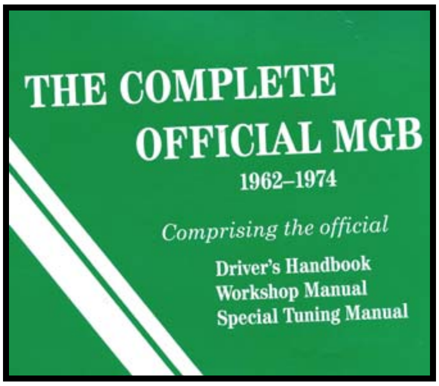
MGB ENGINE TUNING – V5

V5 (November 2022) includes underscored typo corrections

I have written this manual and compiled the additional information to assist owners of MGBs, and in particular my car MGB 973 to carry out basic maintenance and tuning functions. Hard copies of the *MGB Electrical Systems Manual, the Haynes Manual* , the "*Complete Official MGB Driver's Handbook ,and Workshop Manual and Special Tuning Manual*", sometimes called "*The Bentley Manual"* are provided with the car. The "General Data" on the engine specifications and part 4, the fuel system in the Bentley Manual provides more detailed information.

I have also developed a tuning kit which includes all the special tools and instruments to effect the tuning and timing procedures referenced in this paper.



The "Bently" Manual

My Tuning Kit

Also, in pdf format, the SU Manual "*Tuning SU Carburettors*" Manual was provided with all the electronic records of the car.

Note that the wiring diagrams in the "Haynes" Manual are not only difficult to follow, but many MGB owners have found numerous errors.

Accordingly the "Auto-Wire wiring diagrams in the files are properly colour coded and come from the official "Bentley" Manuals.

The folder covers MGB and MGC models from all years of production.

Auto-Wire (Bentley) Wiring Diagrams

This paper summarises my input on the tuning of the engine and includes the specific differences and changes that I have made.

Before embarking on the tuning of the twin SU HS4 carburettors and the associated timing on the car, for newcomers it is worthwhile reviewing the operating principles of a petrol engine together with the issues of air / fuel mixture and timing.

Engine Operation Principles

The MGB is a 4 cylinder 4 stroke "Otto" cycle petrol engine. The "4 stroke" name is given because in any single operation of any one of the cylinders, a piston moves 4 times in a cylinder, each stroke representing 180^{o} in a rotation of the crank shaft.

Figure 1 below shows a single cylinder with each stroke (180^{o}).

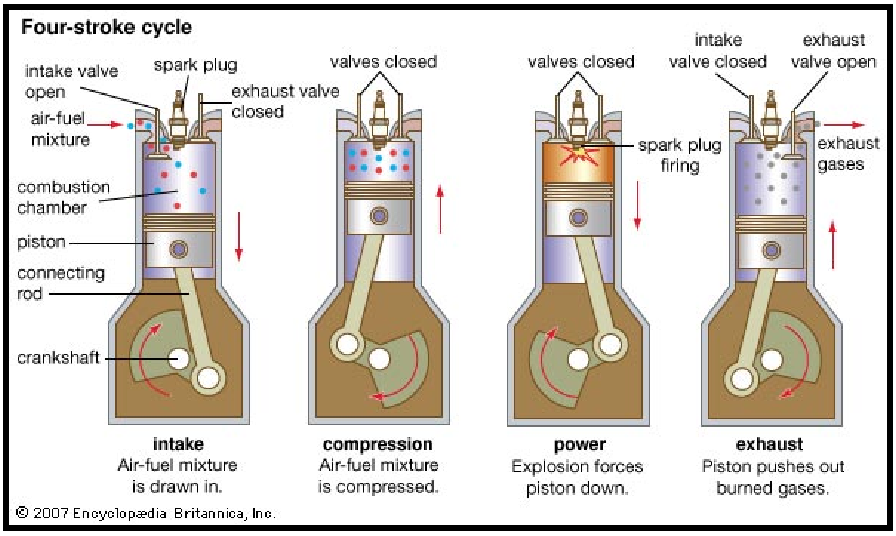


Figure 1 – Four Stroke Cycle

Figure 2 below shows a 4 cylinder engine at a single point in time when No.1 cylinder (at left) is firing, No. 2 is the "power" stroke. No. 3 is the induction stroke and No. 4 is the "exhaust" stroke. Note that this is diagrammatic only and in the MGB, the firing order is 1 – 3 – 2 – 4. Note also that Figure 2 shows an overhead cam system whereas the MGB has its chain driven camshaft lower down in the engine block with push rods acting on rocker arms as shown in Figure 3.

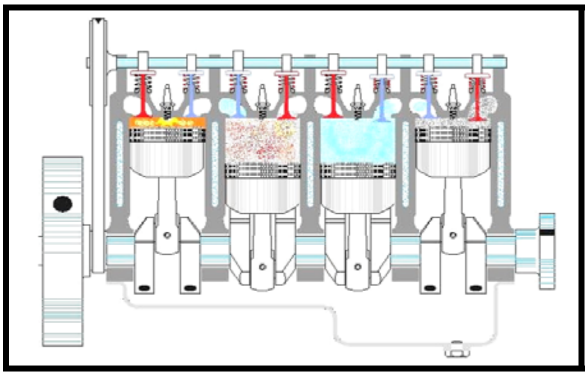


Figure 2 – 4 Cylinder Operation

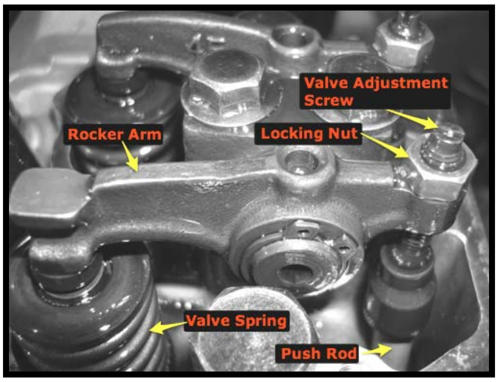


Figure 3 – Push Rod Valve Operation

General

Before embarking on the descriptions and procedures, it is worthwhile to identify the key elements of the fuel and ignition systems.

More than 500,000 MGBs were manufactured with 350,000 being left hand drive for the US market and ~150,000 being right hand drive for the UK market. Additionally ~9,000 were assembled from CKD packages in Australia.

Consequently not only will many variants be found but also many parts were transferred from cars to badly corroded from "donor" cars from the USA and elsewhere. The USA cars invariably incorporated different carburettors, distributors and anti-pollution equipment which have very probably been removed.

Fuel System

The carburettor specifications below may be useful in determining the build date of the car although and as discussed above, parts with part numbers may have been sourced from other cars.

The fuel is delivered into the appropriate cylinder when the inlet valve is opened by the action of the rocker arm / push rod / camshaft.

Fuel is delivered in conjunction with the appropriate quantity of air by the two carburettors as shown in Figure 4, these are connected to an inlet manifold and whilst the manifold cross connects both carburettors, Cylinders 1 and 2 (from the front) are supplied by the front carburettor and cylinders 3 and 4 by the rear carburettor. Note that because cylinders 1 and 2 do not draw in fuel at the same time; and likewise cylinders 3 and 4, the result is that there is a good balance of fuel delivery.

The ideal air / fuel mixture is called the “stoichiometric” ratio and for gasoline (petrol) is 14.7:1. i.e. 14.7 units of air to 1 unit of petrol – measured in mass – usually kilogrammes.

Figure 5 below shows the relationship of air / fuel with notations for “rich” and “lean” mixtures. For the MGB which has not been converted to run on unleaded fuel (by replacement of the valve seats and valves with hardened units); I would suggest that the mixture be on the “rich” side because running “lean: will result in a hotter burn with associated damage to the valves and seats.

Later in this paper I discuss methods of adjusting the fuel mixture.

