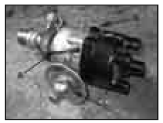
Distributor

Distributor Types

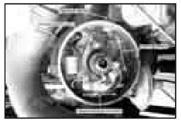
Originally all MGBs were fitted with a points-type Lucas 25D4 distributor rotating anti-clockwise. The main difference in this to other types fitted over the years is the vernier adjustment that allows for fine-tuning of timing. Originally necessary in the days when fuel octane might have been a bit variable between suppliers, since the advent of unleaded it has come back into its own. If you have your timing set to take advantage of the higher 97-99 octanes and get better performance and economy, when touring in the wilds (even in the UK) you may find you can only get 95 octane and your engine will start pinking badly. The vernier adjustment allows you to retard the timing by a couple of degrees to stop the pinking, then put it back again when you can get the higher octane. However not so convenient for changing the dwell, one would normally have to keep stopping the engine, removing the cap, tweaking the points gap, refitting the cap and restarting the engine, but there is way of simplifying the process.



From September 1974 and rubber bumper cars the points-type 45D4 distributor was used to the end of production on non-North American-spec cars and also rotates anti-clockwise. The vernier adjustment was deleted, but the points installation was improved by having a tag on the points wire that pushed into a clip on the points spring, instead of the fiddly insulating washers and nut of the 25D4. Clausager says that some cars in the 1978-80 period used a Ducellier distributor, but I've never heard of one of these being found in the wild. With these distributors to alter the timing it is a case of slackening the clamp plate bolts - or the clamp bolt itself if you are at the limit of the slots in the clamp plate - and twisting the body of the distributor plate, anti-clockwise to retard, clockwise to advance. Again to adjust the dwell one would normally have to

keep stopping the engine, removing the cap, tweaking the points gap, refitting the cap and restarting the engine, but there is way of simplifying the process.

For the 1975 model year onwards North American-spec cars had electronic ignition, as they were required to go for 50k without any engine adjustments, and points needed replacement every 10-12k. Initially the 45DE4 'Opus' system, it proved unreliable and many were replaced under warranty. A much better alternative which replaced the 45DE4 was the 45DM4, which proved to be very reliable, the system being used on many other makes and marques. More on these types can be found here.

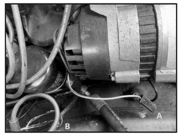


The V8 used the 35D8 points distributor throughout, which rotates clockwise . The feature of note with this distributor is the ability to change the points gap and hence dwell with the engine running by turning a hex shaft that protrudes from the distributor body. Other than that timing is altered by twisting the distributor body - this time **clockwise** to retard and anti-clockwise to advance. However as the factory V8s are low-compression and should be set up for and run on 95 octane, one normally wouldn't need to alter it for reasons of petrol.

Distributor Connections *June 2016*

It might seem obvious what's involved with a cursory glance at the distributor but there is more to it than one wire between the coil and the distributor. That wire carries coil current to the points, but it has to get to earth after passing through the points, and that is via an earth wire which is less obvious. Factory and after-market electronic systems have various ways of achieving this.

Points wire: But first the points wire. On 25D4 distributors the harness wire connects to a spade terminal on the side of the distributor. Internally that then has a very flexible cloth-covered wire connected to the points spring and hence the moving contact. On 45D4 distributors there is black plastic insulated wire coming out of the distributor that terminates in a male spade, which connects to the female spade on the harness wire, i.e. an in-line connection. Internally this wire goes to a tag which goes into a clip on the end of the points spring, and from there to the condenser. Despite being black plastic insulated this is a much more flexible wire than wiring used elsewhere on the car. The reason for these very flexible wires on both the 25D4 and 45D4 is that when driving the points plate is continually being twisted back and fore by the vacuum advance module, as the accelerator pedal moves up and down, to alter the timing, which continually flexes the wires. These wires are designed to cope with this twisting and flexing, but eventually they can fracture, which will give intermittent ignition i.e. cutting-out, and probably backfiring in the exhaust. Fortunately on cars with the electronic tachometer (i.e. not the early mechanical rev-counter) these faults will almost certainly cause the tachometer needle to be jumping about, or have dropped to zero when the ignition is still switched on and the momentum of the car is still spinning the engine. But note breaks anywhere in the ignition circuit - not just these wires inside the distributor, will result in the same symptoms. The fractures will almost certainly be inside the insulation and so not immediately visible to the naked eye. On the 25D4 the wire and spade terminal (37H2981) will need to be replaced, but on the 45D4 it is part of the condenser wire so a new condenser will be required.

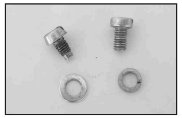


August 23: Someone on the MGOC forum had what he called a yellow/black wire coming out of the harness with the alternator wires but not connected to anything and wondered where it should go. A couple of others said the same, but it turned out that they all had late model cars with electronic ignition. It's actually the original (but discoloured) white/black wire that went from the coil to the distributor, which was puzzling as on my 73 it comes out with the coil wires and not the alternator wires. However I'm pretty sure Bee had it wrapped round the steering column at one point and someone else said the same thing. I wondered if the factory had re-routed it round the back of the oil filter to prevent that, and sure enough that's exactly what the 1978 Leyland Workshop Manual shows in its harness (yes harness, not 'loom') layout drawings for both RHD and LHD.

Points Types *Added January 2008*

Points Gap/Dwell

September 2024: Nigel has had an intermittent misfire for some time accompanied by the tach jumping about, so almost certainly something in the ignition LT circuit. Difficult to track down intermittent faults without connecting a meter or test-lamp where you can see it in the cabin to various points in the circuit and comparing what you see when the car is running as it should with when it isn't. However it also occasionally cut out altogether when run at 2k on the drive so I had high hopes of diagnosing it more easily. But he took the car to a mechanic who initially diagnosed the condenser screw as being too long and fouling the base plate. Couldn't see that causing his symptoms as all that would do would be to affect vacuum advance, although I have heard of the points screw being too long and being hit by the spinning weights which did cause ignition issues. Further examination showed that the points were faulty because the spring wasn't riveted correctly to the moving contact, so was making an intermittent connection - which definitely would cause the symptoms experienced. They were Intermotor brand from the MGOC, and another example was the same i.e. a batch problem, so a different brand has been fitted and hopefully that will be the end of it.



If replacing the condenser or points screw at any time make sure it's not too long or it can foul the weights and cause a misfire. The original screw had a plain section at the end which makes it much easier to insert when replacing the points with the distributor still fitted to the car.

Despite generally there only being two types of points distributors for the 4-cylinder MGB (both Lucas, with Ducellier a possibility) there are at least four points types - two for each.

25D4 use either a fiddly one-part (GCS101) or an even fiddlier 2-part (GCS107). These **may** be interchangeable, but I can't guarantee it as I haven't tried. On both types there a number of parts that go to make up the electrical connection and it is essential that these are assembled in the correct order (click thumbnail) or you can end up with very weak ignition because the condenser is not connected, or no ignition because the points are

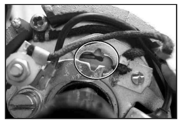
shorted out. Lucas variants of the GCS101 have a red cam follower, and the Lucas GCS107 a black. Colour may vary for other manufacturers, I have seen white. Quality may also vary with other manufacturers! Both position the cam-follower pivot over a pin on the points plate for location, and have an adjuster notch at the connection end. The 25D distributor has a spade connector on the side of the body to which the coil wire attaches. Inside, between this spade and the points, there is a very flexible cloth-insulated wire with very fine conductors inside, to cope with the continual bending which comes from the twisting of the points plate under different amounts of vacuum advance. There is another of these wires between the points plate and the distributor body, which provides the earth path for ignition current. The tags are crimped round the cloth insulation for physical strength as well as avoiding sharp bends at the edge of the tags as the wire flexes. If either of these cloth-insulated wires fray they can give intermittent ignition, usually when you alter the throttle and hence the vacuum advance, and sometimes ignition fails altogether. They do not seem to be available separately (although look to be new in rebuilt distributors), it has been suggested that 'solder wick' aka 'desoldering braid' may make a suitable alternative, but I'd advise crimping connectors to these and not soldering, for obvious reasons (I hope!). The condenser is a separate component.

45D4 have 'quick-fit' points which as the name implies are quick and easy to **connect** (although just as fiddly to fit to the points plate and adjust for correct gap) and there is less chance of getting the connections, at least, wrong. The points include a felt wiping pad which rubs on the cam, the cam must be **greased** not the pad, and not oiled.

Additionally for the 45D4 there are 'non-sliding' (GCS118) and 'sliding' (GCS124) variants. These are not interchangeable as there are significant differences in the points plate. The Lucas GCS118 are similar to the 25D GCS101 in that they have a red plastic 'cam follower' the pivot of which fits over a pin on the points plate, however the adjuster notch is at the pivot end instead of the connection end so whilst they may be interchangeable the wrong combination would be more awkward to fine-adjust. The Lucas GCS124 has a blue cam-follower, a brass peg under its pivot that locates in a hole in the points plate, and the adjuster notch is back at the connection end. These points have a 'sliding' moving contact that can move up and down relative to the fixed contact as well as to and fro as normal. There is a slotted plastic lever under the pivot which engages with a fixed pin on the distributor. As the moving part of the points plate twists back and fore under changing vacuum, the fixed pin moves the slotted lever back and fore. The lever has a cam on its upper surface and there are pegs on the bottom of the cam follower. As the lever is moved back and fore this causes the moving contact to move up and down relative to the fixed contact. Because the points are closed approximately half the time there is a 50-50 chance that they will be closed when the moving contact is moved up or down. This slides the two contact surfaces across each other, and even without sliding the two contacts will make and break on different parts of the contact surfaces. Both these effects help keep them clean and free from the spike and pit that afflicts fixed points. Note that sliding points are not shown in the Parts Catalogue as ever having been fitted to MGBs, although two of the main suppliers ascribe then to 'late' MGBs. One of them says they are for the 59D distributor, but I have seen 45D distributors with them as well albeit not an MGB reference number. You need to look at what your distributor has fitted now when buying replacements, not go by what the reference sources say was fitted to your engine or car originally.

Note that the part numbers given above are original Lucas numbers. Copies may have a similar number but have a prefix or suffix letter or number, for example Halfords refer to the GCS118 as 'GCS2118'. When I ordered (they don't keep them in stock and require payment with order) these they came in a Unipart box marked 'GCS3004' and 'Made in Turkey'! I shall be fitting these this year, it will be interesting to see if they are as good the old ones, which have remained in tolerance for dwell for several years and about 18,000 miles and given no trouble. *March 2019:* In fact I got a spring set for a 25D4 from Distributor Doctor in 2009 and fitted that shortly after. Checked for dwell at each service, this year they were 61 degrees compared to the spec of 60 +-3 degrees having done 17,000 miles, so I think I can say these are at least as good as the previous 45D4 set! There have been many reports of problems with after-market points, like the cam follower wearing down very rapidly which causes ignition problems and requires frequent readjustment. If you can get Lucas items over the counter I would do so - check the points themselves are stamped 'Lucas' and 'Made in England' (may also include references to a patent and registered design) or 'Made in UK', but beware counterfeits at parts shows and the like. **Note Lucas is now no more than a trading name with all their components being made in the same places as anyone else**, their indicator flasher units for example are not fit for purpose. So get replacement points from someone reliable like Distributor Doctor.

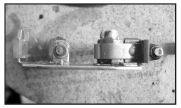
The 45D distributor still has the cloth-insulated earth wire as with the 25D, but the ignition points wire is integral with the condenser wire and the 'quick-fit' connector, and passes through the body of the distributor (via an integral grommet) to a flying spade connector to which the coil wire attaches. This wire has to cope with the same amount of flexing inside the distributor cap as the 25D wire does, and although it is more flexible than standard wire it is not as flexible as the cloth-insulated type. As such it is probably more liable to suffer from a fractured conductor than cloth insulated, but being integral with the condenser at least it is readily obtainable. Note that the conductor can break **inside** the plastic insulation, so on visual inspection it seems OK, but gives an intermittent connection when flexed and in some cases the conductors can be pulled right out of the insulation.



