presumably factory tanks were still baffled at that point, i.e. long after slow-acting gauges had been provided. Many people claim their tanks aren't baffled, but this only has any value if one can be sure that they are original tanks, and who can be that anything from 30-40 years later? I had to change the roadster tank early on in my ownership, but by that time I hadn't really got started on esoteric questions such as this so I didn't look in either old or new tanks, nor on the two occasions I've had to replace senders on each car!

August 2010: A couple of issues recently.



Someone in the USA reported that their new tank takes several minutes of trickling the fuel to get the last gallon or so in, reiterated this month by Morris Wadds. This is not the effect of the anti-overfill device inside American tanks but the filler tube extending down into the tank an inch or more, which is effectively (unless you are very patient) reducing the capacity still more. The effect of this extended filler tube is to trap a significant amount of air at the top of the tank, whereas you should be able to fill to the top (which the American anti-overfill device would slowly reduce after filling). It's only because it was an American tank with the sealed filler cap and the expension vent going to the charcoal cylinder that they **were** able to trickle this last gallon in, UK tanks wouldn't be able to. This is a known problem with Canadian-manufactured tanks, which Moss in the US at least are selling. Moss are looking into it (ho ho), but they may also be available suppied by other vendors. When buying a new tank compare the internal length of the filler tube with its external length to the top of the tank, and if the former is more than 1/4" longer than the latter then reject it. If you already have one, or are desperate, then you may be able to overcome the problem by cutting two slots up from the bottom of the filler tube inside the tank **but stopping short of where it is welded to the top surface of the tank** and bending the resulting tab into the tank to allow trapped air to escape while filling to the top of the tank.

This will however create swarf inside the tank, which should be swilled out as far as possible.

The second issue relates to cleaning and sealing the inside of the tank, for example to stop rust particles affecting the pump and carbs and further rusting perforating the tank. Sounds like a good idea, but there have been a couple of instances where this has blocked the pickup. One chap recently then spent a lot of time disconnecting the pipe from the tank outlet to poke a wire down but he couldn't get it round the angle of the outlet connector. He then drilled through the side of the connector in an attempt to get a wire down the pipe, but it went so far and stopped without clearing the blockage. He then cut the connector off the tank in an attempt to get the pickup tube and strainer out of the tank to clear it, but failed in that as well as the strainer is retained by a strap on the bottom of the tank as can be seen above. After all that time and effort he had to shell out for a new tank, when the old one would have been perfectly serviceable for years! Even if it didn't block the pickup the sealant could block the bleed vent of the anti-overfill chamber which will cause completely filled tanks to overflow on heat expansion, but because of the sealed filler cap this expansion will go through the vent to the charcoal canister and leak onto the ground. And if that vent has been blocked by the sealant, then it will escape via the pump overwhelming the carb float valves and flooding them. Even without heat expansion with the external vent blocked there will be no route for air to replace fuel as it is used, and you will suffer fuel starvation. Note that the 77 and later tanks with the combined sender and pickup can have this removed for sealing, but you could still end up with a blocked bleed vent in the anti-overfill chamber and a blocked external vent. You could continually blow air through the external vent to keep it clear while the sealant hardens, but there is no way of keeping the bleed vent in the anti-overfill chamber clear. UK 77 and later tanks can be sealed with impunity, once the sender and pickup have ben removed, although again earlier tanks might get away with blowing air through the **pickup** tube until the sealant has hardened.

Throttle Cable

Just intending to put Bee back in the remote garage and bring Vee back to the house, I was suddenly reminded that I had been intending to look at the throttle cable for a while - like 15 years - as it was a bit sticky and jerky especially in the lower gears, so much so I've always slipped the clutch for small pedal movements in low gears/low speeds. Got the inner out to find a broken outer strand - ah ha! Thinking one wouldn't make much difference I started peeling it off only to discover the cable kinked a couple of inches from the pedal end to reveal another broken outer strand plus one or two inner strands. Oh well, have to replace it now and in fact it is a wonder it hasn't broken already, but had to put it back to get the car back in the garage, up the slope of the drive. By now I had found that the pedal end of the outer had become dislodged, because although it was wedged in the guide, the flanges had been broken off the guide so it, and hence the cable, was floating about in the cavity in the inner wing. As the inner was damaged where it passed through the body it could well have been caused by the broken guide, so now I need one of those as well. But how to get the bits of the broken flange out which were still screwed to the body inside the cavity? I removed the pedal cover which gave me just enough room to get a Posidrive bit and a selection of 1/2" and 1/4" socket extensions and a UJ to undo the screws, which fortunately were under a layer of old grease or Waxoyl and not corroded. The cable should be easy to source but what about the guide? And if and when I do find one it's going to be fun getting the screws started without cross-threading them.