Figure 4 – Twin Carburettors

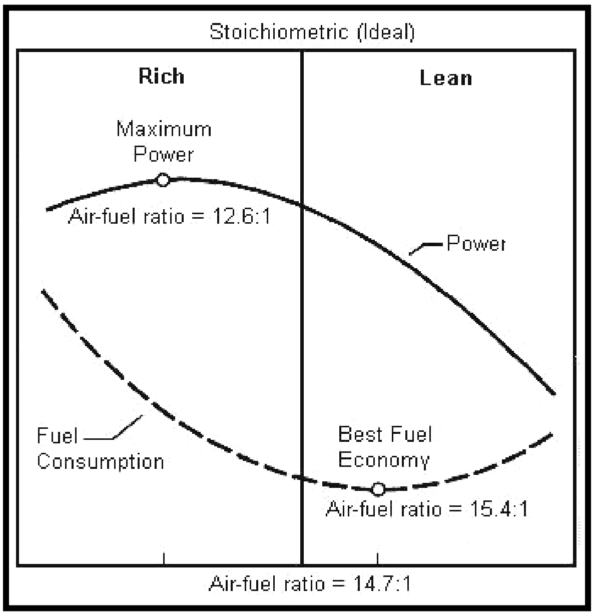


Figure 5 – Air / Fuel Ratio

Firstly, In order to identify the model of carburettor, Table 1 lists the carburettors fitted to MGBs from 1968 to 1976 Table 1 below includes details of the SU HS4 (1 ½”) throat carburettor.

For the carburettor on my MGB, the SU Model is shown as ADU 492 – with suffixes F and R being the front and rear carburettor respectively. Examination of Table 1 and Figure 6a, indicate a 1972 build.

HS4/HIF4 Carburettors as fitted to MG B Series engine
Dual 1-1/2" throat carbs on the 1800cc engine

model year	model name	Carb model	Std. needle	rich needle	weak needle	needle mounting	Needle Guide	Needle Screw	Piston spring	Throttle disk
1968	MGB (USA)	AUD265 (HS4)	AUD1530 (FX)			fixed		AUC2057	AUC4387 (red)	
68-69	MGB MKII (USA)	AUD326 (HS4)	CUD1004 (AAE)			biased	AUD4288	AUD4251	AUC4387 (red)	WZX1329
70-71	MGB MKII (USA)	AUD405 (HS4)	CUD1004 (AAE)			biased	AUD4288	AUD4251	AUC4387 (red)	WZX1329
71	MGB MKII (USA)	AUD465 (HS4)	CUD1010 (AAL)			biased	AUD4288	AUD4251	AUC4387 (red)	WZX1329
72	MGB	AUD492 (HS4)	CUD1018 (AAL)			biased	AUD4288	AUD4251	AUC4387 (red)	WZX1323
72	MGB MKII (USA)	AUD493 (HS4)	CUD1018 (AAL)			biased	AUD4287	AUD4251	AUC4387 (red)	WZX1329
72-74	MGB MKII (USA)	AUD550 (HS4)	CUD1027 (ABD)			biased	AUD4287	AUD4251	AUC4387 (red)	WZX1329
74	MGB (USA)	AUD630 (HS4)	CUD1027 (ABD)			biased	JZX1039	AUD4251	AUC2107 (lt blue & blk)	WZX1329
65-66	MGB & GT	AUD135 (HS4)	AUD1004 (#5)	AUD1005 (#6)	AUD1008 (#21)	fixed			AUC4387 (red)	WZX1323
67-68	MGB & GT	AUD278 (HS4)	AUD1530 (FX)	AUD1004 (#5)	AUD1473 (GZ)	fixed			AUC4387 (red)	WZX1323
69-71	MGB	AUD325 (HS4)	AUD1530 (FX)	AUD1004 (#5)	AUD1473 (GZ)	fixed			AUC4387 (red)	WZX1323
72	MGB	AUD434 (HIF4)	CUD1018 (ABD)			biased	AUD4287		AUC4387 (red)	WZX1323
73-74	MGB (ECE)	AUD616 (HIF4)	CUD1018 (ABD)			biased	AUD4287		AUC4387 (red)	WZX1329
74-76	MGB (ECE)	FZX1001 (HIF4)	CUD1051 (ACD)			biased	AUD4287		AUC4387 (red)	WZX1329
76	MGB	FZX1229 (HIF4)	CUD1051 (ACD)			biased	AUD4287		AUC4387 (red)	WZX1329

Note: 1.) ## signifies throttle valve has a poppet valve on it
2.) Rich/Lean needles are elevation/atmosphere changes not

Table 1 – SU Carburettors by Date & Model

Figure 6a - Carb identification

Figure 6b - Fuel Hose

Note Figure 6b indicating fuel grade hose used. Note also that apart from this hose, it is unknown if the elastomers and hoses in the fuel system are compatible with unleaded fuel, however in the period that I have owned the car <u>I have not used unleaded fuel.</u>

Referring to Figure 7 below, SU carburettors work on the constant depression or constant vacuum principle. The body (1) of the carburettor includes a domed cover (2) housing a spring loaded piston (3) which reacts to the air flow (9) into the engine. Attached to the piston is a tapered needle (5) which alters the fuel delivery as it rises and falls. This tapered needle is housed within a brass jet (6) which is adjustable, up and down by the adjusting nut (7). As the throttle disc (8) is opened, the piston rises by the partial vacuum formed above; the rising if the piston and needle increases the annular space between the needle and the jet allowing more fuel (10) to be drawn into the air / fuel flow (11) into the engine. The oil filled “damper” (4) controls the speed of opening thus giving more even acceleration providing variable amounts of fuel and air to cope with the changing demands of the engine – see below.

On the rear carburettor there is a small port (12) drilled into the body which aligns with the throttle disc. This is connected to the Distributor diaphragm by a hose shown in Figure 8. When the throttle is opened, the disc edge uncovers the port and the vacuum caused by the increase in engine speed is sensed by the distributor and the timing is advanced, this is known as “vacuum advance”. There is also “mechanical advance” effected by weights within the distributor. Vacuum and Mechanical advance is explained on page 8 in this paper.

Note that on a twin SU set up, the front and rear carbs are NOT interchangeable because the rear unit has a vacuum advance connection and the front not!

At this point I would like to mention the use of Weber carburettors. Many drivers consider that the equivalent size to the twin 1 ½” SU (40mm) being the twin throat DCOE 40mm provides an increase in horsepower. Having used both types of carburettors on my previous race cars (1650cc 105E Ford Cortinas), I can vouch that neither properly set up SUs nor Webers have any significant advantage. The Weber however has a separate high rate fuel delivery feature on hard acceleration compared to the SU feature of even acceleration mentioned previously. Dyno testing indicates that an SU setup provides more torque than Webers.

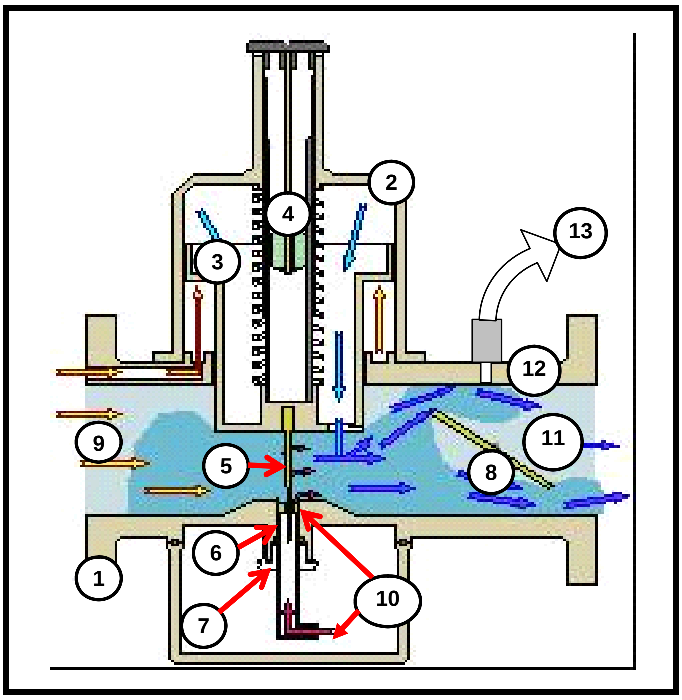


Figure 7 – SU Carburettor Principles

Figure 8 – SU Carburettor Vacuum Advance Connection

COMPRESSION TEST

The condition of the engine can readily be ascertained by doing a compression test. This shows if there are issues with the cylinder head gasket, piston rings or valve seats. It is recommended that a compression test prior to buying the car and every year subsequent to that.