Points Gap/Dwell All three types have a feature to make gap-setting slightly easier, which consists of a V-notch somewhere on the points base and a matching V-notch or pip on the points plate of the distributor. By only lightly tightening the points fixing screw you can use a flat-bladed screwdriver in the V-notch to nudge the gap up a bit or down a bit until it is right, then fully tighten the screw. I always use .014 and .016 feeler gauges as go and no-go, rather than try to judge the right amount of 'grip vs slip' with a .015. And if you put a .016 feeler gauge between the contacts when first tightening the screw, you will be pretty close to the correct figure. If that is too big then use a .015, and so on. However dwell is a far more accurate way of setting and checking points gap, more info here.

Just for completeness, the points for the V8 35D8 distributor. *August 2021:* Wondering when I had last changed the points and not finding a record of a replacement spare set since 1995 (!) I thought I probably ought to change them, and

found the contact surfaces in remarkably good condition. Subsequently found the original of the above photo taken in March 2008 which was probably when I fitted them, but still 30k ago.



Bee's points have done at least 12k and possibly as much as 15k miles. I've never touched them since I first fitted them, although I check the dwell at every service and they have been within tolerance every time, which is why I've never had to touch them. Nevertheless I decided I didn't want to go on until they actually did fail, and I felt I had proved (to my own satisfaction if no one else's) that points aren't the trouble they are made out to be. When I took the old points off there was no sign of any spike and pit, which is surprising as they are the earlier 45D non-sliding type which usually suffer from it, there was just a relatively slight indentation in the larger fixed contact. I did notice that they were coated in oil or grease from the felt rubbing pad, so whether that had acted as a spark quench I don't know. Then again one would expect oil or grease on the points to be a bad thing, but it's always gone like a train. The old ones were stamped LUCAS, whereas these are unstamped in a Unipart box marked 'TURKEY'. I hoped that refers to the country and isn't a comment on their quality ... *March 2019:* In fact in 2009 I got a set of 25D4 springs from Distributor Doctor and fitted that distributor shortly after. Checked for dwell at each service, this year they were 61 degrees compared to the spec of 60 +-3 degrees having done 17,000 miles, so I think I can say they are at least as good as the previous set 45D4 set which did 18k!

Earth wire:

The points are screwed to a points plate, which as described above is being continually twisted back and fore by the vacuum advance module as you move the accelerator pedal. Some manufacturers rely on a sliding contact between the twisting points plate and a fixed backing plate, but as I found out on a Scimitar GTE this can result in an intermittent contact and a misfire just as you accelerate to pull out of a junction, which is most unwelcome. The Lucas 25D4 and 45D4 have a very flexible cloth-covered wire (similar to the 25D4 points wire) between the points plate and the distributor body. This copes very well with the twisting action for many years, but eventually will fray and/or fracture giving intermittent ignition as described above, and need replacement. Never shown in the Leyland Parts Catalogue for the 25D4 (where one end is spot welded to the points plate) it was drawn for the 45D4 but not listed with a part number. Moss Europe list an alternative which in their words may need 'some adaptation' for the 25D4 but should be a direct fit for the 45D4. John Richards seems to have the original 45D4 type however they say 25D4 and it may be a bit short. Powerspark have an alternative, Watford Classics ditto at one point, all three cheaper than Moss and with loop terminals both ends for the 45D4, so the same adaptation may be needed for the 25D4. One tip from MG Experience is to use a length of desoldering braid with through-hole tags crimped to both ends.

Condenser *October 2009:*

Testing

If replacing the condenser or points screw at any time make sure it's not too long or it can foul the weights and cause a misfire.

There are two types of condenser used in the MGB - one with a short wire and bolt-through terminal that connects to the points on the 25D4 distributor used on chrome bumper cars (GCS101), also V8s (GCS108), and one with a longer wire with quick-connect 'terminal' to the points near the condenser and the end of the wire with the male spade going out through the distributor body connecting to the harness on 45D4 distributors used on rubber-bumper cars (GSC110 or GSC2109). Note that parts are usually supplied according to the vehicle year, but as the 25D4 and 45D4 distributors are physically interchangeable you must order the condenser by the type of distributor, not the date of the car.

I've never had a condenser (an old-fashioned term for 'capacitor') fail in 40 years, but I've been carrying a spare in each of my MGBs for probably the whole time I have had them. However current stock from many of the usual suppliers are a different matter and there have been reports of new ones failing within days. For that reason you should always get replacements from a specialist such as Distributor Doctor, ditto rotor arms.

Ignition Theory will explain the function of the condenser, which isn't just to prevent points burning but significantly boosts the energy in the HT and the spark at the plugs. The reduction in points burning is merely a side-effect of putting energy into the spark instead. A diode would be much more effective at quenching the spark at the points, but would greatly reduce the spark at the plugs. When the condenser isn't in circuit the plug spark energy is much reduced but will just about jump a plug gap, but that is 'on the bench' i.e. plug out looking at the gap. Under compression the spark finds it harder to jump the gap and fire the mixture. So it is possible that your engine will start and run, but misfire badly under acceleration. The tach will be relatively steady while this is happening, so you know it isn't anything else in the primary circuit like points, coil primary, ignition supply or connections. Note that this symptom is identical to when the HT circuit is breaking down somewhere, like at the rotor or distributor cap, because the HT voltage has to rise higher before the spark can jump the plug. But if you can reproduce the problem with a timing light connected to the coil lead and plug leads you can isolate it a bit more by watching the flashes as it happens. If the flashes start getting erratic or missing altogether on the plug leads but not the coil lead, then you know the problem is with the cap and/or rotor. If the erratic flashes are on the coil lead as well, then it will be coil or condenser. The condenser is much cheaper (and should be carried as a running spare anyway) than a coil, and you don't even have to disturb the distributor to test the theory. Simply croc-clip the condenser between the points terminal on the coil (white/black) and earth (case to earth although they are not polarity sensitive) and if that solves the problem you know it is the condenser. If not it must be the coil, although coil HT failures seem to be very rare.

It's held that while condenser capacitance (nominally 0.22 micro-farads) can drift, usually with little if any apparent effect on running, when they do fail they usually do so completely and for good. But I have heard of condensers with a poor mechanical connection between the foil and the case or wire, and these could exhibit intermittent or heat-related failure as well as complete and permanent failure.

Testing: If your condenser has failed the engine will either run very poorly or not at all. A quick test is to compare the spark at a spare plug laying on the block from flicking the points open by hand, with tapping the distributor wire on and off the coil terminal - ignition on and points closed in both cases. The spark at the points should be far far less than you get by tapping the wire on the terminal, and give a better spark at the HT lead. If they are both the same the condenser has failed. To confirm temporarily connect a good condenser between the distributor terminal at the coil and earth. If the engine now starts and runs normally the internal condenser has failed. If it makes no difference either your spare condenser is faulty, or it is something else. Note that having a second good condenser connected for testing will have no adverse effect on a running engine. Obviously if the engine is running normally there is no need to leave it connected, but to give you a quick getaway if your internal condenser should fail you could mount a spare to a coil bracket bolt but leave its wire - fitted with a female spade - disconnected, ready to connect to the distributor terminal at the coil if needed. You can get purpose-made external condensers, but £40 (Feb 2025) a pop is ridiculous. Neither do I consider the MGOC after-market item at £20 worthwhile. Get one from Distributor Doctor instead - 25D4 or 45D4 each at £11. And if you have an original that is working well, **don't change it just for the hell of it!**

It's possible to do a crude go/no-go test of a condenser using an ohmmeter. Connect the meter probes to the condenser one way round, then connect them the other way round. Each time you reconnect them you should see a pulse on the meter needle or change in digital display before it falls back to zero. Note that the pulse will be bigger on reconnecting than on first connecting, so you may not see anything happen on the first connection. What you are seeing with the first connection is a pulse of current as the condenser charges up from the battery inside the meter. When you disconnect the meter the condenser stores that charge, and when you connect the leads the other way round that stored voltage discharges into the meter before it charges up in the other direction. That doubles the current flowing through the meter (like connecting two batteries in series) which is why reconnections give a higher pulse than the initial connection.

Rotors

Rotor Problems
Rotor Phasing

Rotor problems:

There seems to be a problem with current rotors, at least from some manufacturers, breaking down after a short period of use. The problem could be caused by the round-headed rivet as on the rotor on the left in this image (click thumbnail) being too close to the distributor shaft when fitted. If the line of the rivet is **outside** the circular base of the rotor body, i.e. more than halfway from the centre of the rotor contact to its tip, it should be OK. Note the rotor on the left in this case is from an aftermarket electronic ignition system and has magnets to operate a Hall-effect trigger in the collar at the bottom and hence is deeper than normal.

December 2009: You can test a rotor for breakdown as follows. Remove the coil lead from the distributor cap and the cap from the distributor. Turn the engine until the points are closed, if not already so. Turn on the ignition, hold the free end of the coil lead about 1/8" away from the brass part of the rotor while you flick the points open. If a spark jumps the gap the rotor has broken down. **NOTE:** If the rotor has **not** broken down then a very high voltage will be developed at the coil lead so an insulated implement should be used to hold the lead, even by its insulation.

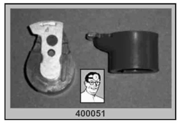
January 2010: Note that it is normal for a rotor to show burning along its curved edge as the plug jumps a gap between it and the contact inside the cap as well as at the plugs. Note also that the burning is usually along a significant part of the curved face as the relationship between rotor and cap contact changes with vacuum advance (see 'phasing'). Ideally it should be central with a clean area at either end, but I've never seen this in practice, it being biased to one end. Potentially this means the rotor could just have passed (or not quite reached) the cap contact as the spark occurs. If this gap gets too big it could stop plugs firing, and note this effect has been seen with some electronic triggers.

April 2010:

Another failure, this time within hours of installation. This has a domed rivet a bit further away from the shaft, but not as far as some. Distributor Doctor discusses this problem putting it partly down to a more conductive insulation medium, and a long rivet which is too close to the spring (which is against the shaft). He puts the higher conductivity down to a higher carbon-black content, but carbon-black - despite the implication in its name i.e. carbon rods being used in arc-lamps and dry-cell batteries - when used as a dye as here, is non-conductive. Two other forum

threads on the problem from British-Cars.net and the Marlin Owners Club. However the original poster on the British-Cars.net includes a photo of three failed rotors, one of which looks to be the problem style, but another looks to be an original 'no rivet' style and the third is very similar to the Distributor Doctor's TR style with the 'rivet' miles away from the shaft. There has to be suspicion of some other problem in that case, maybe excessive plug gap causing a raised HT voltage.

March 2013:



In the last year or so 'red' rotors have become available from Distributor Doctor which have an improved insulator in red material and no rivet, and these are the ones to go for. However at Stoneleigh in February I was struck by just how many people had red rotors for sale, and it occurred to me that the unscrupulous will almost certainly start making inferior rotors with red insulators. I go to Distributor Doctors site while writing this update and sure enough that's exactly what he says is now happening, and he is having to emboss his with 'DD'. So go for the supplier, not just the colour.

September 2020: If that wasn't enough it seems that some rotors have an internal resistor that can fail, although possibly only for more modern applications than the MGB, and as it seems to be from German legislation possibly more likely to be Bosch items. Typically 5k ohms but can be less, it serves the same purpose as suppressed leads or caps, but if you have those plus the resistor rotor plus resistor plugs you could start to impact on spark energy.

Rotor Phasing

I first wrote the following in response to someone who wanted to fit a Crane system with electronic trigger but had lost the information on how to adjust the position of the trigger to obtain the correct 'rotor phasing', which is the relationship between cap, rotor and trigger. It is not normally an issue for points systems.

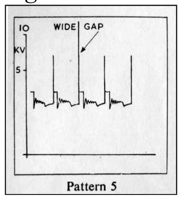
When vacuum advance is applied the points plate moves clockwise relative to the dizzie cam and the rotor arm, and this causes the spark to occur at different relative positions of rotor and cap. You can see the effects of this movement by looking at the edge of the rotor arm. You should see that quite a large part of it shows some burning, this is normal. If the phasing were incorrect the spark could occur before the rotor had reached the cap contact, or after it had left it, and hence you could lose HT. In fact I notice from one of my rotor arms that the burning goes from the middle right up to one edge. This could be causing loss of HT at one extreme of vacuum advance or the other, but since I have never noticed a misfire I assume my points must be right at the limit of correct phasing. Ideally the full range of movement would, occur within the centre section of the rotor arm leaving small unburnt areas either side.