Got both cable and guide very quickly from Sussex Classics, plus new screws for the pedal box as I had three odd ones (they supplied five but there are only four holes), and bottom and cover seals for good measure as I intended to repaint the cover. The guide had a bit of flashing in the cable and screw holes but a moments work with a needle file soon removed that. With the pedal box cover removed again I found I could start the guide screws by hand (slim hands wedged behind the pedal support frame and in the access hole for the 'trumpet'), much easier than I had anticipated. I had screwed them up from the inside of the cabin first to make sure the threads were good and clear. Once started I used the same combination of bit, extensions and UJ to tighten them. Lubricated the new cable by gripping the outer gently in the bench vice, then fed the inner in slowly while I daubed Copper Grease on it, dragging it in to the outer. Once fully in worked the inner back and fore to distribute it, then removed the inner hanging it up to keep it clean. Fitted the outer into the guide, then with clean newspaper over the carpets and seats to avoid getting grease on them and picking up dirt, fed the free end of the inner up through the throttle pedal slot and through the hole in the firewall shelf, the guide, and into the outer.





Clamped the free end into the carb linkage. Needed a couple of goes to get the travel right so the pedal hit the stop bracket on the toeboard just as the butterflies hit their stops, then adjusted the pedal back-stop to remove excess play, but still leave the 12 thou clearance between the finger on the throttle interconnecting spindle and the choke spindle. Much smoother now, no jerking.

Stripped and repainted the cover with two coats of Hammerite Smooth, then stuck on the self-adhesive upper seal. Replaced the bottom seal, which was fun. In the end I chose to remove the pedals, then slacken the four bolts holding the pedal frame to the horizontal part of the firewall. I left the two upper bolts to the vertical part, but had enough play to lever the frame upwards gently while I removed the old seal with a flat blade, and slid the new seal into place. Note that it is handed left and right as well as back and fore. Retightened the four bolts, ensuring that the holes in the seal for the cover lined up with those in the firewall, and refitted the pedals, greasing the pivots and clevis pins with copper grease.

Three of the cover screws are easy to fit, but the fourth is in the very narrow gap between the cover and the edge of the wing. I chose to put the screw in the cover, then carefully move the cover into position but raised up a bit so it didn't push the screw out, then got it started using a screwdriver bit handle, 1/4" extension, and appropriate bit. Fitted the other three screws loosely, then tightened all four down. Job done.

Update August 2005: Having done a few hundred miles now the cable seems nearly

as sticky and jerky as before. Oh well, at least I know it is sound. Subsequently I removed the 3rd spring from the throttle cable which has improved things.

Unleaded

For the FBHVC list of approved additives click here.

For the Bayford Thrust list of petrol stations selling Leaded 4-Star click here. Note that Bayford claims that genuine leaded 4-star has an octane rating of 99.7 significantly better than LRP, Premium Unleaded with octane boost, or most Super Unleadeds. Tesco 99 and Shell V-Power come closest.

For the Greenergy list of Tesco 99 octane outlets click here.

For a brief explanation of octane ratings and how they vary from country to country click here.

Update May 2010

The FBHVC reported in January of this year that Shell V-Power may now contain ethanol. It's not entirely clear whether it does or not, since the actual wording is *"Shell ... has begun blending ethanol into some Unleaded grades, including Shell V-Power ..."* i.e. is V-Power included in the grades it **is** adding ethanol to? Or is it that V-Power is merely one of its unleaded grades, only some of which contain Ethanol, which may or may not include V-Power? At any rate it is going to 5% or less, which isn't required to be stated on pumps, and is **supposed** to be compatible with classic car fuel systems. More here.

Spotted a typical media scare story in Classic Car Weekly today - "TOXIC FUEL DANGER", long on hyperbole, short on facts, about Ethanol and how classic cars are going to require expensive modifications or blow up!