In the first instance you should take the car for a run for about 15 minutes in order to warm the engine up. This makes the tuning and timing process – especially the tappet adjustment and plug condition more accurate.

On returning to "base" immediately stop the engine without letting it idle, you want to retain the heat and prevent excessive fuel delivery which will mask the condition of (oil up) the plugs.

Next, being careful not to burn your fingers, remove all the spark plugs – noting their condition and "store" them in the purpose built rack as shown in Figure 9 below.

Figure 9 – Plug Rack

Next remove the air cleaner filters so that you can see the pistons within the carburettor body and, using a small rubber wedge, hold the throttle assembly open so you can see the carburettor piston open about half way. This is to ensure that the pistons move freely

1. Set up the tachometer as shown in Figure 10 below with the red wire to +ve (tag marked "tacho"), the brown wire to the marked ground and the yellow lead to the –ve post on the coil.

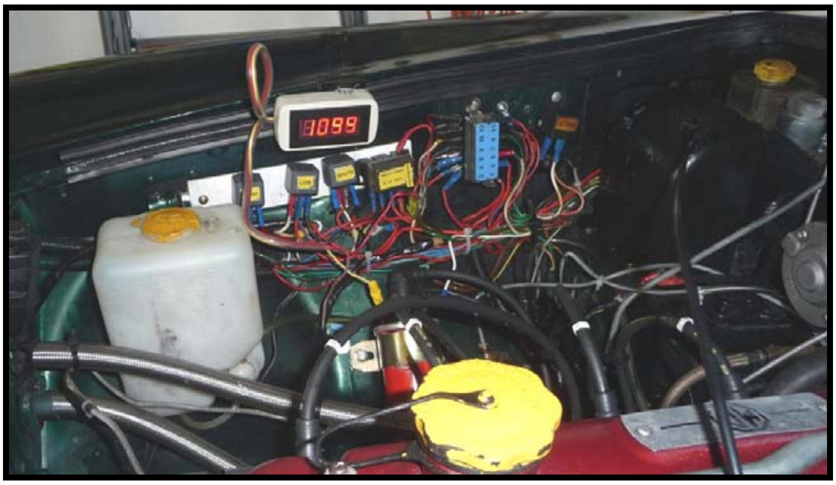


Figure 10 – Tachometer

2. **Remove the high tension (HT) (centre) lead from the coil, this will prevent the engine from starting.**
3. Leave all the plugs out and rotate the engine using the starter motor.
4. Now, using the correct adaptor, screw the compression test hose into No.1 cylinder plug hole and tighten it up.
5. Now crank the engine at as close to 600rpm as possible so that you can get a consistent reading on the compression tester pressure gauge. Pressures for the for the *18V 582F* for the 9.1 high compression engines should 170 psi as detailed in the "Engine Tuning Data" at the end of this paper.

These figures are for the specified engines and it is important to note that settings for timing will vary for different engines in a model range and also for special stages of tune.

6. Note that before unscrewing the hose, de-pressure the tester by pushing the button beneath the gauge.

Continue with all other cylinders noting the pressures on the plug rack as shown in Figure 9.

What if the readings are low? This indicates that there is a "leak" somewhere in the cylinder head or valve.

- If the low pressure is only in one cylinder, remove the test hose and pour a small amount (~1cc) of light machine oil into the cylinder. Retest the cylinder. If the pressures comes up to near those of the other cylinders, it indicates that there are worn or broken piston rings.
- If the low pressure is in two adjacent cylinders, it indicates that there is a cylinder gasket leakage between the two cylinders as shown in the blue circle or to the water jacket as shown in Figure 11.

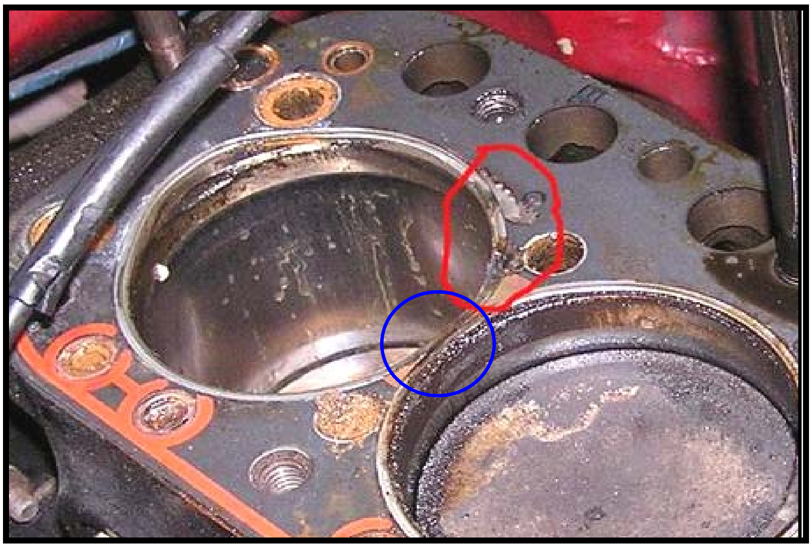


Figure 11 – Leak Points

If the leak is between the cylinder and the water ports, this will manifest itself by blowing bubbles in the cooling water with the radiator cap off. Be careful not to scald yourself.

None of the symptoms will be evident if the leak is past the valve seats meaning that a top end rebuild is necessary

Any of these issues require new piston rings (and therefore an engine rebuild) or a replacement head gasket, again necessitating a top end rebuild. If not already done, this might be the right time to fit a cylinder head suitable for unleaded fuel – and maybe a polished and ported one!

IGNITION TIMING

Subsequent to carrying out a compression test,, and assuming that all is ok, getting the ignition timing correct is the first stage in my tuning regime, if the timing is out, no amount of carburettor and / of fuel balancing will have any effect. See the timing and tuning details and procedure following from here.

These specified timing figures as detailed in the "Engine Tuning Data" at the end of this paper are for the standard 18V engine and should be checked if there have been performance modifications.

Distributor

The distributor on my car is a generic BOSCH unit instead of the normal LUCAS45D unit.

Remove the distributor cap and examine the surfaces of the contact breaker points. If the points are severely pitted or indented with tiny craters they should be replaced. If they appear to be in good order then check the contact breaker gap. With the spark plugs removed, rotate the engine manually by the fan blades or, put the car in gear and push it forward to turn the engine until the cam of the distributor drive fully opens the points, now you can insert a feeler gauge to measure the gap.

To adjust the gap it will be necessary to slacken the set screw in the centre of the points so that some movement of the assembly is possible. Then insert the flat blade of a screw driver into the slot at the end of the points just before the condenser and to open or close the contact breaker gap.

Using a feeler gauge to measure the gap when the points are fully open on the cam, it should be between .014 to 0.15in (.35 to .40mm) for most MGB engines.

Contact breaker points

Removal and replacement is quite straightforward but take careful note of how the points are fitted and the position and route of the wiring. When the new set is in position, make sure the distributor cam is holding them in the fully open position, and adjust the gap as described above.