I have a bench rig that I use for testing centrifugal and vacuum advance of distributors so it was relatively easy to connect the coil direct to a plug and with the distributor cap off use a timing light to show me where the rotor arm is when the points open. Of course, the timing light flashes four times in each revolution, hence 'freezes' the rotor arm in four positions instead of one. I would imagine you could get a similar effect on the engine as follows: Remove the plugs to make life easier for the starter and battery and connect the output of the coil to a plug laying on the block somewhere. Disconnect the vacuum advance pipe. With the cap on, wrap a piece of stiff wire around the body of the distributor with one end laying up the side of the cap right in line with one of the plug leads - doesn't matter which one, whichever is easiest to see, then remove the cap being careful not to disturb your wire 'pointer'.

Crank the engine and with a timing light connected to the coil wire (note that a 12v timing light may need to be powered from a separate battery or car to work reliably when cranking) point it at the rotor and you should see it 'frozen' in four positions. Adjust your trigger so that your pointer wire is near the **trailing** edge of the rotor arm contact. If it is too near the leading edge then when vacuum advance kicks in the rotor arm will move away from the plug lead contact in the cap when the spark occurs and could interrupt the HT.

Depending on how hard you can suck you may be able to create enough vacuum to move the points plate, in which case you should see the rotor arm appear to move in a clockwise direction in the flash of the timing light. If you have a MityVac, or can get your fingers or a lever in there without getting in the way of the rotor arm, twist the points-plate against the spring-loading of the vacuum module as far as it will go and make sure your wire pointer is still within the width of the rotor arm contact.

August 2013:



Pattern 5

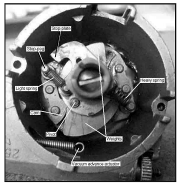
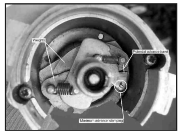
If you have access to an oscilloscope then you may be able to see the effect of the rotor moving away from the cap contact by there being an increase in HT voltage between minimum vacuum advance and maximum vacuum advance - click the thumbnail to see the likely effect of this. Peak HT voltage is more a factor of the air gaps in the system - usually considered to be the plug gaps - than advertised coil voltage, but there is the (normally) small gap between the rotor and the cap contact to be considered as well. If your rotor moves away from the cap contact during HT pulses then this gap gets larger, and the measured HT voltage will increase. You don't need to make electrical contact between the oscilloscope probe and the HT lead (indeed it would be unusual for anything other than an engine analyser to be able to cope with voltages of 10kV or so), just physically attach the probe to the outside of the insulation somehow, and that should be enough to pick up radiated energy with the oscilloscope switched to a suitably **low** input voltage.

I also wondered about the effects of centrifugal advance on phasing. I came to the conclusion that because the relationship between cam and points doesn't change with centrifugal advance like it does with vacuum advance, then the phasing doesn't change either, and indeed was able to confirm that on the bench.

Added January 2010: Note that with a fully electronic distributor like the 123 both centrifugal and vacuum advance will change the phasing i.e. the relationship between rotor and cap because the distributor shaft is solid (no weights or springs) and both cause the trigger point to be advanced electronically.

Centrifugal Advance

Centrifugal advance is obtained by turning the upper part of the distributor shaft, carrying the points cam, relative to the lower part of the shaft and hence the position

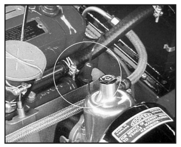



of the crankshaft and the pistons in the cylinders. Because the distributor rotates anti-clockwise, centrifugal advance turns the upper part of the shaft also anti-clockwise relative to the lower part, to open the points sooner for a given position of the piston in the cylinder and hence advance the timing. The lower part of the shaft has a pair of weights restrained by springs. The faster the shaft spins the more the weights will try to fly out, up to a maximum controlled by a stop-plate. The springs give a varying amount of advance through the rpm range depending on their strength and other factors. One of those factors usually relies on there being two different springs - a weak and a strong, the weak being 'tight' on its mounting posts and the strong being loose i.e. having free play. This means that as the distributor spins up from a standstill only the weak spring is restraining the weights, so they move out a relatively large amount, advancing the timing a relatively large amount for each step increase in rpm. This movement eventually takes up the free play in the strong spring, then that is also restraining the weights, so the same step increase in rpm moves the weights out and advances the timing a relatively smaller amount than before. This gives the curve its characteristic 'knee' which can be seen - in varying positions on the rpm range and to varying degrees - in most if not all MGB distributors.

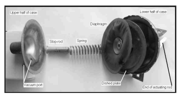
Vacuum Advance *Added January 2008*

General description:

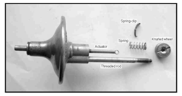
As described here the vacuum module is part of the system that changes the spark timing according to various conditions pertaining at the time. Specifically, it adds more advance under cruising conditions and a light throttle, and less under acceleration i.e. a heavier throttle. There is a difference between the vacuum and hence amount of added advance at idle depending on whether the vacuum source is a carb (prior to 1971 North America, 1975 RHD) or the inlet manifold but that is purely an emissions measure and doesn't affect running, off idle the conditions are the same.



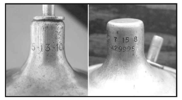
Mk1 cars used a copper tube with fuel trap to connect the rear carb to the vacuum module, Mk2 used a plastic tube with rubber connectors at each end.



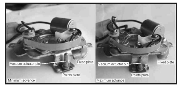
The vacuum module consists of a flexible diaphragm in a chamber which is open to atmosphere on the distributor side and sealed on the suction side. The suction side has a port which was originally piped to the top of the rear carb on HS carbs on 4-cylinder models, moving to the inlet manifold on North American and other export models from August 1971 when they gained 18V engines and HIF carbs, but not until September 1976 on UK cars even though they gained HIF carbs - the rear carb having the port underneath - in November 73. V8s were always connected to the nearside carb underneath. On the vacuum side of the diaphragm there is a coiled return spring. The strength of this spring determines how far the actuating lever will move the points plate under a given amount of vacuum. How much this spring is compressed at rest, in conjunction with its strength, also controls how much vacuum is required to start moving the diaphragm. Inside the spring is a stop-bar, the length of which determines the maximum amount the diaphragm can move, and hence the maximum additional vacuum advance that can be applied. An actuating lever is attached to the distributor side of the diaphragm, which locates on a pin on the points plate inside the distributor, to twist it clockwise (on the 4-cylinder, anti-clockwise on the V8) as the level of vacuum increases, which causes the points to open sooner and so advance the timing. As vacuum advance is applied the relationship between the points (or other trigger) and the rotor is changed, so the HT spark will occur when a different part of the rotor is adjacent to the cap contact (see 'phasing'). This is why rotor contacts are usually an arc, some longer than others. If changing the vacuum advance characteristics i.e. increasing the amount of vacuum advance that is applied make sure the rotor arc is long enough or you could get HT problems at one extreme of vacuum advance or the other, if the rotor contact starts moving away from the cap contact when the spark occurs. If replacing a rotor, make sure the new one has at least as wide an arc as the old one.



The module for the 25D distributor had a knurled adjuster wheel on a threaded rod which allows the whole module to be moved in and out of the distributor body by a certain amount. This effectively alters the static timing, and hence the starting point for both centrifugal and vacuum advance curves. Originally this was to cope with varying grades of fuel which might be encountered when touring, when the majority of fuel supply was from small independent suppliers (originally chemists!) and fuel quality and octane rating could be very variable. With the spread of national and international chains of filling stations and standardisation and quality control of fuel grades many years ago the need for this adjustment vanished, which was probably one of the reasons why the 45D was introduced with a fixed vacuum capsule (another being cost-reduction as ever). However it is relevant again with the very low octane rating of standard unleaded (95) compared to the original 4-star leaded (99+), and even Super unleaded may only be 97 or 98 octane from some suppliers. Whilst national and international chains of petrol stations usually have both grades, the smaller independents particularly in rural areas often don't. So if you have your timing set to run on Super, you will usually get significant pinking on 95 with a high compression engine, and I have had to adjust the timing when touring Scotland in the past. If I'd had a 25D installed at that time it would have made it much easier, as it was I had a 45D so it was out with the spanners. It depends on how many serrations you have around the edge of your knurled wheel and hence how many clicks for a full turn, but typically about 10 clicks equals one degree of timing adjustment. Mine has 35 serrations, and can go through 7 full turns, which gives plus or minus 12 degrees timing adjustment from a central position.



The characteristics of the module are stamped on the upper casing as three groups of numbers e.g. '7 15 8'. In this example vacuum advance will start to be applied at 7 in. Hg. of vacuum, maximum vacuum advance will occur at 15 in. Hg., and the maximum amount of advance that will applied is 8 degrees. This is 8 **distributor** degrees, which doubles when read at the crankshaft i.e. to 16 degrees in this example. MGB vacuum modules vary considerably. Vacuum advance can start at anything from 3 to 10 in. Hg., maximum advance can be reached at anything from 8 to 15 in. Hg., and the maximum additional advance that can be applied ranges from 6 to 24 **crankshaft** degrees. The V8 distributor starts at 5, finishes at 17, and applies 16 **crankshaft** degrees.

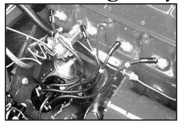


The vacuum capsule changes the timing by pulling and pushing on a pin on the points plate, which twists it and changes the relative position of the points and the cam. When vacuum is applied to the capsule it pulls on its rod, which twists the points plate clockwise (on the 4-cylinder, anti-clockwise on the V8), which advances the points relative to the cam and so advances the timing. 45D4 distributors with sliding points have an additional feature whereby as the points plate twists a fixed pin acts in a slotted cam on the points, which causes the moving contact to move up and down relative to the fixed contact as the vacuum and hence the amount of vacuum advance changes. This means the point are continually making and breaking at different points on their surfaces, which reduces if not eliminates the pitting and spiking of old.

November 2022: As I need to replace some of the vacuum connections on the V8 I did some browsing. Early cars had a copper pipe 12H733 with a cylindrical 'fuel trap' mounted in bracket 11H841 between the top of the rear carb and the vacuum capsule with a straight rubber connector ACH9041 at the carb and a screwed connection at the capsule. Subsequently plastic tubing 37H4229 was used with either a straight rubber connector 12B2095 at each end or on 18V engines one right-angle rubber connector 12B2062 at the carb (under the carb with HIF, later inlet manifold) and one straight 12B2095 at the capsule. No fuel trap probably because with the port at the top even with the right-angle connector any fuel should always run back into the carb, and I've never had a problem with capsules on the 4-cylinder. V8s use right-angle connector 12B2062 at the carb and straight 12B20956 at the capsule, and with the carb port underneath on the HIFs and the pipe angled downwards all the way to the capsule fuel can run down and rot the capsule diaphragm.

June 2016: It should be noted that this continual twisting back and fore as you move the accelerator pedal can eventually fracture two wires inside the distributor. One of these is the points wire that passes through the distributor body of course, and the other is a less obvious earth wire between the points plate and the distributor body. On 25D4 distributors the points wire is a short length of very flexible brown cloth-insulated wire from the spade terminal to the points, but on 45D4 distributors it is a longer grommeted wire that passes through a hole in the distributor body to a male spade terminal which connects to the harness, and internally goes to a tag that attaches to the points and on to the condenser. A new condenser is required if the wire fails. On both types the earth wire is the same type of very flexible brown cloth-covered wire as the 25D4 points wire, see here.

Positioning: *May 2024*



I'm surprised at the variation in vacuum capsule positioning in various photos.

- The correct position of the **rotor** at TDC on the compression stroke of No.1 cylinder is at about 2 o'clock, and that cap contact should go to No.1 plug. The usual position for the vacuum capsule is pointing upwards as that is the most convenient position for the vacuum tube to go up and over the rocker-box, and be clear of other engine components.
- The distributor can only engage with the drive gear in one rotational position because the drive slot is slightly offset to one side.
- With the rotor positioned correctly instead of the vacuum capsule pointing upwards the distributor could be turned such that it is pointing right, left or down i.e. 90 degree intervals and the engine will still run correctly, it's just a matter of positioning the leads in the cap such that No.1 plug lead is at about 2 o'clock and so-on.
- The distributor could have been dismantled and the two halves of the shaft assembled incorrectly which will put the rotor 180 degrees out.
- The drive gear has 9 teeth where it engages with the camshaft gear so that it can be inserted in any one of nine positions, only one of which is correct. This means there are eight possible incorrect positions of the rotor when No.1 piston is at TDC on its compression stroke, each multiples of 40 degrees from the correct position. The WSM describes how to install the gear correctly but Haynes is incorrect which puts the rotor 180 degrees out.