Update March 2009

Just found this The Lead-Free Petrol Question first published in the journal of the Morgan Threewheeler Club in 1998, reproduced online by the MG T-ABC club in 2001. A long and interesting article on the origins of lead in petrol, the myth of tin pellets and Spitfires in WWII Russia, up to the loss of leaded petrol in the UK.

Update February 2009

Undated but Bayford claims to have reduced the price of its 4-star by up to 65p per litre or £2.95 per gallon for 2009 over 2008. Nice work if you can get it, but my nearest stockist no longer does, and the next nearest are too far away.

Update September 2008

Bayford's blender of its 4-star leaded seems to have ceased production by May 2008 due to low volumes. Bayford is trying to find another, but is this the end of 4-star leaded? I must admit I have never bought any myself.

Update Autumn 2006

Sainsbury in Solihull (at least) has signs showing '4 star' in red and including the four stars that used to be applied to 4-star leaded. However when one gets to the pump and you read the small print it isn't 4-star leaded at all but nothing more than the old Lead Replacement Petrol. Quite why Sainsbury have just started stocking this when most other outlets dropped it some time ago is a mystery. Take care, whilst it does contain an anti-wear additive, like LRP it is only going to be half the ideal quantity. And mixing this with petrol containing other additives can cause valve sticking and consequent burning. Advertising LRP in this way is misleading and annoying in my opinion as they are using the same signage as other small independent outlets that **do** have the proper 4-star leaded. As 'proper' 4-star leaded is significantly more expensive than this LRP one could easily be sucked into thinking it was a cheaper but equivalent option. It isn't - caveat Emptor! **Summer 2007** - All the LRP pumps and 4* signage have vanished completely.

Update Summer 2006.

BP Ultimate 102 available at a few outlets, claimed to be 102 octane, but at about £2.50 per litre! Some confusion over 'ordinary' BP Ultimate, it is only a claimed 97 octane i.e. the same as most Super Unleaded, and not the 99 of Shell V-power which has replaced Optimax (98).

Update March 2006.

You may have heard of Tesco doing a trial of 99 octane super unleaded in some filling stations in the southeast in the Autumn of last year. The news release gives more details and incidentally confirms that BP's Ultimate and Esso's Energy Supreme are only the same as 'ordinary' Super Unleaded at 97 octane. Many had assumed that because of the publicity they would have been 98 like Shell's Optimax even though you would never find a statement of the octane in any of their publicity. As well as being 99 octane Tesco's also contains 5% Bio Ethanol which reduces CO2 emissions, and claims to be cheaper than Optimax. See also this Green*ergy* (supplier of the 99 octane to Tesco) site which gives the current locations it is available, including Norfolk, Suffolk, West Midlands and Yorkshire.

Update November 2003.

Rumours of LRP being withdrawn at the end of 2003 in my local paper more info on the Department of Transport site.

Update May 2000.

BMIHT approves Superblend Zero Lead 2000.

Update April 2000.

Part III of "The Lead-Free Petrol Question" from The M.G. Car Club.

Update March 2000.

With the availability of Leaded 4-Star from Bayford Thrust at various locations in the UK the question "Can I switch between Leaded 4-Star and LRP, or Leaded 4-Star and Unleaded (with or without additives) from time to time?" Both the MGOC and the Automobile Association say that there is no reason why not, and the AA goes further to say that if you have a high-speed or heavy-load journey coming up it would probably be beneficial. They remind us that petrol companies, before the 'banning' of Leaded 4-Star, used to advise a regime of '3 tankfuls of Unleaded (no additives then) to 1 tankful of Leaded 4-Star' as giving adequate protection with reduced pollution.

There are rumours that the petrol companies have doubled the dosage of anti-wear compounds in LRP (as a reaction to the bad press it has received?) but that it still falls short of what is considered to be an adequate for high-speed/heavy-load use.

Part II of "The Lead-Free Petrol Question" from The M.G. Car Club.

The UK Government information site 'Making the change to unleaded'.

Update February 2000.

This month's Classic Motor Monthly reports that Super Unleaded has had its Octane rating reduced by one point from 98 to 97 in accordance with an EU Directive, thus making it the same Octane rating as the old Leaded 4-Star. It further reports that LRP is now being produced from Super Unleaded plus anti-wear additives.