Distributor cap and rotor arm

Carefully examine the distributor cap and rotor arm for hairline cracks, if any damage is found the cap must be replaced. Although barely visible, hairline cracks will cause misfiring and poor starting.

Check the inside of the distributor cap for wear and cracks.

Condenser and Connections

Faulty condensers and connections manifest them selves with “stuttering” of the engine and probably stopping. This is also evidenced by wild swings of the car tachometer, note that the tacho works by detecting pulses from the distributor, if this occurs, firstly check **all** connections on the ignition circuit, I had similar conditions until I found that the wiring of the condenser to the distributor side terminal had fractured under the insulation leaving only a few strands capable of continuity at low revs!

Ignition leads

Always ensure that your leads are not cracked or damaged.

Make sure that you replace the ignition leads in the correct firing order of 1- 3- 4 - 2. When working out the order of the leads note that rotor arm rotates in anti-clockwise direction.

Ignition coil

The ignition Coil is an induction coil which is used to increase the low voltage of battery (12 Volt) to a very high voltage to produce spark within the engine cylinder for the combustion of fuel.

It consists of primary winding, secondary winding and an iron core. When the current through the primary winding makes and breaks repeatedly by contact breaker, it induces a very high voltage in the secondary winding (about 50,000 V). This high voltage from the secondary winding is transferred to the spark plug through ignition distributor to produce spark within the cylinder as shown in Figure 12.

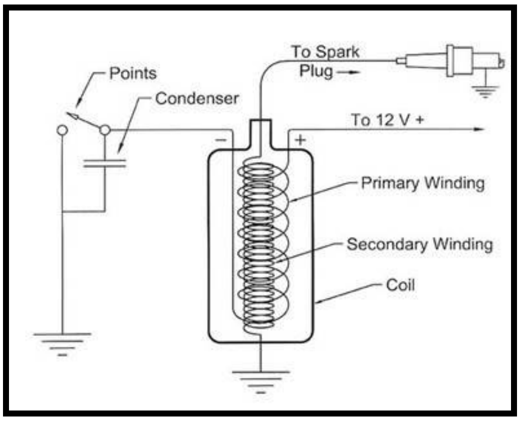


Figure 12 – Ignition Circuit

Mechanical Advance

The lower base plate in the distributor houses a set of weights which, as the engine speed increases, move outwards by centrifugal force advancing the ignition timing.

Vacuum advance

The vacuum advance mechanism advances the ignition timing at part throttle to improve economy and performance. You can check if it is operating correctly by disconnecting the pipe which connects it to the rear carburettor and sucking hard on the end; you will hear a click as the base plate moves. The movement is only very slight and is best detected by listening for the noise it makes. If sucking hard produces no response then the diaphragm is probably faulty and replacement will be necessary.

Timing Settings

There are 2 basic methods of setting timing – static (engine not running) and dynamic (engine running) (also known as stroboscopic).

To achieve the best and most complete combustion or burn, the spark plug should fire just before the piston reaches top dead centre. It is for this reason that ignition timing is described in terms of advance or degrees before top dead centre (BTDC).

At low rpm the piston speed is relatively slow and there is more time for combustion to occur, so for example an initial setting for an MGB high compression engine the *static* timing should be 10 ^{o} before top dead centre and 13^{o} BTDC at 600 rpm using a *stroboscope* as detailed in the "Engine Tuning Data" at the end of this paper.

As the revs rise and the piston speed increases there is less time for the burn to occur, therefore to produce the best cylinder pressure the spark must initiate the burn much earlier. So that at 3000 rpm for example, the spark should occur at around 20 degrees earlier, making a total advance of 13 degrees plus 20 degrees of mechanical advance before top dead centre. These figures are for 18V 582F and 18V 583 engines and it is important to note that settings for timing will vary for different engines in a model range and also for special stages of tune.

Static Timing

Here's the easiest way to set static timing, It is close enough to get the car started and no more, see Figure 13 below for set up..

1. Remove the dip stick and replace it with a plug, this will not only stop oil being splashed up the tube during later tuning when the engine is running but also give more space so as to adjust the distributor rotation. See Figure 13 below.

Figure 13 Dip stick plug

2. Remove the distributor cap and all plug and HT leads.
3. Switch on the ignition.
4. Remove the spark plugs to make rotating the crankshaft easier. Making sure that the rotor is pointed to the #1 plug terminal in the distributor,
5. Loosen the distributor clamp (see Figure 14) by loosening the 3/8" AF nut on the captive bolt on the right. Note that it is advisable before this stage to loosen the 7/16" bolt on the right ton set the distributor body in the mid point of the slot.

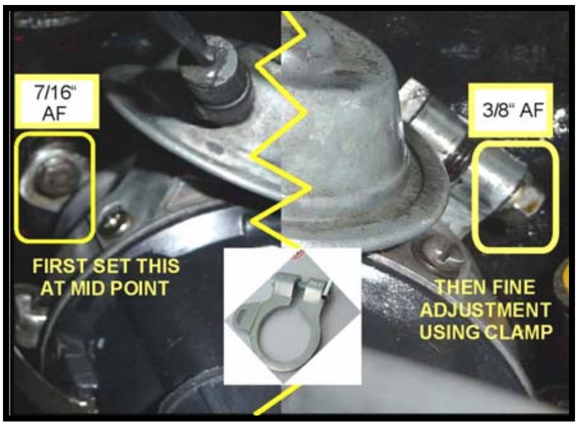


Figure 14 Distributor adjustment

6. Set the crankshaft pulley to 13° BTDC as shown later in Figure 19.
7. Connect the static timing light with the alligator clip to the –ve terminal on the coil or preferably to the low tension connection at the side of the distributor, see Figure 15.
8. With the timing light "point" to ground, rotate the distributor until the light illuminates, this occurs as the points open. If you have a Lucas distributor with vernier adjustment, you can use this but note that some vernier adjusters need 50+ clicks to make an adjustment of 1 degree. I would use the first method of rotating the distributor body and leave vernier adjustment for minor later adjustments whilst the engine is running.
9. Tighten the distributor clamp.
10. Switch off the ignition. NOTE that extended periods of ignition coil being energised will damage the coil
11. Replace plugs, distributor cap, plug and HT leads.

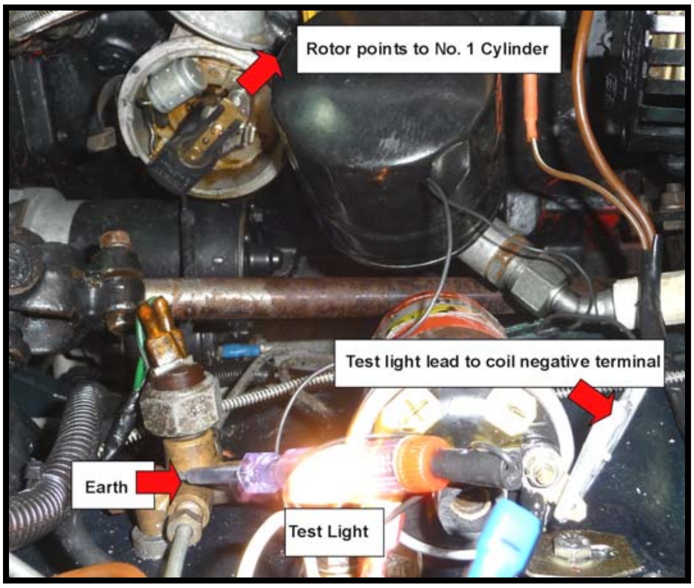


Figure 15 – Static Timing

Stroboscopic timing

Note that stroboscopic timing is always with the vacuum advance disconnected

This method of dynamic timing involves using a hand held timing light connected up to the spark plug in number one cylinder. First identify the timing marks, pointer and on the notch on the crankshaft pulley.