But Clausager shows the vacuum capsule anywhere in a 90 degree arc from about 11 o'clock to about 2 o'clock - how can that be? One possibility is on the 25D4 with it's vernier adjustment giving a timing range of plus or minus 10 degrees. Nominally this would be centred on the book value for timing, giving up to 10 degrees variation either side of that. But if the vernier adjustment was positioned at one of its limits then the distributor body would need to be twisted 10 degrees from the norm to get the book timing - but only 10 degrees at the most. Another is known to come from some electronic ignition modules. These can have a significantly different 'trigger point' i.e. spark generation compared to the points they have replaced, and the distributor has to be twisted to get the timing back to how it should be. In extreme cases that can put the rotor away from the cap contact at the point of firing and the spark has to jump a much bigger gap. It would be interesting to see the rotor positions when the capsule position varies from the norm.

45D4 capsules have the port coming off the capsule at an angle instead of off the end for 25D4 so that may have an impact on what fouls and what doesn't. With the capsule pointing vaguely upwards the cap clips on a 25D4 are top and bottom and the bottom one is a pain to get of with the steering rack in the way. By contrast 45D4 have the clips on the sides when the capsule is pointing upwards, so much easier to deal with.

Someone on the MGOC forum was having problems adjusting his timing by twisting the distributor body as the vacuum capsule tube was fouling the oil gauge hose from the block. In that case his was 90 degrees out so it was a case of turning the distributor 90 degrees clockwise, then moving all the leads round one position anti-clockwise,

which kept the firing positions the same, and the capsule was then pointing upwards. With a 25D4 by positioning the vernier adjuster in the middle of its range before resetting the timing would give the best range of 'easy' adjustment in the future.

Transmission Controlled Vacuum Advance (TCSA): *April 2013*

North American spec cars from late 76 had a system of inhibiting vacuum advance until 4th gear was selected. Clausager says this was to prevent the engine surging when the clutch was operated, which was presumably an unwanted by-product of all the emissions equipment that had been added to the cars by then. This consisted of a vacuum switch or solenoid in the vacuum pipe between the inlet manifold and the distributor, which when unpowered disconnects manifold vacuum from the distributor. With the solenoid released the distributor side is opened to atmosphere to dissipate any vacuum already in the vacuum advance capsule. The solenoid was energised, to connect vacuum to the distributor, by a switch or switches on the gearbox that only operated in 4th gear. The diagrams show a third gearbox switch, possibly this microswitch that operates in Reverse, 2nd and 4th, in series with the overdrive inhibitor switch that still operated in 3rd and 4th. Thus power was only supplied to the TCSA solenoid when the gearbox was in 4th gear. Whether the additional switch proved unreliable, or whether it was simply penny-pinching I don't know, but it wasn't long before the microswitch was deleted and the overdrive inhibitor switch modified (like V8s) to operate in 4th gear only, powering both the TCSA and the overdrive. By this time the manual switch for the overdrive was on the gear lever, and that circuit was ignition supply - gearbox switch - manual switch - overdrive solenoid so overdrive could still be manually switched on and off in 4th gear. The TCSA feed came off the gearbox switch i.e. before the OD manual switch, so the TCSA solenoid was powered all the time in 4th gear.

V8 Vacuum Module:

I have had to replace this unit (608194A) twice in the first eight years owning Vee and they are very expensive - in the region of £35 a time. In both cases petrol had caused the rubberised diaphragm inside the unit to shrink and pull out of the seal, which allows outside air to be drawn up the vacuum pipe into the carb. This results in a weak mixture on one carb as well as no vacuum advance when cruising. Having said that I noticed no difference in running, performance or economy when they had failed and only detected it when checking the distributor at routine servicing.

I think this occurs because on the V8 HIF the vacuum port is on the bottom of the carb throat, therefore any liquid fuel in that area will run into the port and from there along the pipe to the module, which is downhill all the way. I notice early MGBs with the copper vacuum pipe have a chamber near the carb end of the pipe attached to a head bolt or similar which is described as a 'fuel trap'. This is also positioned above the carb throat so will have the same effect. But my roadster has the plain plastic pipe and as I say hasn't had the same problem, almost certainly because the carb port in HSs is on top of the throat and the pipe runs up before it goes down to the distributor so fuel cannot get into it anyway.

Someone mentioned getting a fuel or vapour separator as used on some later BL cars but when I went to the MG Rover dealership they were very unhelpful insisting I give them model details before they would look on the computer, so after the second replacement I decided to make something myself.

I reckoned all I needed was a small chamber, mounted higher than the carb port, and with the carb pipe going in the bottom and the distributor pipe coming out the top. So even when fuel pools in the port and the first section of pipe it should never get high enough in the chamber to reach the top pipe and run down to the distributor, carb suction and the relative heights being enough keep the distributor section of the pipe clear.

Amongst my treasure trove of bits I found a cap used to seal off the end off the open end of 1/2" copper water pipe. I cut out a disc of copper to seal the open end and soldered it on to make the chamber, soldered a short piece of steel brake pipe vertically into the bottom as the 'inlet' (carb) and another piece horizontally near the top for the 'outlet' (module). I did one vertically and one horizontally so I could use the same rubber connectors as used at the V8 carb and module i.e. one angled and one straight. Originally this was so I could get a pair of V8 items knowing they would fit but then I noticed an old 1.0L Metro engine I have kicking around in the garage uses the identical items. Unfortunately the angled one split shortly after fitting but at least I could quote the Metro at the MG Rover Parts place instead of getting an old-fashioned look when I quoted the V8. Got a shock when he quoted the price though, about a tenner, even the salesman was embarrassed.

I made a bracket that bolted under one of the accelerator cable bracket bolts, shaped such that I could clamp the cylindrical body of my chamber to it using a worm-clip, cutting the plastic vacuum pipe in a suitable place for the two rubber connectors. The position of the chamber is such that the whole of it and the angled connector is well above the bottom of the carb port, the top of the chamber being just about level with the top of the carb mounting flanges, so there should be no chance of fuel getting into the chamber, let alone high enough to get into the distributor pipe. Time will tell. Click on the pictures at the left for enlarged views of the general construction and placement.

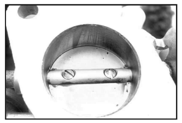
November 2022: That seems to have worked well for many years but then investigated different dynamic timing measurements at successive routine services - despite the car running better on 97-99 octane now than she had ever done on the 95 she had always used! Rotor was free - twisted anti-clockwise (this distributor rotates clockwise) it flicked back with no hesitation and negligible slop. Sucked on the vacuum pipe at the capsule (easier to get at that at the carb) and it did not move the points plate, and only holding a bit of vacuum. Pushing at the points plate with a screwdriver it moved, but seem to require a lot of force. So capsule suspect again as well as possibly the points plate. But one of the rubber connectors on my separation chamber is perished with splits showing so the first job is to replace all four of them. The one at the capsule had always been held on with a cable-tie, I maybe should have replaced that years ago but the points plate was moving originally so was obviously sealing and given the cost at the time wasn't worth it! With the benefit of the internet now not only do the usual suspects give the original part numbers, but Googling the numbers reveals a whole raft of suppliers, with prices now less than £2 each. The usual suspects and some eBay sources add a fair bit on for P&P, but Wood & Picket

have both the right-angle and the straight for that price with free 3-day postage. I get two of each with my separation chamber, and get a 10p discount off the total price into the bargain. Current prices for the capsule 608194A range from £46 inc. VAT and P&P from Clive Wheatley up to £150 plus £30 P&P from Italy! One MG supplier does have them at £39 inc. VAT plus P&P but I refuse to use them as they have repeatedly supplied faulty or incorrect parts. But I'll wait for the connectors, and check the full length before splashing out on one of those.

Any road up, as they say, the W&P items arrive just a couple of days later. I'd not investigated the old ones until they arrived - no point taking them off only to have to put them back if I could use the car, but took them off now. The long distributor pipe with the two straight connectors leaked when sucked - both split and replaced. Back on the capsule, sucked, and the points plate was moving as it should - result, £50 not needing to be spent! The two right-angle ones on the short carb pipe held a vacuum, but they were a sloppy fit on the fuel trap pipe at least so both those replaced as well. Tested the full length through the fuel trap to the distributor and points plate still moving so all good now, and confirmation that the fuel trap has done its job as that capsule has been in 20 years now.

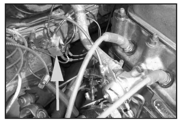
Carb vs Manifold Vacuum:
After many years of discussion over the differences - can a carb distributor be used on a manifold engine? (Yes and vice-versa) Is one vacuum advance and the other vacuum retard? (No, they are both vacuum advance) Are the vacuum advance curves completely different depending on connection? (Not when running, only at idle and just off it) - I decided to do some tests to show how little difference there really is between the two and that any distributor can be carb connected **or** manifold connected.

The first thing to reiterate is that it doesn't matter whether a distributor was fitted to an engine with carb vacuum or manifold vacuum, the advance mechanism in the distributor is identical - the more vacuum that is applied the more advance is applied and vice-versa.



The second is that the only difference between the two is at idle and just off it. Manifold vacuum is high at idle reducing to almost zero as the throttle is moved towards fully open. Carb vacuum is zero at idle as the butterfly plate covers the port and the port is effectively on the piston or low-vacuum side of the butterfly. As the throttle starts to open the port is uncovered and is effectively moved to the same side of the butterfly as the manifold port i.e. the high-vacuum side. Therefore the vacuum rises very rapidly, and when the throttle is only slightly open it becomes the same as manifold vacuum, thereafter it reduces gradually to almost zero as the throttle is moved towards fully open, exactly as manifold vacuum does.

I had recently obtained a TCSA vacuum solenoid from Gordie Bird (for some experiments with knock-sensing retard) which I modified slightly to provide a short tube on the atmosphere port in place of the filter. This allows the solenoid to acts as a 'change-over' switch passing vacuum from one of two sources depending on whether the solenoid is powered or not. My car has carb vacuum so that was one source. I have had a vacuum gauge for nearly 40 years that I used to use for tuning as well as economy driving, and had made an adapter to screw in place of one of the blanking plugs on the MGB manifold, so that was the other source. Thus a simple on/off switch taped to the bracing bar behind the dash allowed me to select the vacuum source. I made a 'T' junction and inserted this between the solenoid and the distributor to connect the vacuum gauge so I could see the signal the distributor was receiving. The following two pictures show the vacuum connections to carb and inlet manifold, and the solenoid and its connection from the vacuum sources and to the distributor and vacuum gauge:

In the cabin I attached the vacuum gauge with a bracket to one of the screws holding the centre console in place and rigged up a simple pointer that moved across the face of the gauge as the throttle was opened. The next two pictures show zero throttle with the pointer at the left, and full throttle with it at the right (engine off!):

The remaining pictures show the vacuum signal at various speeds and throttle openings, carb signal on the left and manifold on the right. The first pair are at a steady 20mph on the flat in 3rd gear. Even with the very small throttle opening carb vacuum is already at 10 in. Hg. with manifold at 19. Incidentally this manifold reading is **higher** than at idle as the engine is operating more efficiently:

The next pair are at about 25mph on the flat in 3rd gear now the throttle has opened a bit more carb vacuum has risen to about 13 but manifold has fallen to 17:

The final pair are at about 30mph, and carb and manifold vacuum are virtually identical at about 14 in. Hg.:

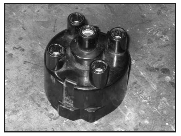
As you can see the throttle opening is still very small from the position of the pointer. At any higher throttle openings the vacuum falls away on both at the same rate. All these readings were taken at a steady speed on the flat. Under light acceleration vacuum will be significantly less than this, and under significant acceleration it will be much lower and the resultant additional advance will be zero. The important thing is that **both carb and manifold vacuum give the same results in most normal driving conditions.** The only reason for the change is that manifold vacuum results in a higher idle speed than carb vacuum. This allows the idle screws to be backed off slightly to achieve to same idle speed, which reduces fuel consumption and hence pollutants. The final thing to remember is that UK cars didn't get manifold vacuum until September 76, **but had the same engine and distributor from the start of rubber bumper production in 1974 to the end of production in 1980**. Which itself is surely proof that the two are interchangeable.