As the level of additive in LRP is known to be about half the ideal level, and not of the ideal chemical, it adds weight to the Automobile Association's recommendation that the best protection and running performance is obtained by adding an un-boosted additive to Super Unleaded.

Super Unleaded is already the subject of a 'health tax' because of its higher levels of reputedly cancer-causing Benzene and aromatics, so it remains to be seen how long ***it*** will remain available. After that, Premium Unleaded will probably be banned because it is flammable, then maybe the anti-car lobby will finally be happy.

PS. Don't even ***think*** about using water as a fuel, people have been known to drown in it.

Part I of "The Lead-Free Petrol Question" from The M.G. Car Club.

Update January 2000.

The FBHVC have updated their information to include two new products from

Car Plan - 4-lead and 4-star - currently being advertised on TV by Stirling Moss. The AA lists (in Technical Information leaflet TIC 20 06/99) a product called V-Guard along with the original four approved products but the FBHVC does not indicate approval for this product. The same AA leaflet also says that running Premium (i.e. standard) Unleaded with the timing retarded can still cause problems, that octane boosted additives can give unpredictable results with different brands of Premium Unleaded, and recommends that an unboosted additive is used with Super Unleaded (98 octane) if you want at least the same octane as four-star leaded (97 octane).

AA Technical Information leaflet TIC 29 10/1999 on LRP states that LRP is 97 octane i.e. the same as four-star leaded indicates that it will not protect for sustained motorway or heavy load use, but says that 'most of the larger oil companies' will be using Potassium as the additive i.e. brands can be mixed according to availability, unlike additives which means if you use an additive and go to unfamiliar territory you may well have to carry sufficient supplies with you.

See the Bayford Thrust site for locations of UK filling stations selling 4-star leaded (yes, the good old stuff).

Update October 1999.

LRP is beginning to take the place of leaded, but be warned, it is dispensed from red pumps and called 'four-star'. How can you tell which is which? There is no British Standard for LRP, so the pump will not have a BS number e.g. 'BS 4040', but should have the letters 'LRP' contained within each star instead. However, some stations are leaving the 'BS 4040' stickers on the pump body even though they have 'LRP' on the pump nozzle. So be warned!

Also petrol stations seem not to be selling any of the FBHVC endorsed additives (unsurprisingly, since it would compete with their own LRP), so anyone wishing to use these will have to locate them elsewhere, and they don't seem widely available.

Millers contains an octane-booster, and Castrol sells an octane-boosted version as well as un unboosted version. The others may need you to retard your engine's timing. The Castrol ad in the MGOC magazine is interesting in that it purports to show comparative wear for 4-star leaded, each of the additive compounds, and straight unleaded as follows (my figures extrapolated from its graph):

Additive	**Mean**	**Max**
Lead	100	100
Phosphorus (Castrol Valvemaster)	111	100
Manganese (Millers VSP)	222	129
Potassium (SuperBlend Zero Lead 2000)	333	200
Sodium (Red Line Lead Substitute)	556	471
No Additive	1889	1243

Needless to say, the Castrol product uses Phosphorus. The Classic Cars & Unleaded Petrol From the Year 2000 site above contains its own FBHVC press briefing.

LRP from the major petrol companies is said to have the same octane rating as 4-star leaded so engines using these should not need adjusting, although the MGOC say that users are experiencing pinking and lumpy idling. However, the story is that they contain less of the additives than the recommended dosing levels, and so probably offer less protection. Since the FBHVC recommends that overdosing and mixing of additives should be avoided, also mixing of additives with LRP, presumably mixing of different LRPs should be avoided as well. Although with the lower dosing levels of LRP, possibly the mixing of these is less of an issue.

Of the major petrol companies, Shell LRP uses Potassium.

April 1999.

Mainly for UK owners with the impending loss of leaded fuel. Classic Cars & Unleaded Petrol From the Year 2000 has some useful information on the history, risks, additives, engineering changes and 'memory effect', but the section on specific marques is woefully inadequate as far as MG is concerned - it just consists of the statement "All pre-1989 models: Fit higher-spec seats and valves, plus new guides". This is incorrect, certainly as far as V8s are concerned, which can run unleaded as standard.