Setting up the timing light for the stroboscopic timing is straightforward as follows, with firstly setting up the home made tachometer kit as shown in Figure 16.

1. Set up the tachometer as shown in Figure 16 below with the red wire to +ve (tag marked "tacho"), the brown wire to the marked ground and the yellow lead to the –ve post on the coil.

Figure 16 – Tachometer

2. Set up the timing light as shown in Figure 17 connected to the accessory socket (a later home fitment to this car) on the right hand side of the radiator and the pulse clip around the No. 1 spark plug – note the directional arrow on the clip.

Figure 17 – Timing Light Setup

3. With the engine running as near as you can get to 600rpm, aim the timing light at the crankshaft pulley. You will see that the strobe effect of the light will illuminate the mark on the pulley against one of the pointers on the engine block. See Figures 18 and 19 below.

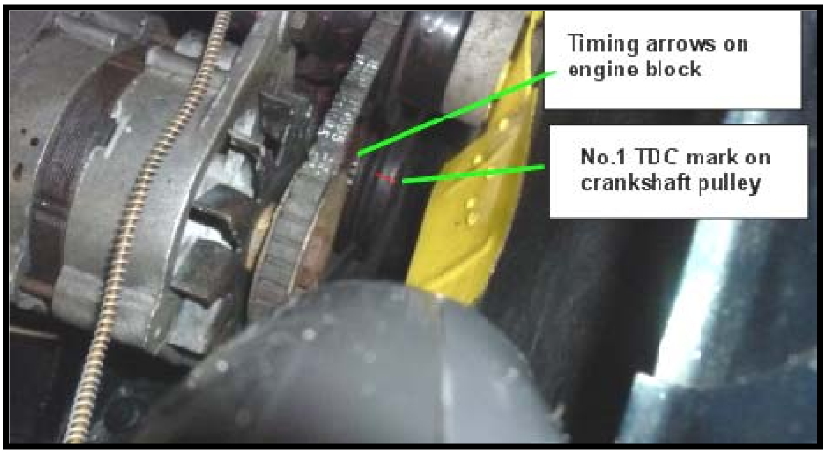


Figure 18 – Timing Arrows

Figure 19 shows the timing arrows on the block with, in this instance, the notch on the flywheel at 10^{o} BTDC.

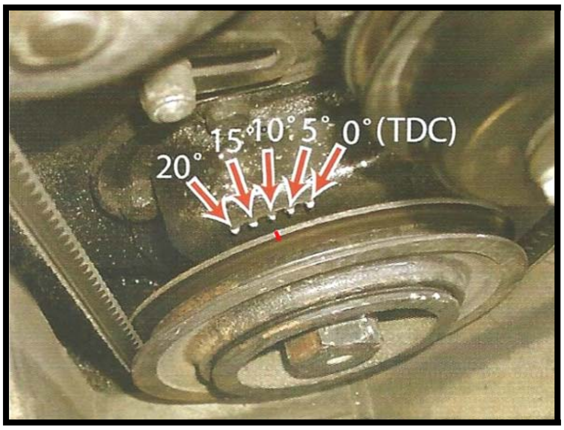


Figure 19 – Timing Marks

Whilst this stroboscopic timing method at idle speed is acceptable for most stages of engine tune, it is sometimes advantageous to check / set the timing at higher engine speeds.

As the engine speed increases, the centrifugal force on the weights in the distributor cause the base plate to rotate such that the ignition timing is further advanced. Typically for an MGB this should be about 20^o at between 2,000 and 3,000 rpm. Therefore the total advance will be 13 plus 20 being 33^o BTDC. Checking this setting confirms or otherwise, the condition of the distributor advance mechanism.

With the timing light aimed at the pulley, increase the engine speed to 2,500 rpm, it should be observes that the pulley marker will rotate anticlockwise to a point where you can estimate its reading as being beyond the 20^O mark. If this occurs, then the distributor advance mechanism is working correctly.

TUNING

Static Carburettor Balancing

The first thing to carry out is to ensure that the carburettors are "mechanically" balanced and the throttle pedal provides the full range of **each** throttle (butterfly) opening at the same time.

When this is omitted, the will often be a tendency to observe very poor performance at higher revs.

Therefore in looking first at Figure 20, note that when running the pistons should be at equal height.

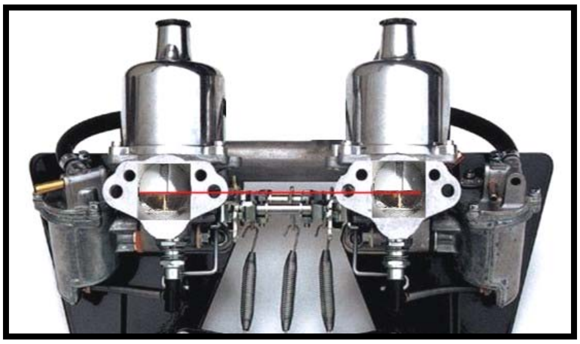


Figure 20 – Equal Piston Height

If they are not, then the fault is always because the throttle butterflies are not equally open. First, remove the air cleaners so that you can observe the pistons and later the butterflies paying particular attention to all the connections and clamps and linkages, some shown in Figure 21.

In looking at Figure 21, slacken off the throttle shaft clamps (shown circled in blue) so that each carburettor butterfly is closed, then tighten the clamps. You can do this by using an endoscope connected by WiFi or smart phone or tablet; see the images in Figures 22a and 22b for the front carburettor and Figures 23a and 23b for the rear carburettor.

Then adjust the throttle cable connection (shown in a red rectangle) to the throttle shaft lever so that a full travel of the throttle pedal produces full rotations of the butterflies.

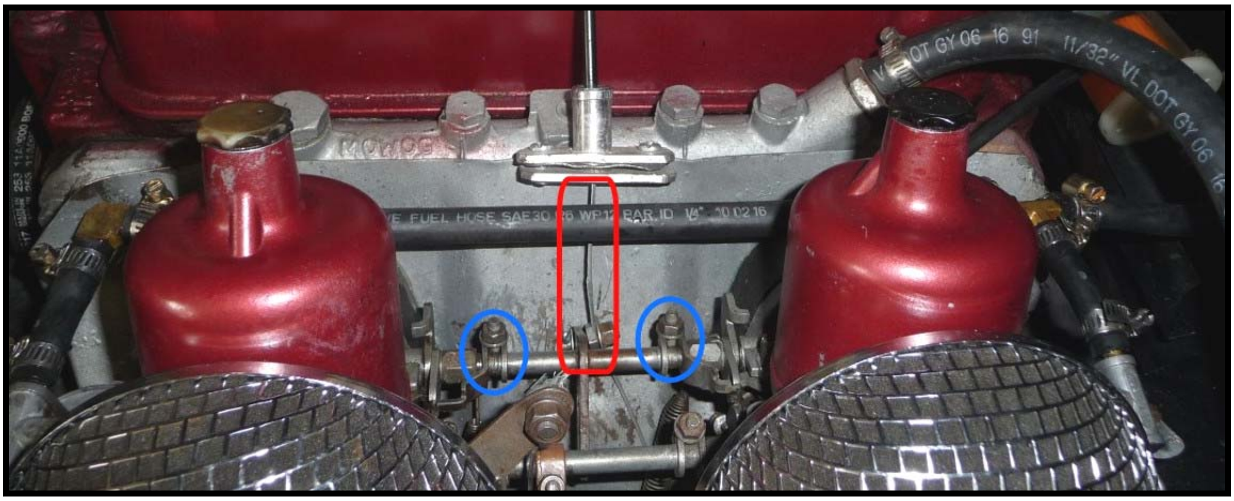


Figure 21 – Butterfly throttle linkage and throttle adjustment

Figure 22a Front butterfly closed

Figure 22b Front butterfly open

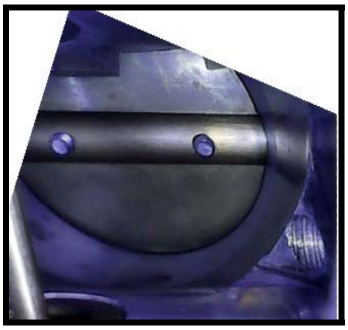


Figure 23a Rear butterfly closed

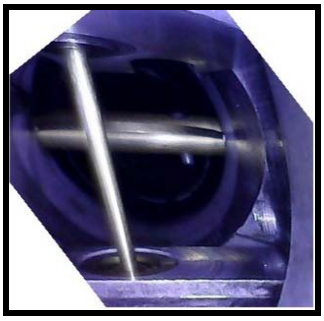


Figure 23b Rear butterfly open

Now that the carburettors are balanced in terms of equal butterfly opening and full throttle travel, the next stage is to balance them whilst running.