See also http://www.iwemalpg.com/Vacuum_gauge.htm which has information on using a vacuum gauge for fault diagnosis.

Distributor Caps *Added April 2010*

Side-entry (Mk1 originally) for screw-fit leads and top-entry (Mk2 and CB production to November 73) for push-fit leads are available for the 25D4. The side-entry cap accepts leads with cut ends - either suppressed or copper - and are secured in the cap with screws.

Top-entry types accept ready-made suppressed leads fitted with terminals which are a simple push-fit. Straight cap connections can rub on the steering column UJ on RHD cars but right-angle types are available for both 25D4 and 45D4 which avoid that.



For the 45D4 (from 18V779/780 in November 73) the cap is GDC132 top-entry push-fit leads. The same cap was used on North American 45DE4 and 45DM4 electronic units but like the 25D4 top-entry on RHD the leads can rub rub on the steering column UJ but again right-angle types are available which avoids that. The beauty of the 45D4 is that when fitted to the engine with the vacuum capsule uppermost the cap clips are on the sides so easy to access, particularly on RHD, unlike the 25D4 where the clips are top and bottom.

Side-entry versions were used on the classic Mini screwed to the distributor body, but several suppliers show DDB194 side-entry push-fit caps that can be secured with either screws or clips so should be suitable for the MGB.

Reports of very early failures of rotors and condensers (sometimes within road-hours of fitting) is becoming all too common, are we also to get similar failures in distributor caps? This relatively new cap lost its carbon contact, then damaging the rotor, requiring replacement of both. The new rotor almost immediately proceeded to give intermittent misfiring shortly before total failure. *March 2024:* Another example on the same type of 45D4 cap.

February 2015:

Another new cap failure - Lucas boxed, this time the retaining springs had punched holes through the cap and shorted out the HT.

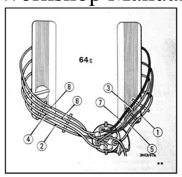
Firing Order and lead positioning

4-cylinder: 1 3 4 2 counting **anti**-clockwise round the cap, where No.1 is at the front of the engine. The standard position of the rotor for No.1 firing is top right (i.e. closest to the plug) but depending on how the distributor drive gear is inserted or the distributor reassembled after dismantling it can be in several other positions. Haynes also contains incorrect instructions which can put the rotor 180 degrees out i.e. bottom left.

With the top entry cap one of the leads (usually No. 4) exits very close to the steering column UJ and the clamp bolt can hit the lead as the steering is turned. Ben Columb had an intermittent misfire because it was virtually touching and the spark jumped that gap rather than the plug gap. I discovered the rubber boot on one of my leads had been gouged but wasn't causing a misfire - yet - so I routed that lead round the other leads on its way to No.4 plug which keeps it out of the way. The original side-entry cap would be better but I think they only take cut leads, and for the 23/25D4. However there are lead sets with right-angle connectors for both 25D4 and 45D4 which should avoid that. But a down-side may be that you can't slide the boots up the leads at the distributor end to make sure the connectors are fully seated in the cap before sliding the boot back down again, and a right-angle cap on the rear plugs may foul the heater valve. Personally I would rather have right-angles at the cap and straights at the plugs, they do exist, a bit dearer than ANG, but you have to look carefully because some are the other way round i.e. straights at the cap and right-angles at the plugs which would be the worst of both worlds!

For the 45D4 a possibility is cap DDB194 which is a side-entry for push-fit leads. Used on the Mini with screws to attach it to the distributor body a number of sources show this cap with recesses for standard spring-clip fitting. I've not been able to find a side-entry push-fit cap for the 25D4.

V8: 1 8 4 3 6 5 7 2 counting **clockwise** round the cap, where No.1 is at the front of the left bank i.e. on the right as you look back from the front of the car. Note the Leyland Workshop Manual Supplement states the direction of rotation incorrectly but the

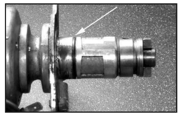


drawing is correct. The plug leads are clipped into 'combs' which would normally take the leads as they went to the cylinders from front to back, but 3 and 5 must be swapped over so 5 and 7 and not adjacent. 5 and 7 are next to each other in the firing order, and if the leads are run closely together when 5 fires it can fire 7 prematurely.

One comb each side is 'floating' and one screwed to the top of the rocker cover, with No.8 in a single comb screwed to the side of the rocker cover. Screws unknown although carb piston cover screws (3/4 BSW/Whitworth) fit the thread, albeit a bit shorter and with a flatter slotted head rather than a cross-slotted cheese-head.

Distributor O-rings *March 2013*

To O? Or not to O? That is the question. My blind pal Terry is just starting to fit the ancillaries to his newly installed engine and I mentioned to check that the distributor had an O-ring fitted. I described where it should be but he just couldn't locate the slot. He sent some pictures and it was immediately obvious his doesn't have one. Googling showed that a number of people said they did have one, and a number didn't, for marques other than MG as well as MG, but no clear statements on the subject (was ever thus). And one claim (in a source that should be world-famous for its mis- and dis-information) that a groove at the bottom of the dizzie body is for an O-ring is completely incorrect. There is one in the drive dog, and one between that and the distributor body. The drive dog rotates of course, and an O-ring here would get ripped to pieces if the housing extended that far, or do absolutely nothing if it didn't.



Looking in the Parts Catalogue although all the drawings show a groove and a O-ring, for both 25D and 45D, when you start reading the detail, distributors for early engines are shown having it, also later ones, but there are a batch of 25D4s in the middle that don't show it:

- 18G, GA and GB (i.e. all Mk1 cars) show it - 27H 6547
- 18GD to 18GK and 18V 581 to 585 (i.e. Mk2 with HS carbs) don't show it
- After that anything with HIF carbs, including chrome bumper cars with 25D4 distributors all show it again - 27H 6547

However in July 2016 when I had Bee's engine out to change the clutch and cleaned up the very mucky engine in the process, I've been keeping an eye for any oil trickling down the block after trips. I noticed one under the distributor, which is a 25D4 41228 i.e. for an 18V581/582 and hence shouldn't have the slot. However thinking I may be able to utilise it in some way I bought an O-ring. And on removing the distributor I was quite taken aback to find a slot! However this is a remanufactured unit, so perhaps not surprising it has the slot. So O-ring fitted. The block face the distributor clamp plate butts up to seemed clean, and there are a couple of plugged oil-ways immediately below that so it could be from there. But after a few dozen miles there is no sign of more oil, so O-ring it was. For Mk2 distributors without the slot it may be possible to fit a thicker O-ring in the larger groove right at the top of the shaft, to bear down on the edge of the hole.

Installation

The most important part of installation concerns the drive gear if the engine has been dismantled at all particularly involving the camshaft or distributor drive gear. Even then there are considerations for the distributor itself - whilst the distributor will only fully engage with the drive gear in one rotational position, if it has been dismantled and reassembled at any time the upper shaft that carries the rotor can be put 180 degrees out relative to the lower shaft that engages with the drive gear. All these can affect where the rotor is pointing when the engine is at TDC for No.1 (and No.4) cylinder.

With the drive gear inserted correctly the rotor should be pointing at about 2 o'clock when the distributor has been fully seated in the block. If it points to about 8 o'clock the distributor may have been incorrectly assembled, and if to any other position the drive gear has been inserted incorrectly. The distributor body can be rotated - the rotor itself should NOT move - and as well as altering the timing (by moving the points around the cam on the upper part of the shaft) it will change which cap contact is by the rotor when the points open, and that cap contact has to go to No.1 cylinder when the engine has that piston at TDC on its firing stroke.

With TDC and rotor position established there are typically two positions for the distributor body - one with the vacuum capsule pointing to the left of the heater valve and the other two the right. I've not seen any definitive original BL document that shows the distributor in its installed position, Clausager shows them in both, so either can be considered 'correct'. Pointing to the left puts the vacuum pipe towards the rear of the rocker cover instead of over the middle so that may be a factor if you have the metal tube instead of the plastic. Otherwise pointing to the right probably makes access to the lower cap clip easier for flicking it off.

That decided with No.1 lead connected to the cap contact by the rotor fit the others counting ANTI-clockwise round the cap from there 3, 4, 2. Side-entry caps keep the leads clear of the steering column and UJ but top-entry put them very close, I've had to wrap No.4 lead round the others to keep it away from the nut and bolt on the UJ.

Setting initial timing: Static is easiest, some electronic ignition systems have a light to enable this, others don't so you have to go by trial and error to get the engine running then adjust by strobe. For static connect a test-lamp or meter to the points wire and turn the engine in it's normal direction (clockwise looking at the front of the engine) to bring the timing mark towards the pointers on the front cover. This page has the static figure for most if not all the MGB distributors, but it maybe best to use those just as a guide and start closer to TDC. This is because I have found that even with a strobe timing of just a couple of degrees less than the book figure the strobe figure was a full 10 degrees retarded from the book figure, which can be caused by worn i.e. slack distributor springs.

The distributor fits in a circular clamp plate that is bolted to the block. With the clamp loosened the distributor can be turned to any rotational position, there can either be a square-headed bolt that doesn't turn and a hex nut that does, or the other way round. When tightening do not overtighten - with the hex nut the torque figure is only 2.5 ft lb (if the clamp bolt has the hex head it is 4 ft lb), it can apply a lot of force to the alloy shoulder of the distributor body, distort it, and the distributor can jump out of the clamp plate. The holes in the clamp plate for the block screws are elongated which gives a small range of timing adjustment just by slackening the two clamp screws. When initially setting the distributor lightly tighten one of the clamp screws with the

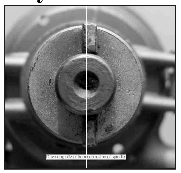
clamp plate positioned in the middle of the available adjustment, so small advance and retard adjustments later on can be done within the elongated holes. If needing to turn the distributor further than that it may be necessary to slacken one of the block screws as well as the clamp plate nut to allow the distributor to be turned.

With the 45D4 distributor timing adjustments can only by done by moving the clamp plate relative to the block or twisting the distributor in the clamp plate. The 25D4 has the very useful Vernier adjuster on the vacuum capsule that allows several degrees of timing adjustment just by turning a knurled wheel, nut or screw slackening and body twisting not needed. Again when first installing a distributor set the knurled wheel in the middle of its range of adjustment so future adjustments both advance and retard will almost certainly be within the scope of that wheel.

Drive Gear

4-Cylinder
V8

4-Cylinder:



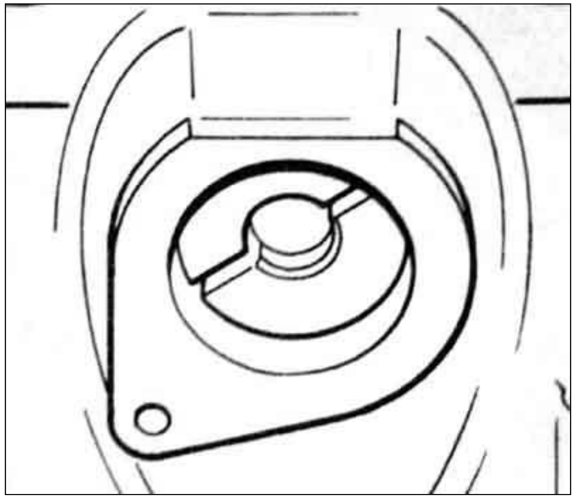
At first sight it would seem that the drive dog on the end of the distributor shaft and the driving slot in the gear in the crankcase would allow the two to be assembled in either of two positions. However they are both offset slightly, by about half the width of the dog/slot, so they will only fully engage in one position. But they are so close that if turning the rotor while pressing the distributor down gently to locate the slot, it will seem to partly engage in the incorrect position. But as said, it will only fully engage in one position, which is when the distributor flange is flush to the clamp plate, and the clamp plate is flush to the block.

Whilst, as long as each plug gets its spark at the correct time, any position on the cap can be used for No.1, the 'correct' position is around 2 o'clock when looking down on the top of the cap whilst standing beside the right-hand wing. The rotor should be pointing at this lead when at TDC (Top Dead Centre) at the end of the compression stroke of No.1 piston, which is at the front (radiator end) of the engine. You can determine TDC either by examination of the valves when turning the engine by hand, or as John Twist describes below. Using the valves the compression stroke is the one where both valves are closed (up) for the majority of the up-stroke of the piston, and also for the expansion down-stroke. To avoid having to remove the rocker cover (damage to gasket, leaks afterwards etc.) an alternative is to remove the plugs and turn the engine by hand with your thumb over No.1 plug hole. When you can feel compression blowing past your thumb, that is the compression stroke. When the piston gets to the top of the cylinder on that stroke, that is the firing point for that cylinder. Whichever method you use, wherever the rotor is pointing when the piston is at the top of its compression stroke, the cap contact it lines up with should be wired to No.1 plug. Thereafter the correct firing order is 1-3-4-2 counting round the cap in an **anti**-clockwise direction.