This MG BBS News item contains some information, but for the 'full monty' read Part 1 and Part 2 of Roger Parker's articles originally published in the MG Owners Club magazine, and now on the MG BBS.

The text of an article published in the Electronic Telegraph relating to the first four products 'approved' by FBHVC/MIRA in the UK as petrol Lead Replacement additives.

Autodata Publications products include a booklet that claims to have information on what modifications each type of engine requires to run on unleaded - Unleaded Petrol Information Manual, Ref. 89-1630 at UKP7.50.

Zenith Choke - Making a Blanking Plate for MGB Rubber Bumper Cylinder Heads when removing the automatic choke by Les Bengtson

There are several reasons why one may wish to blank off the water choke take-off on the cylinder heads of cars equipped with the Zenith Stromberg carburetor. The first is when a different carburetor is fitted. Both the Weber DGAV and the SU HS-4s are commonly adapted for use with the MGB engine. The SU HIF-44 and Weber DCOE are also encountered at a significantly lower rate. None of these uses a water choke and the connection must be sealed if the cooling system is to be kept from leaking.

A second reason is the removal of the trouble prone water choke and it replacement with a manual choke on the Zenith Stromberg. A number of people, based on the research of Barry Kindig, have begun to find that the Z-S carb is really a fairly good one, offering acceptable performance and economy (plus being part of the original pollution control equipment). The primary problem with the carb is the water choke system. They have found that replacing the water choke with a manual choke is far less expensive than converting to a different carburetor .

A third reason for wishing to plug the water choke take off is that one has replaced a cracked cylinder head on an earlier model engine with one from a later model car. All of these reasons are valid. Unfortunately, most of the solutions are not.

The standard solution to the problem of closing off the water choke take off on the cylinder head is to leave the existing hose in place and plug it. Sometimes, the hose is shortened and allowed to hang down behind the rear of the engine. It is less visible then, but is still a problem, perhaps a very expensive one, waiting to happen. The insertion of a bolt, or in some cases a spark plug, into the hose, especially when a hose clamp is used to secure it in place, is a useful method of plugging a hose on a temporary basis. It seals the end of the hose and does not allow the coolant, under 10-15 pounds of pressure, to leak out. But, how often do people replace this hose? We know that the radiator and heater hoses should be inspected regularly. We know that they should be replaced every two years as a preventive measure. But, how many people remember to replace the hose left over from the water choke? This is a great potential for a cooling system failure, with a possibility of engine damage. So, if the plugging of the line is only a short term solution, what is the long term solution?

When I was faced with this problem, on my daughter, Theresa's, car, I decided to make a blanking plate to replace the hose connection on the head. The hose connection is a piece of steel with a tube, bent at about a 90 degree angle, attached. It is held on the cylinder head with two ¼" studs. A paper gasket ensures that there is a good seal between the cylinder head and the hose connector. It seemed to me that the easiest way to block off the hole in the cylinder head was to make a blanking plate out of scrap steel and use the original studs and nuts to hold it in place. I did this, and it has worked well for over a year.

To make a blanking plate, you need the old hose connector off the cylinder head. This will serve as a pattern for the new blanking plate. The blanking plate is made from scrap steel that is about 1/8" thick (from .125" to about .180" will work). The first step is to coat the scrap steel with some form of "layout" covering. The clean steel can be colored with a magic marker, layout blue or given a quick coat of paint. Next, the hose connector is placed on top of the scrap steel and the outline of the hose connector is marked. This can either be scribed, using a sharp steel scribe, or drawn with a pencil or a Sharpie marker. Then, you cut the piece out.

The easiest way to cut the piece out is to use a hacksaw to remove most of the superfluous metal. Cut as close to the lines as possible without cutting into the lines themselves. You then are left with a rough blank. It is in the general shape of the hose connector, but oversized and lacks the mounting holes. The next step is to bring the outside shape to the proper dimensions.

To shape the outside of the blanking plate requires either a grinder, a belt or disk sander or a file. (Which ever method you use, wear safety glasses. Steel bits in the eyes are very uncomfortable and very expensive to correct. I speak from personal experience when I say you do not want to find out how painful it can be.) Grind, sand or file the blanking plate until you have just remove the scribed/drawn lines. This represents the true size of the original hose connector. When you are finished, you will have an oval-diamond shaped piece that duplicates the original almost exactly. It should be a close duplication, but need not be exact. Comparing the two as you go along will help to make your first attempt a successful one. Now you have your blanking plate and only need to make the holes for the securing studs to have a completed blank.