Dynamic Carburettor Balancing

Balancing the twin carburettors whilst running is the next stage in my tuning regime; it is also repeated at the end of the process if the fuel mixture is to be adjusted.

Whilst there are a number of commercial balancing "tools" available, mostly being devices that measure the "suction pressure" at the air inlet, two are shown in Figures 24 and 25, the first being a "Syncro-Meter which measures "air flow" kilogrammes per hour and the second, being a manometer, measuring inches of mercury suction.

In my opinion, both of these instruments partially restrict airflow to the carburettor being measured and when reading the "next" carburettor, the first reading has a fully open intake as opposed to the partially restricted second carburettor!

Accordingly my method sets up both carburettors with equal restriction.

Some mechanics favour a stethoscope or piece of plastic tube and listen for the intake "hiss".

Figure 24 - Syncro-meter

Figure 25 - Manometer

I have found that the use of an air velocity meter is very accurate and, with the engine at idle of approx 800rpm and the linkage loosened, they can be adjusted so that they exhibit the same inlet air velocity and therefore balanced.

The tools to be used are shown in Figure 26, being the air velocity meter and two plastic plugs with 45^o bends glued on to them, these act as adaptors so that the inlet diameter is the same as the propeller housing on the air velocity meter. Adaptors are fitted to both carburettors so that the friction losses at the inlets are equal, making for more accurate balancing.

Figure 26 – Tools for Balancing

1. Remove the two air cleaners as shown in Figure 27 to reveal the two air cleaner backs and the carburettor throats. Figure 28 also shows the air venturi plates which are removed from the original Coopers air cleaners (cans) and reused behind the new air filters. Note in Figure 28 you can just see the piston in the throat of the front carburettor which rises in conjunction with the opening of the butterfly as the throttle is opened thus opening up the annular space between the piston and the needle increasing both the fuel and air flow If you are only balancing the carbs, there is no need to remove the air cleaner backing plates. At this stage fit the adaptors into each venturi stub as shown in Figure 29 and read the air velocity for each carburettor.

Figure 27 – Dual SU HS4 (1½") Carburettors

Figure 28 – Venturi Subs

2. At this stage it is preferable to check that fuel is being metered into the carburettor throat as discussed on Pages 4 and 5 and in Figure 7. Figure 29 below shows the fuel being drawn into the carburettor throat as the piston and needle rises due to the vacuum being created above the piston.

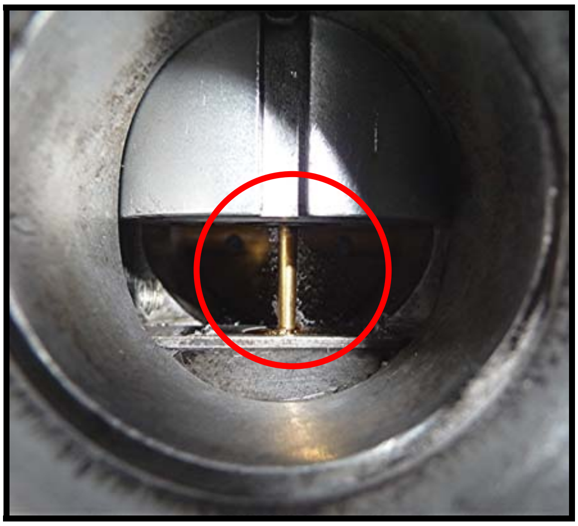


Figure 29 Atomised fuel induction

If no fuel is being induced in one of the carburettors (the other one **must** be ok for the engine to run) there is obviously issues with the fuel delivery from the bowl. This is likely to be a blocked needle valve and **both** carburettor bowls must be disassembled, cleaned and new needles and gaskets fitted.

After both carburettors show even fuel induction and atomisation, move on the next tuning stage.

3. It is preferable that the shaft connecting the throttle butterfly valves in each carburettor is disconnected at this stage. Loosen the shaft lock nuts shown in Figure 30 and insert the plastic plugs into each carb throat taking care not to foul the pistons as shown in Figure 31. Both plugs are needed because each carburettor needs to have the same air inlet (friction loss) characteristics.

Figure 30 – Loosen Throttle Shaft Clamps

Figure 31 – Plugs Inserted

4. Measure the velocity – (Figure 32) at each carb throat and adjust the idle adjuster screw(s) Figure 33 so that both carb velocity readings are the same at the idle speed of 800rpm. This will probably be about 4.0 to 5.0 metres/second but the actual figure is not important, being equal is what matters.

Figure 32 Reading Air Velocity

Figure 33 – Adjust Idling

When the idle adjuster screws have been set so that each carburettor exhibits the same air inlet velocity and the idle speed is satisfactory, tighten the throttle shaft lock nuts and replace the air cleaners.

Now using the digital tachometer, you can do the same at higher revs if desired at say 2,500 rpm with either someone in the car pressing the throttle achieving a constant speed or wedging the throttle lever open.

Fuel Mixture Adjustment

If the fuel mixture is to be checked and adjusted, you will have to remove the air cleaner backing plates as follows

1. Remove the air cleaners then loosen and remove the hex bolts holding the backs of the air cleaners in place to threaded connections in the “U” shaped brackets behind the carburettor flange. Note that the fuel line overflow pipe is bolted with “P” clips to the back of the air cleaner rear plates (Figure 34), unclip, remove hoses from float chamber and put to one side.

Figure 34 – Carburettor Overflow Pipes

2. Hold and retain the front "U" shaped bracket (see Figures 35 & 36) and restore in place using the shorter ½" hex bolts in the kit. This is needed because it forms the static part of the choke adjuster cable.

Figure 35

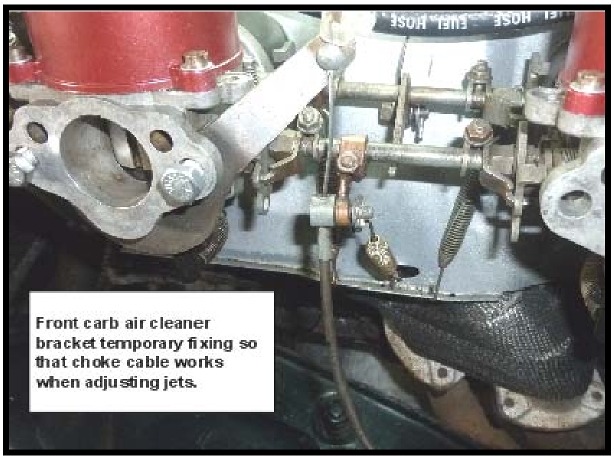


Figure 36

3. Put to one side the "U" shaped bracket from the rear carburettor – Figure 37.

Figure 37

4. One good indicator of the fuel / air mixture is the condition of the spark plugs. It is recommended that before embarking on the process of disconnecting the carburettor air cleaners to access the jets, you take the car out for a drive until temperatures are indicated as normal, don't just idle the car because this will not give an indication of plug condition.