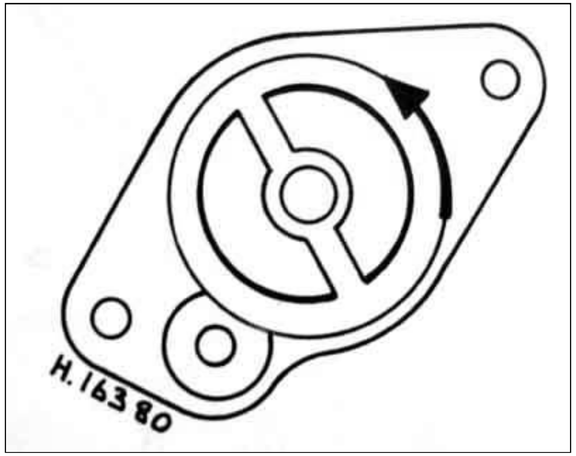
If the engine has been rebuilt it is possible for the drive gear to be inserted in nine different positions (the number of teeth at the cam end of the gear), only one of which is correct. The rotor can also end up 180 degrees out as the Workshop Manual and

Haynes explain things differently and Haynes is incorrect. It can also happen if the distributor has been dismantled and reassembled incorrectly, as apart from knowing the relationship between the drive-dog on the lower half of the shaft and the rotor location notch on the upper half there is nothing else to indicate which way is correct.

Haynes also gives different processes for 18G/GA (3-bearing) engine, 18GB and later (5-bearing) prior to 1978, and another one for 1978 and later, the following three drawings are from Haynes:

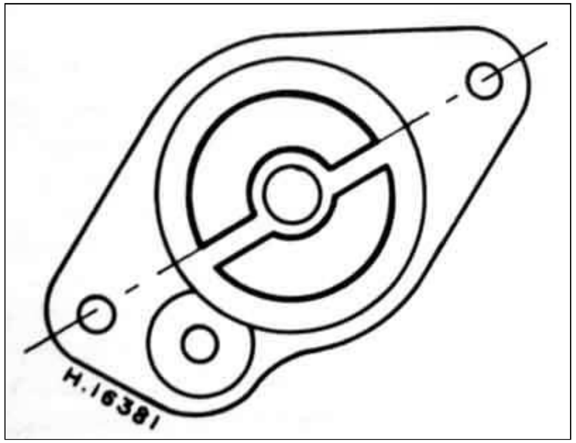


18G/GA - no starting position only how it ends up, with the slot from about 2:00 to 8:00. Not clear which side the slot is offset to, but the text says 'below the horizontal'.



1978 and later starting position - drive gear rotates anti-clockwise as it engages, with a starting position of about 5:00 to 11:00. However John Twist says "drop the gear back into the engine, keyway offset below horizontal, large half of the driving dog uppermost, with the keyway 9:00 to 3:00". .

1978 and later finishes up as here with the slot below the horizontal. This is the same as how John Twist describes it "As the gear drops into place, it will rotate anti-clockwise and set in at about 2:00-8:00". John Twist implies only 30 degrees rotation, whereas Haynes shows it more like 90 degrees. The drive gear is the same throughout including 3-bearing engines - 12G4499. Maybe one day I'll take mine out and see.



No drawings for pre-78 5-bearing engines but Haynes says "Position the pistons half-way up the cylinder bores and enter the spindle. Turn the crankshaft (putting No.1 piston at TDC on the compression stroke), withdraw the spindle sufficient to clear the camshaft gear, hold it with the slot horizontal and the small offset at the bottom, and re-enter the gear. Note that as engagement takes place the slot will turn to the 2 o'clock position". Having the slot horizontal before the final insertion is the same as John Twist's 9:00 and 3:00. But why it needs to be initially inserted with the pistons half-way up, then the engine turned to TDC, then the spindle withdrawn, slot positioned horizontally, then reinserted is a bit of a mystery.

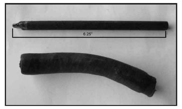
DISTRIBUTOR DRIVE GEAR POSITION from John Twist:

> Find top dead center, number one firing, by examining the rockers with the valve cover off, or by using one's index finger on the #1 spark plug hole while pushing the MG forward (#1 fires at the end of the compression stroke, which will blow one's finger off the hole). Use the timing marks to be certain the engine is at TDC. Remove the distributor and clamping plate. Thread a LONG 5/16"-24 stud into the centre of the distributor drive gear (find the stud in the air cleaner assy, twin SU models. *NB: This refers to the UNF bolts on HS carbs only, HIF carbs use UNC bolts*). Remove the slotted screw holding the distributor housing, and withdraw that part. Pull the distributor drive gear from the engine. After THOROUGHLY CLEANING AND GREASING THE GEAR AND HOUSING, drop the gear back into the engine, keyway offset below horizontal, large half of the driving dog upmost, with the keyway 9:00 to 3:00. As the gear drops into place, it will rotate anti-clockwise and set in at about 2:00-8:00. The rotor should then face 1-2:00.

That is the correct position for the gear, but if you find the rotor is now (or still) 180 degrees out then either the timing gears and chain were fitted incorrectly, or the distributor is 180 degrees out. I'll leave you to decide how far you want to go in investigating this, but the easiest way of getting the rotor and leads correct will be to remove the drive gear again and rotate it 180 degrees before reinsertion. Remember that a change of distributor may well put it out again, if the new is incorrect and the old wasn't, or vice-versa.

August 2019: It's possible to rotate the drive dog on the end of the distributor shaft 180 degrees by driving out the roll-pin, but if the distributor is replaced, or the drive gear or timing gear is corrected, the rotor position will be out again.

V8: The V8 distributor arrangement is completely different to the 4-cylinder - and I don't just mean having twice as many cap contacts. Whereas the 4-cylinder can only go back in one position, the V8 is driven directly by gears from the camshaft so can go back in as many positions as there are teeth on the gears. I know the 4-cylinder also has a drive gear, but that is only disturbed by exception for example during an engine rebuild. The other difference to the 4-cylinder is that whereas the camshaft drives the oil pump and the distributor independently, as said above the V8 camshaft drives the distributor directly, and it's a dog clutch in the shape of a tongue and slot that drives the oil pump. The 4-cylinder drive gear also has a dog clutch to the distributor, but it is offset to one side which means the two can only engage in one rotational position. The V8 distributor can engage with the oil pump in two positions, but that has no impact on anything else. Up to 1976 all Rover V8 engines had the tongue on the distributor and the slot in the oil pump shaft. With the introduction of the SD1 the engines for that car had electronic ignition using a 35DE8 distributor, and this had the slot on the distributor and the tongue on the oil pump shaft. Points engines e.g. Range Rovers changed to the later drive arrangement in 1978, but kept points for a further four years! See Fitting a V8 into an MGB by Roger Parker.



One benefit of either type of drive is that the distributor can be removed and a drill with suitable drive shaft inserted into the hole to drive the oil-pump directly. After a rebuild or any interference with the oil delivery system it is far better to build up oil pressure this way than cranking or even worse running the engine and hoping it eventually shows on the gauge. Have the drill on minimum speed, and I gripped the chuck firmly with my hand as well to slow it even further.

Note: The down-side is that if you crank with the distributor removed the oil pump is disabled!

So when inserting the V8 distributor, not only do you have to ensure that the correct teeth engage to get the rotor pointing to No.1 cap contact at TDC on No.1 compression stroke, you also need the tongue on the distributor to be aligned with the slot on the oil pump before it will fully seat. Just look at the positions of the tongue, and slot you may well say. But as the distributor engages with the camshaft the distributor shaft is turned by about half the distance from one cap contact to the next. So not only do you have to turn the rotor back half a cap contact (or is it forward ...) before you start insertion, you have to set the oil pump slot to where the distributor shaft tongue is going to be once the gears are partially engaged! That's tricky, and you could spend much time tweaking the position of the oil pump shaft before you get it right, and the distributor has to come fully out and go back in each time. It's actually easier to turn the crank bit by bit to get that aligned with the oil pump slot, but you do have to back the distributor out just a fraction or simple friction between the two shafts could turn the oil pump with the distributor, and you get nowhere.

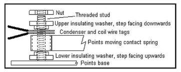
This all has to be done with the engine at TDC on No.1 compression stroke, and of course there is a TDC for its exhaust stroke as well. You can tell which is which from

the rockers once the rocker cover has been removed, but another way is to inject compressed air into the cylinder with a modified spark plug body with a Schrader valve attached. Having a compressor and said modified spark plug, that is my preferred approach. The difference between the two TDCs is very clear - on the compression stroke the pressure only bleeds off relatively slowly, whereas on the exhaust stroke is bleeds off pretty-well instantly.

Distributor Adjustments

4-cylinder
Dwell
V8
What do I set my timing to?
Timing marks
Plotting centrifugal and vacuum curves and dwell electronically by Frodo Irrxsom

4-Cylinder: The points are so difficult to get at with the oil pipe and steering column in the way on RHD cars (it's bad enough just getting the cap off) that I always remove the distributor to check or change them. I also remove it by undoing the two screws that hold the clamp-plate to the block (pulling out the dipstick for better access) and removing distributor and clamp-plate together, rather than slackening the clamp bolt itself. This is for several reasons, the most important of which is that frequently undoing and tightening the clamp bolt can damage the shoulder on the distributor body, which can make it jump out of the clamp when driving. Don't worry about turning the engine or the distributor while it is out, it only goes back in one way, and you are going to have to check and adjust the timing anyway, as the holes in the clamp-plate are large enough to give several degrees of variation in timing and replacing the points or even altering the gap of existing points will change the timing.



When replacing points where everything is held on with a nut it is vital to get the tags from the condenser and the coil in the right place. Basically, everything except the nut goes between the two insulators i.e. baseplate - insulator (narrow end up so it fits in and locates the points spring) - points spring - condenser tag - coil tag - second insulator (narrow end down so it fits in and locates the two tags and the points spring) - nut. If any of the points spring, condenser tag or coil tag touch the baseplate bolt or the nut the engine will not run. Other distributors have a simpler method of location where the points spring rests against an insulator that rests against a flange on the baseplate, and the condenser and coil wires are connected to the same tag that slips under a fold at the end of the points spring. Less likelihood of getting things in the wrong place.

The points gap is typically set to .014 to .016 using feeler gauges, and measured with the heel of the points on the highest part of the cam such that the gap is at its greatest. There should be light resistance with the .016 gauge and no resistance with the .014 gauge. When checking used points there will often be a spike on the one contact and a hole on the other, in this case using a feeler gauge will result in a much wider gap then intended. It is possible to clean up points with a fine sharpening stone, but once you have them off you may as well fit new ones. When the gap is correct insert a piece of clean paper between the points, close them, pull the paper slightly, open the points and remove the paper - this cleans off any oil etc. that might have been transferred from the feeler gauges. Don't pull the paper all the way out with the points closed as this can leave fibres behind that can cause an intermittent misfire.