The original hose connector is then laid over the new blanking plate and a pencil or scribe is used to outline the holes for the studs. Remove the old hose connector and draw cross hairs on the blanking plate to locate the center of the circles you have just made. I did this by eye and it worked out fine. The holes in the original hose connector measured .283" while the studs are ¼" (.250") so there is considerable tolerance built into the original piece. I my case, I used a somewhat smaller hole of .261", using a letter G drill. You can also use a 9/32" drill (.281") which will duplicate the original holes. Before drilling, you should center punch the centers of the holes or use a #2 center drill to start the hole. If you center punch use a 1/8" drill to drill a pilot hole. If you use the center drill, run it down until the major part of the drill bit makes a hole for the larger drill to guide on. Then, drill the holes to final size. If you are lucky, they will be an exact fit on the cylinder head studs. If not, determine where the hole needs to be enlarged and use a round or oval needle file to file the hole to an exact fit.

With the blanking plate now fitting on the cylinder head, all that remains is a gasket. You can either buy a gasket for the hose connector or make one. All auto parts stores will have sheets or rolls of gasket material. Get the paper kind. Then, lay your new blanking plate on top of a small section of the gasket material and draw around it with a sharp pencil. Also, draw in the stud holes. Use an Exacto knife or a pocket knife with a sharp blade to cut out the stud holes. I find that pressing straight down with the knife in a series of overlapping cuts is the best way to do this. Then, use a pair of scissors to cut around the outline of the blanking plate. You now have a complete blanking plate and a gasket that can be fitted to the cylinder head. At this stage, I prefer to paint the blanking plate.

There are two reasons for painting the blanking plate. First, is to match the engine color (black). Second is so that the underside, where it is contact with the coolant, cannot rust. You can use regular engine paint for this purpose. Having trained as a gunsmith, I am aware of some better coatings--ones that will resist heat and chemicals better than paint. I used a coating called Gun-Kote because I had it available and it matched the engine color. Brownell's, Inc. also sells a "baking lacquer" which does the same thing and is less expensive. Both are sprayed on, allowed to dry thoroughly and then baked in an oven to harden. Any of these methods should work fine.

After the part has received its finish, I wire brush the studs to remove built up rust and crud. If the cylinder head is off the car, I use a wire brush in either a drill or a die grinder. If the cylinder head remains on the car, I use a wire brush by hand. Then, a thin coat of gasket cement (non-hardening) is applied to the cylinder head and the underside of the blanking plate. The gasket is fitted over the studs, the blanking plate is installed and the lock washers and nuts fitted. I use the blue Loc-tite on the studs to prevent loosening. The engine is then run up to operating temperature and the new blanking plate checked for leaks. There should be none if the surfaces were clean before installation. At this point, you can forget about the modification until the next time head work is required. It should hold up indefinitely and you will no longer have that nagging worry about a burst hose. The average time involve is about one hour and the cost less than a dollar. Quite a bargain for the piece of mind provided.

ADDENDUM

Since this piece was written I have had the opportunity to remove the water choke take off studs from an 18V cylinder head. The studs are 0.770" long and are threaded ¼"-28 on both ends. The shorter threaded end, ¼" in length goes into the block. The studs go directly into the water passages and, if removed, should be re-installed using some form of sealer such as Loc-tite or gasket cement. The original nuts are plain nuts with lock washers. It should be possible to use a standard nylock nut. Providing extra security. It would also be perfectly possible to replace the studs with two ¼"-28 grade 5 machine bolts of 3/8" to ½" length and use lock washers between the underside of the bolt head and the blanking plate. This would make a slightly better looking installation. Before re-installing the studs or using the bolts, run a ¼"-28 UNF taper tap into the holes to clean them up and ensure the threads are clean.

See here for rebuild and set-up info for the Zenith carb **with** water choke, and here for a picture of one with a manual choke. Note this picture came from a Calgary, Canada ad for rebuilt Zenith carbs and may not be the same model as for an MGB.