   A traditional method is that if the plug ends are white and the electrode is pitted, then the mixture is too lean (Figure 38). On the other hand if the plug is sooty (Figure 39), then the mixture is too rich. The optimum colour is a "biscuit brown (Figure 40). If the plug is oily (Figure 41), it indicates that there is oil contamination possibly from valve stem or piston ring wear.

Figure 38

Figure 41

Figure 39

Figure 40

5. Figure 42 shows the internal arrangement of an HS4 carburettor (*reproduced from the "Bentley" Workshop Manual*" with the following parts identified:-

   1 Jet locking nut
   2 Jet adjusting nut
   3 Jet head
   4 Feed tube
   5 Piston lifting pin (see also Figure 26)
   6 Needle securing screw
   7 Oil damper reservoir
   8 Needle

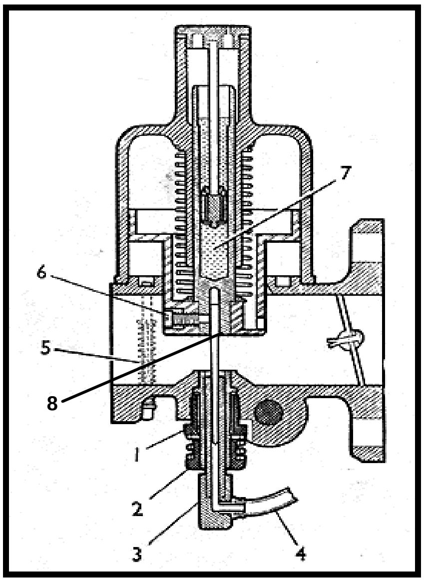


Figure 42 – HS4 Carburettor details

   Now referring to Figure 42, the jet head (item 3) has a parallel bore into which the needle (item 8) fits. The needle has a tapered diameter with the smallest diameter being at the bottom. Accordingly as the needle is raised (turning the jet clockwise), the annular space between the needle and jet increases thus allowing an increased quantity of fuel to flow into the carburettor throat, i.e. enriching the mixture.

   Lowering the needle reduces the annular space thus leaning the mixture.

6. Beginning with the front carburettor, lift the piston using the lift button Item 5 in Figure 42 and below in Figure 43. If the engine increases speed momentarily, and then settles back to the preceding speed, then the mixture is ok. If the engine increases speed and remains at a higher speed, then the mixture is too rich. If the engine increases speed and then drops back to a slower speed with hesitation and / or roughness, then the mixture is too lean. Remembering the response of each carburettor, adjust the mixture by following the procedure set out in point 7 below.
7. Now disconnect the throttle shaft and choke shaft lock nuts as shown in Figure 21. The jet adjusting nut (Figure 44) can be moved without loosening the locking nut which is only loosened when centering the jet, otherwise DO NOT loosen it.
8. Now remembering the response when lifting the piston pin shown in Figure 43 and beginning with the front carburettor, turn the jet adjusting nut (Figure 44 up (clockwise) to weaken (lean) the mixture until the engine speed starts to fall. Then turn the jet adjusting nut (Figure 44) down (anti-clockwise) to richen the mixture until the increase in engine speed steadies. Then repeat the process on the rear carburettor and tighten the locking nut. Then repeat for the rear carburettor.

   Finally check the idle speed and readjust it as necessary with the throttle adjusting screws – Figure 33 turning each by the same amount.

Figure 43 – Piston Lift

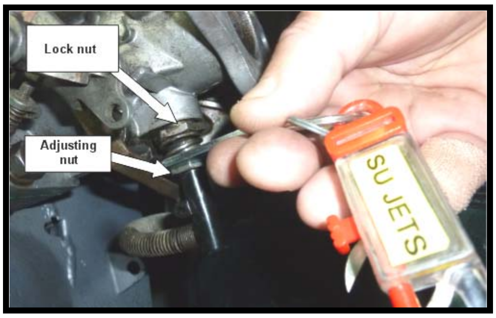


Figure 44 – Jet Adjustment

9. Now adjust the choke throttle adjuster so that there is a "40 (thou) $^{40}/_{1,000}$" or 1mm clearance when the choke is in and when the choke is pulled, the screw end bears on the throttle cam thus increasing engine speed. The jet movement should not occur until at least one quarter of the choke is out and at that point, with the engine warm the revs should be even.
10. Next readjust each carburettor balance using the air speed meter and the idle screw.
11. Lock the throttle and choke shafts before replacing the air cleaner back plates, the fuel overflow pipes and the air cleaners.
12. At some time it is good practice to clean and adjust the fuel bowl floats. Figure 45 (*reproduced from the "Bentley Workshop Manual*" shows the details.

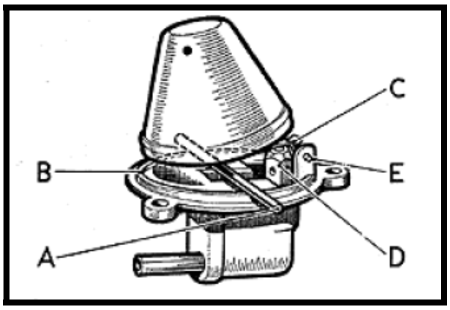


Figure 45 – Fuel Float (from Bentley manual)

A – 1/8" or 3/16" drill bit

B – Machined lip

C – Float lever resetting point

D – Needle valve assembly

E – Hinge pin

Note that early HS4 carburettors had brass floats and later ones (as in this car - MGB973) has plastic floats.

The overflow pipe off of the float bowl lid on SU carbs serves a dual function. It provides for overflows to be directed to some non-hazardous location but more importantly it is the means of venting any vapor buildup out of the float chamber. A fuel level is maintained in the float bowl by the float and float valve assembly. Fuel flows by gravity to the jet orifice. If the vent pipe for some reason becomes blocked vapor pressure can build up in the float chamber and cause severe flooding at the jet.

Remove the float bowl covers, clean the float bowls, remove old sediment, and check/adjust the float setting (turn the cover upside down, and get a 1/8" (for brass floats) or 3/16" drill bit(for plastic floats), set the drill bit across the cover, the float tab should just touch the bit. Don't press down on the float; let it rest under its own weight). Make sure the needle is moving and seating properly. Replace the cover.

If available, use compressed air or WD40 to blow through the fuel entry port with the float in the down position to clear any debris from under the needle.

Note: You can check for matching float settings, after setting the mixture and after the car has been run, by removing the pistons, and peering down at the jets. The fuel level should be about the same on both carbs, a little below the top surface of the jet.

<u>Finally – happy and safe motoring.</u>

Model Specifications

MGB Tourer and MGB GT - produced from May 1962 to Nov 1967 (GT from Sep 1965). Roadster; GHN3, GT; GHD3.

Production of the first MGB Tourer (also known as a Roadster) on 22 May 1962 and MGBGT production started in Sep 1965.

Engines: Variants: 18G - May 1962 to Feb 1964, 18GA - Feb 1964 to Oct 1964, 18GB - Oct 1964 to Nov 1967.
The 18G and 18GA engines are fitted with a 3 bearing crankshaft and from 18GB onwards the engines are all fitted with a 5 bearing crankshaft.
4 cylinder 80.26 x 88.9mm, 1798cc, 2 x 1½in HS4 SU Carbs, 95bhp (net) at 5,400rpm. Maximum torque 110lbs. ft. at 3,000rpm.
Compression ratio: as per engine number prefix, H (high compression) 8.8:1, L (low compression) 8:1.

Electrical System: From May 1962 to Nov 1967 - Positive earth electrical system with two six-volt batteries connected in series to give twelve volts output. The batteries are located behind the driver's and passenger's seats under an access panel in the floor.