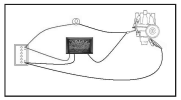
Dwell:
However dwell is a much more accurate way of checking/setting the points (see here for electronic ignition) than using feeler gauges, and as far as checking goes is far preferable as it is 'non-invasive' i.e. the dwell meter just clips to 12v, earth and the coil CB/-ve terminal so you don't even have to take the cap off let alone put greasy feeler gauges between the contacts. If you don't have a meter with a dwell scale you can use an analogue voltmeter or ammeter, and maybe some digital meters if they have an averaging function - with caveats. The dwell meter is basically measuring the changing voltage at the coil CB/-ve and you can do much the same by connecting a voltmeter between there and a 12v supply such as at the fusebox. With the points closed the meter will show your system voltage (typically 14v with the engine running) and zero volts when they are open. Thus on a running engine the meter will stabilise at a point which shows the proportion of time that the points are closed, just as a dwell meter does. You do need to measure your system voltage first (Vs), then express the displayed 'dwell' voltage (Vd) as a percentage of that, i.e. Vd/Vs*100. As dwell figures are usually given in degrees rather than percent this would have to be converted to degrees, but it's easier to convert the specified dwell degree range to percent once, and compare your percentage reading with that. On a 4-cylinder engine each cylinder occupies 90 degrees of the distributor, so a nominal dwell of 60 degrees (for a 25D4) equates to 60/90*100 or 66.7%, but more usefully the tolerance of +- 3 degrees gives a range of 64% to 70%. For a 45D4 with a nominal dwell of 51 degrees or 57% and +- 5 degrees tolerance (the lower figure coming from the use of more efficient coils and enables them to run cooler) gives a range of 51% to 62%. On a V8 each cylinder occupies 45 degrees of distributor rotation, so with a nominal dwell of 27 degrees you get 27/45*100 i.e. 60%, and with +-1 degree of tolerance (a factor of having double the number of lobes in the same 'space') you get a range of 58% to 62%. You can do a similar thing with an ammeter inserted in series with the coil, using the standing points closed current in place of the system voltage.

The caveat referred to above means that voltage and current can only be used as a guide to dwell, and do not exactly replicate a dwell meter. This is because the measured voltage or current is modified by the voltage surges that occur as the points open, which the dwell meter has been designed to ignore. For example the Workshop Manual quotes the points closed current of a 12v ignition system as 3.9 amps, which represents a nominal 3.3 ohm coil being powered at 13v. It then quotes the running current as 1.4 amps, which is only 36% of 3.9 amps, and not 67% (calculated from the stated dwell above) as one might expect. It also quotes that current at 2000rpm, as additionally the readings change as engine speed changes. Hence saying above that use of a voltmeter or an ammeter is only a guide. The Workshop Manual would have used an analogue meter, digital meters may give different results or no usable result at all depending on type. I have taken dwell, voltage and current readings using an analogue meter on the CB roadster (12v ignition system) and the V8 (ballasted system) and the results were as follows:

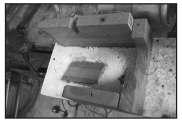
Ignition System	Measured dwell (book dwell)	1000rpm		2000rpm	
12v	56 deg (57-63 deg)	7V	1.8A	8V	1.5A
Ballasted V8	28 deg (26-28 deg)	8V	1.9A	8.6V	1.7A

So the voltage and current figures are very similar for the two ignition systems, and may prove useful as an alternative to using a feeler gauge if a dwell meter is not available.

If removing the distributor to replace the points on the face of it you can't set the gap with dwell until it is back in the car - unless you make a bench-test rig. In its simplest form this can just be an 'arm' such as a small Allen key lightly clamped to the rotating part of the shaft with a Jubilee-clip, that you rotate with a finger-tip, and an analogue ohmmeter. A little-known feature of analogue ohmmeters is that on a regularly interrupted circuit such as points, if the distributor shaft is turned fast enough the damping of the meter needle is such that it will indicate a relatively steady average value between infinity (a zero reading) and zero ohms (full-scale deflection). Note that an ohmmeter can't be used on-car with a running engine as the ignition voltage interferes with the internal battery of the ohmmeter, and is primarily of use for testing on the bench, and because of that it does not suffer from the voltage and current caveat referred to above. The position of the needle represents the percentage time that the points are closed, between 0% and 100%, which can be used as a direct comparison with the percentage figures calculated above i.e. 64% to 70% for a 25D4, 51% to 62% for a 45D4, and 58% to 62% for a 35D8. If you have an analogue ohmmeter with a 10v (or 100v) full deflection scale, you can read the percentage dwell off that, even though the meter is switched to ohms. If you have a 10v scale multiply the reading by 10, and if you don't have a 10v or 100v scale use an appropriate scaling factor with a scale you do have. I.e. if you have a 30v full deflection scale you will be looking for a value on that 3.3 times higher than you would on a 10v scale. Rotate the 'arm' on the shaft of the distributor with your finger-tip fast enough to get a useable reading, and simply read off your percentage dwell. Tweak points and repeat, ad infinitum.



Confused? No worries, if you have a dwell meter showing degrees you can use that on the bench as well! This will need a battery and a load simulating the coil such as a 12v bulb, as well as the dwell meter. One side of the battery goes to one side of the bulb, the other side of the bulb goes to the points wire of the distributor, and the body of the distributor goes to the other side of the battery, such that as the distributor rotates the bulb switches on and off. It doesn't matter which way round you connect the battery to your bulb and distributor but it makes sense to use the same polarity as your car to make things simpler. As to what voltage battery to use, you may be able to get away with a low-voltage dry-cell battery, or you may need a 12v source. With the circuit connected up as described turn the distributor to open the points and the meter should show zero. Turn the distributor to close the points, and an analogue dwell meter should show full scale deflection, a digital switched to 4-cylinder and degrees should show 90 (360 divided by 4 remember?). If you find either meter shows less than this (they expect to be working at 12-14v) then you will have to use a 12v-14v battery, which again could be a series of dry cells (when using dry cells use a low wattage 12v bulb such as a 2.2w instrument bulb to avoid flattening the battery too quickly). You probably won't be able to use a battery charger on its own as these generally output rectified AC which is a series of voltage pulses at 50 or 100 Hz, and when the voltage from this is zero the meter won't be able to tell the difference between that and the points being open/closed. If you have an old 12v car battery in the garage, then connecting the charger to this and then the battery to your test rig should be fine (once it gets up to 12v), as the battery will smooth out the voltage pulses. Again rotate the 'arm' with your finger-tip to get a useable reading of your dwell. Note that analogue meters can have switched dwell angle scales for 4, 6 and 8 cylinders (sometimes saying for 8 divide the 4 scale by two), others (like my Gunson's TestTune) have a single switch position with a 4-cylinder dwell angle scale and a percentage closed scale. Tweak points and repeat, ad infinitum.



However whilst my analogue ohmmeter is damped enough to get a usable reading from finger-tip rotation of the distributor, my analogue dwell meter isn't. And if you get fed up doing the twiddle - tweak - twiddle - tweak etc. etc. you might like to make a rig to drive the distributor from a motor. I used a box to hold a drill and the distributor as shown here. The great advantage of this is that with the cap and rotor removed, and using care, you can tweak the points while the distributor is being driven and getting a continuous reading off the meter. Using a rig, try adjusting the dwell up and down and observe the bulb - you will see it getting dimmer as the dwell reduces, and brighter as it gets higher. The ultimate irony with the V8 is that the distributor is in about the most accessible position imaginable - top front of the engine, but has an external hex shaft that is used to adjust the points with the engine running anyway!

Dwell with electronic ignition: I'm not aware of any electronic ignition systems for the MGB where you can adjust the dwell, but it can still be measured in the same way as for points. However there are two distinct forms of electronic ignition - fixed dwell (as for points) and variable dwell. Fixed dwell will give much the same results as points - fairly constant over the rev range, maybe a little higher than the figures for points (which will run the coils a little hotter). Variable dwell are very different - at idle you will see a very low dwell - maybe only around one third of the points figure, but rising steadily as the revs are increased the dwell increases until at about 5000rpm it may be the same, and beyond that it can be higher than points. When using a voltmeter to gauge dwell again fixed dwell systems will be much the same as points. However for variable dwell the voltage at idle will be significantly higher, maybe around 11v, dropping as the revs are increased. These tests are a useful way of determining whether you have fixed or variable dwell - variable run the coil at a significantly lower temperature other than at peak revs.

Put a little grease on the cam where the points heel rubs but don't oil the cam wiper pad that's attached to the points. Put a little oil down through the baseplate onto the advance weights and springs, and in the end of the spindle under the rotor arm. Refit the distributor, rotating the spindle by hand till it engages with the drive. If you left the clamp-plate on the distributor the timing will be close enough to start the engine and allow you to fine-tune it with a timing light. Refit the cap - No. 1 plug lead should come out of the top-front hole (2 o'clock), and the leads are counted anti-clockwise - 1, 3, 4, 2. Note that if your distributor is not in this position, or the engine does not run when it is, the drive gear may have been positioned incorrectly. Although the

distributor can only engage with the drive gear in one position the drive gear can engage with the camshaft in a number of positions. You can correct the position of the drive gear as described by John Twist. Note that if the distributor is dismantled the two halves of the shaft go together in either of two orientations, the 'wrong' one will put the rotor 180 degrees out.

To determine the correct position of the rotor and leads if the engine or distributor are new to you or have been dismantled and rebuilt, and won't start: With the plugs 2, 3 and 4 removed i.e. only No. 1 in turn the engine until you can feel the effect of the compression in No.1 cylinder and the timing mark on the pulley is approaching the pointers on the front cover. When the timing mark is at the TDC pointer (the last one it passes) the piston should be at the top of its stroke, look at the direction the rotor is pointing in, and the cap contact nearest there is the one that should be connected to No.1 plug. The others are counted from there, anti-clockwise round the distributor cap, 1 3 4 2.

I use an electronic timing light with a dial that allows me to set a given number of degrees of advance then adjust the position of the distributor till the flash shows the groove on the pulley lining up with the TDC mark on the timing cover. This type of light is also bright enough to be used in full sunlight without having to paint the marks. With lesser lights you will have to set the timing using the specified mark on the timing cover. The TDC mark is the last one the pulley mark passes (the pulleys turn clockwise as you stand at the front of the car and look back into the engine compartment), the others typically indicating 5, 10, 15 and 20 degrees BTDC (although some only show 5 and 10 degrees). Sometimes the marks are different sizes - TDC being the biggest, 5 and 15 degrees being the smallest, and 10 and 20 being in between. On early cars the marks were below the pulley, on later cars they are above and towards the RHS, nice and convenient for watching while you twist the distributor. If the marks are missing altogether you can derive true TDC as follows:

- As above with plugs 2, 3 and 4 removed i.e. only No. 1 in turn the engine until you can feel the effect of the compression in No.1 cylinder and the timing mark on the pulley is approaching the pointers on the front cover. When the timing mark is at the TDC pointer (the last one it passes) the piston should be at the top of its stroke.
- With the engine turned back a little way so the piston is below the top of its stroke, insert a probe into No.1 plug hole. A rod though the middle of an old spark plug and secured in position makes a good probe, the length of which should stop the piston coming up shortly before it reaches the very top, turn the engine forwards so the piston touches the probe.
- Attach a card to the front cover and mark on it the position of the notch in the pulley.
- Turn the engine **backwards** so the piston goes down backwards through the compression stroke, and the previous intake stroke, until the piston just touches the probe again.
- Make a second mark on the card where the notch is now, and TDC is exactly between these two marks.

March 2024: In a book on sundials by Albert E Waugh he writes that the ancients (who didn't have watches or clocks) derived noon by the same method i.e. used a pole *to create a shadow, put a peg in the ground when the tip of the shadow was a measured distance from the base when it was obviously before noon, and another when the tip of the shadow was the same distance from the base when it was obviously after noon, and the noon shadow will be exactly between them.*

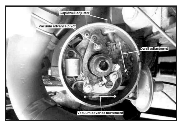
Note that the pulley consists of a metal-rubber-metal sandwich and there have been some reports of the two metal parts getting out of line with each other and being useless for setting timing. If in doubt remove No. 1 plug and turn the engine till the piston is at its highest, this will either be TDC or 180 degrees off TDC, in which case keep turning till the piston goes down and back up again. The intake and exhaust valves will be closed during most of the compression stroke (which finishes at TDC) whereas the exhaust valve will be open on the exhaust stroke (the other time the piston is moving upwards). If you put your thumb over the plug hole while turning the engine it will be blown off while the piston is approaching TDC whereas it won't if the piston is on the exhaust stroke. If you find the pulley notch is **not** pointing at the TDC mark on the plate when the piston is at its highest position, then either the plate has been fitted in the wrong place or the pulley has delaminated. In the latter case it is not worth altering the marks to suit as the pulley outer will in all probability continue to move in relation to its inner.

When setting timing it is advisable to remove the vacuum pipe from the distributor and plug it, North American cars from about 1971 used manifold vacuum and you **must** disconnect the pipe before setting timing on these cars, although UK-spec cars used the original carb vacuum until rubber bumpers, even on HIFs. You shouldn't have to do this with carb vacuum but it won't hurt. However if you do remove it you can check your centrifugal advance is working properly by checking the total advance at various rpms as given in Dizzie Curves. The total advance is the static advance plus the centrifugal advance. A common problem on older distributors is that the advance springs stretch, which will allow maximum advance to be obtained at too low an rpm, which can cause pinking under load. This check is done much more easily with the adjustable timing light, you will need additional marks if you only have the simple light.