Transmission: Axle ratio 3.909:1. Overall gear ratios 3.909:1 (overdrive 3.14:1), 5.369:1 (overdrive 4.31:1), 8.656:1, 14.214:1, reverse 18.588:1. Gearbox with synchromesh on 2nd 3rd and 4th gears only. Optional Laycock de Normanville D Type overdrive with a ratio 0.802:1 from January 1963. 17.9mph/1,000rpm in top gear, 22.3mph/1,000rpm in overdrive.

Suspension and Brakes: Independent front suspension (IFS), coil springs, wishbones, Anti-roll bar (optional on tourer until Chassis No 108039), live rear axle, half-elliptic leaf springs, lever-arm dampers. Rack and pinion steering. 10.75in. front disc brakes, 10 x 1¾in. rear drums. 4.0in. rims (Tourer disc), 4.5in. rims (centre-lock wire) or 5.0in. rims (GT disc).

Dimensions: Wheelbase 7ft 7in; front track 4ft 1in; toe-in 1/16th to 3/32nd in. (1.5 to 2.3 mm.) (unladen); rear track 4ft 1.25in. Length 12ft 9.3in; width 4ft 11.7in; height (Tourer) 4ft 1.4in, (GT) 4ft 1.75in. Unladen weight 2,030lb. (Tourer), 2190lb. (GT).

Exterior Door Handles: From April 1965 Body 57986 - change from 'pull' type exterior door handles to the 'push-button' type handles when anti-burst door locks were introduced.

Performance:
Top speed: 105 mph.
0 - 60 mph: Roadster 12 seconds GT 13.5 seconds.
Fuel consumption: 22 - 28 mpg.

MGB Mk II Tourer and GT - produced from Nov 1967 to Aug 1971. Roadster; GHN4, GT; GHD4 to Sep/Oct 69 then Roadster; GHN5, GT; GHD5 from there to Aug 1971.

Specification as for Mk I MGB models except for:

Engines: Variants: 18GD - Nov 1967 to Oct 1968 for home market cars, 18GF - Nov 1967 to Oct 1968 for North American cars. 18GG - Oct 1968 to Aug 1971 home market, 18GH - Oct 1968 to Aug 1970 North America, 18GJ - Oct 1969 to Aug 1970 California cars, 18GK - Aug 1970 to Aug 1971 North America.
(Federal markets) 1971 model-year, 2 HIF4 SU carbs, 82bhp (DIN) at 5,400rpm. Maximum torque 97lb ft. at 2,900rpm. Home market cars continued to use the HS4 carbs.
Compression ratio: as per engine number prefix, H (high compression) 8.8:1, L (low compression) 8:1.

Electrical System: From Nov 1967 to Aug 1971 - Negative earth electrical system with two six-volt batteries connected in series to give twelve volts output.

Transmission: From Nov 1967 new gearbox with all-synchromesh gears. Axle ration 3.909:1, overall ratios 3.909:1 (overdrive 3.2:1), 5.4:1 (overdrive 4.43:1), 8.47:1, 13.45:1, reverse 12.098:1. Optional Laycock Type LH overdrive introduced with ratio of 3.14 . From 1970 model-year (Sep/Oct 69) wheels 4.5in. rims, Rostyle sculptured steel pattern or optional centre-lock spoked (wire) wheels as before.
Borg-Warner Type 35 three speed epicyclic automatic gearbox offered as an optional extra from Nov 1967 with overall ratios 3.909:1, 5.668:1, 9.34:1, reverse 8.17:1.

Dimensions: As above but with unladen weight 2,140lb. (Tourer), 2,260lb. (GT).

Performance:
Top speed: Roadster 107 mph GT 104 mph.
0 - 60 mph: Roadster 11 seconds GT 14 seconds.
Fuel consumption: 22 - 28 mpg.

MGB Mk III Tourer and MGB GT - produced from Aug 1971 to Oct 1980.

1972 model-year (Aug 71) to 1974 model-year (Aug 73) inclusive, specification as for MGB Mk II except for:

155-14 (Tourer), 165-14 (GT) radial-ply tyres standardized on British market from start of 1973 model-year (Aug 72): all markets 1974 model-year (Aug 73). Brake vacuum-servo standardized (British market) from start of 1974 model-year (Aug 73).
Sep 1974 start of Rubber bumper production.
Dec 1974 MGB GT no longer available in North America.
1975 model-year (Dec 74) and 1976 model-year (Sep 75) inclusive, specification as for Mk II and earlier Mk III models.

Engines: Variants: 18V - Aug 1971 to Oct 1980. There were an number of variations of this engine depending on carburation and emission controls.
British models now have a recalibrated power output of 84bhp (DIN) at 5,250rpm. Maximum torque 104lb. ft. at 2,500rpm. HIF4 carbs were introduce on the home market cars from Nov 1973.
Federal models: Zenith-Stromberg carburettor. 65bhp (DIN) at 4,600rpm. Maximum torque 92lb. ft. at 2,500rpm.
Overall gear ratios unchanged except optional overdrive 3.21. 21.8mph/1,000rpm in overdrive.
The Zenith-Stromberg carb was introduced in Dec 1974.
Compression ratio: as per engine number prefix, H (high compression) 9:1, L (low compression) 8:1.

Transmission: Optional automatic gearbox discontinued in Aug 1973.

Electrical System: From Aug 1971 to Sep 1974 - Negative earth electrical system with two six-volt batteries connected in series to give twelve volts output. From Sep 1974 on with the introduction of the 'rubber bumper' cars this was changed to a single twelve volt battery.

Dimensions: Overall length 13ft 2.25in; height 4ft 2.9in. Otherwise as before. Unladen weight not affected.

From the start of 1977 model-year, specification as for earlier MGB models except for:

Suspension: Front and rear anti-roll bars now standard.

Dimensions: Unladen weight 2,253lb. (Tourer) 2,260lb. (GT).

Performance:	Top speed:	Roadster 107 mph	GT 104 mph.
	0 - 60 mph:	Roadster 11 seconds	GT 14 seconds.
	Fuel consumption:	22 - 28 mpg.	

MGB production ceased on 23 October 1980.

ENGINE TUNING DATA

18V 581F, 18V 582F and 18V 583F ENGINES

ENGINE

Type		18V.
Displacement		109·8 cu. in. (1798 c.c.).
Firing order		1, 3, 4, 2.
Compression ratio:	H.C.	9·0 : 1.
	L.C.	8·0 : 1.
Cranking pressure		Nominal 170 lbf./sq. in. (11·95 kgf./cm.²) at 275 r.p.m.
Idle speed		750 to 800 r.p.m.
Valve rocker clearance:	Set cold	·015 in. (·38 mm.).
	Set hot	·013 in. (·33 mm.).
Static ignition timing:	H.C.	10° B.T.D.C.
	L.C.	10° B.T.D.C.
Stroboscopic ignition timing:	H.C.	13° B.T.D.C. at 600 r.p.m.
	L.C.	13° B.T.D.C. at 600 r.p.m.
Timing mark location		Pointer on timing case, notch on crankshaft pulley.

DISTRIBUTOR

Make/Type	Lucas/25D4.
Contact breaker gap	·014 to ·016 in. (·35 to ·40 mm.).
Contact spring tension	18 to 24 oz. (510 to 680 gm.).
Rotation of rotor	Anti-clockwise.
Dwell angle	60°±3°.

Centrifugal advance

	Serial number 41288 (*H.C.*)
Crankshaft degrees/Speed (vacuum pipe disconnected)	0 to 6° at 600 r.p.m. 4 to 9° at 700 r.p.m. 7 to 11° at 900 r.p.m. 13 to 17° at 1,600 r.p.m. 18 to 22° at 2,200 r.p.m.