You can also check the operation of the vacuum advance by sucking on the end of the tube (but be warned that the tube may contain petrol) and checking that the timing advances accordingly. You can watch for movement of the points plate if the distributor cap is off, or advancing timing if the engine is running and a timing light connected, and in this second case the idle speed should also increase and decrease as the amount of vacuum increases and decreases. If you can continually draw air through the vacuum module it is punctured and must be replaced, otherwise it will upset the carb mixture as well as giving insufficient advance when cruising, which affects performance and economy.

See also http://www.iwemalpg.com/Vacuum_gauge.htm which has information on using a vacuum gauge for fault diagnosis.

V8:



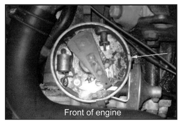
Many features are as above for the 4-cylinder but there are some significant differences. Firstly the points attach to the points plate in a fixed position, not adjustable as in 4-cylinder distributors. The coil and condenser wires attach as for the 25D 'fiddle-fit' 4-cylinder

points. Grease the cam lobes (not the felt pad, and not oil) as for 4-cylinder 45D 'quick-fit' points.

The gap/dwell is adjusted by turning a hex bar that should be sticking out of the back of the body. Turn the bar clockwise (imagine looking onto the end of the bar i.e. from the back of the engine) to reduce the gap/dwell, anti-clockwise to increase it. In theory the benefit of this is being able to adjust the dwell with the engine running, but in practice I find whilst turning the bar clockwise to reduce the gap or dwell does so steadily and progressively, if you go too far and have to turn the bar anti-clockwise nothing seems to happen for a bit and then it jumps a large amount. This is because it relies on spring pressure to take up the back-lash, but the friction is overcoming the spring tension. Turning it anti-clockwise a bit then pressing on the end of the hex bar and wiggling it up and down helps, but it is best to unscrew the bar to get more gap/dwell then you need, then turn it clockwise again to reduce it to the correct value. Gap is the same as for the 4-cylinder at .014" to .016", but dwell is only 26 to 28 degrees as it has twice the number of cylinders of course, and dwell represents the length of 'time' in each rotation of the crankshaft the points are closed.

Distributor rotation is **clockwise**, and not anti-clockwise as for the 4-cylinder. Firing order is 1-8-4-3-6-5-7-2, where the front cylinder (i.e. the furthest forward) of the left bank (on the right as you look in from the front) is No.1. An easy way of remembering is that No.1 cylinder is closest to the distributor. Odd cylinders are on the left bank, even on the right bank. This puts cylinders 5 and 7 adjacent in the firing order as well as the cylinders being adjacent. For this reason the leads 3 and 5 should be swapped over in the combs to avoid a long run of 5 and 7 side by side which can induce cylinder 7 to fire with cylinder 5 i.e. way before it should.

The distributor clamp is a much more positive design than on the 4-cylinder, being a fork that presses down on a flange on the distributor body, both being large and robust. Unless the clamp bolt is unscrewed a large amount the V8 distributor can't jump out like the 4-cylinder can (although see below about the oil pump), although it can lose the timing just by being loose, of course.



The distributor shaft is fitted with a skew gear as well as a drive dog on the end. The skew gear engages with the end of the camshaft, so can be fitted in as many positions as there are starts in the skew gear. Therefore unlike the 4-cylinder distributor, which can only go back in the correct position no matter how the distributor and crankshaft have been turned while the distributor has been removed, on the V8 you will almost certainly lose the original position if the distributor is removed. To regain the correct position:

- Turn the crankshaft so that timing cover pointer is over the 6 degree BTDC mark on the crank pulley and No.1 cylinder is at the top of its bore.
- Orientate the distributor such that the vacuum capsule is at the front of the distributor and pointing to your right as you face the engine.
- Turn the rotor so that it is pointing at the cut-out in the distributor body (should be pointing at the left-hand wing). This allows for the 30 degrees that the rotor will turn through as the skew gears engage.
- Turn the oil pump spindle such that it's orientation is as close as can be judged with the drive dog on the end of the distributor shaft.

- Insert the distributor, and watch for the rotor turning as the skew gears engage. If the distributor body doesn't fully seat down onto the timing cover, turn the crankshaft either way until it drops fully down.
- Turn the crankshaft back to 6 degrees BTDC, and turn the distributor body so that the points are just opening. Lightly tighten the clamp ready for static and/or dynamic timing.
- Check that No.1 lead is fitted to the cap such that its contact is by the rotor when the cap is fitted. If it isn't, move the leads round, following the firing order in a **clockwise** rotation. This should put No.1 lead just below a half-way line across the middle of the distributor.

However it's not that critical, one tooth either way doesn't make that much difference on the 8-cylinder, with the distributor fully in just look at which cap contact the rotor will be pointing at with the cap fitted and put No.1 lead to that, counting clockwise from there.

As mentioned above the distributor shaft dog engages with the oil-pump drive shaft, so it is the camshaft that drives the distributor, and the distributor that drives the oil-pump. Remember that with the distributor removed, or lifted away from the timing cover more than a certain amount, cranking or running the engine will **not** develop any oil pressure.

What should I set my timing to? *January 2016* What follows relates to high-compression engines. Low-compression as in the factory V8 are probably best left with the factory figures, as even on 95 octane you are almost certainly not going to be able to adjust by ear listening for pinking. If you do, then you may over-advance so much it stalls the starter.

Each engine has a published figure, but that assumes the engine is unmodified and in good condition, the distributor is the original type and in good condition, and you are using the original 4-star leaded petrol. Meeting all of those is highly unlikely - 4-star is only available in very few outlets, and most engines these days are running with some wear if not an incorrect distributor. Even if you did meet all three, the original timing specs were conservative - tolerances between individual engines of the same type meaning some were more likely to pink than others, and the factory selected a 'worst case' figure to limit warranty claims. This meant that some engines from new could be run with more advance than the 'book' figure without pinking, to give better performance and economy. I found that with a new Marina in the 70s, which I used to set-up using a vacuum gauge. But when I got my roadster I found that even on unleaded I couldn't run any more advance than book, so didn't bother using the gauge any more. On unleaded, even the higher 97-99 octanes, I found I had to retard slightly from book, and so-called octane-boosting additives didn't make any difference.

And the upshot? Unless you are prepared to spend quite a lot of money and time buying and setting up a programmable ignition system, or on a rolling road, the best you can do is to advance the timing just short of getting pinking at any combination of throttle-opening, revs and load. In fact Haynes says "Small readjustments can be beneficial. ... accelerate in top gear from 30 to 50mph and listen for heavy pinking. If this occurs, retard the ignition slightly until just the faintest trace of pinking can be heard under these conditions". However that's a bit aggressive for me hence backing

off until there isn't any, which is unlikely to have negative effect on performance. This does mean that if you live in and set-up for Lincolnshire, then when touring in Wales, the Scottish Highlands or the Lake District you are quite likely to get significant pinking from the higher loads of climbing hills. You will have to 'play it by ear', and this is where the 25D4 distributor with its vernier adjustment comes in - it is very easy to make small timing adjustments just by twiddling the knurled wheel. Typically 10 clicks per degree of adjustment, giving +- 12 degrees from a central position. Turning the knurled wheel to show more thread retards the timing by turning the points plate anti-clockwise hence delaying when the points open, and turning it to show less thread advances it.

Added December 2009: Out of interest early battery ignition systems used a low tension system which basically had the contact breaker points (the igniter) **inside** the cylinder, a simple coil with one winding instead of the later type with primary and secondary windings, and no condenser. When ignition was required the igniter contacts (inside the cylinder) were opened mechanically, which broke a series circuit, which causes a spark. The inductor results in a bigger spark than a simple resistor would, and a condenser is not fitted as the system requires the largest spark possible inside the cylinder.

Ignition Coil

All frequent questions as part of a lot of confusion on this subject. Coil manufacturers don't help - I have come across two coils marked '12v' but also saying it needed an external ballast resistor! This is confusing if not incorrect, and some suppliers do have completely incorrect information on their web pages. **You won't know what you have got until you measure both the wiring and the coil, and that goes for newly purchased coils.**

There is lot of conflicting and confusing information on the web regarding coil and ballast resistances. The original 12v system was changed to a different coil with an external ballast resistance in series with the introduction of V8s and rubber bumper cars. This system boosts the coil voltage - and hence the HT spark - during cranking and so gives a better chance of starting under adverse conditions such as weak battery or poor state of tune, but has no effect in normal running. More information here.

Haynes and Clausager differ in some respects, and even the Leyland Parts catalogue for September 76 on i.e. ballasted ignition isn't immune as it specifies GCL110 for other than cold climates and the USA, but every other source I have seen says that is a 12v coil i.e. for unballasted i.e. chrome bumper cars. One example of a coil marked '12v' and 'must be used with an approved resistance' measured 2.2 ohms which is too high for a 6v coil, but also too low to run on an unballasted system as it will overheat. Hence the label saying it must be used with an approved resistor, but that can only be one measuring 0.3 ohms at most or it will degrade the spark. One MGOC advert states "Ballast Ignition Coil 12 Volt - GCL111 - DLB111 Ballast ignition coil, 12 volts, 3 ohm. Rubber bumper only." which is completely incorrect. The distinction between the three original types of 6v coil seems to have been lost as far as replacements are concerned. Some sources specify a GCL132 coil for ballasted systems but others say this is a 9v coil and not a 6v. I've not been able to find a resistance quoted for this coil, but the implication is that using a 9v coil on a 6v system will result in lower spark output. Rimmers GCL132HP quotes the same resistances as for a 6v sport coil. Reference to '9v' could simply be down to incorrect interpretation of coil voltage

measured on a running engine. The ballast resistance should measure about 1.4 ohms, taken between the white/light-green or white/light-blue removed from the coil +ve and the white or white/brown at the fusebox.

Chrome bumper 4-cylinder cars had a 12v coil with a direct ignition feed (white). Rubber bumper cars and all V8s had a 6v coil connected to the 12v ignition feed via a ballast resistance. From the factory this resistance is not an identifiable component but a length of resistance wire contained within the harness. The resistance wire itself is usually pink with a white tracer, but has a white or white/brown tail at the supply end, and on the coil end a white/light-green on a 4-cylinder or white/light-blue on a factory V8. This is how the cars came out the factory, but if replacing the coil it is important to know if a PO has bypassed the ballast resistance or a rubber bumper or V8 for some reason, or even added one to a chrome bumper 4-cylinder car. Using a 6v coil in a 12v system i.e. with no ballast resistance will result in overheating of the coil and burning of the points (unless you use a variable-dwell electronic ignition system in place of points which raises more questions). Using a 12v coil in a 6v system will result in reduced HT spark. You can't go by the colour of the wiring, there are some unfeeling butchers out there, you have to do a simple electrical test. Remove the wires from the coil on the points-side, usually black/white. Connect a voltmeter on its 12v scale to the other coil terminal and turn on the ignition. On all cars you should see battery voltage i.e. 12v. Now connect an earth to the points terminal...

- If the voltage stays at 12v or only drops a couple of tenths, there is no ballast resistance in circuit which is correct for a chrome bumper. There **should** be a 12v coil, but you will have to measure the primary resistance or do a current measurement as below to check you don't have a 6v coil.
- If the voltage drops to about 6v it looks like there is a ballast resistance in circuit and there is a 6v coil which is correct for a rubber bumper and all V8.
- If the voltage only drops to about 9v it looks like there is a ballast resistance in circuit but with a 12v coil, which is incorrect.
- Other voltages can indicate some other type of coil has been used, it is faulty, or the ballast resistance is faulty or incorrect. You will have to measure the individual resistances of the ballast and coil to see which exactly what you have.

However you could have a combination of an incorrect coil and incorrect ballast resistance which will give the correct voltage, which is why a current test should be done as well if you are having spark problems.

Testing a coil: It is possible to test a coil, and tell the difference between 12v, 6v and other coils, by measuring the primary and secondary resistances (all wires and HT cable removed) with an ohmmeter looking for these resistances:

Coil	Primary Resistance (ohms)	Secondary Resistance (ohms)	Designations	Notes
12v	3	5.4k	GCL101, DLB101, GCL110	1
6v (15C6 UK)	1.5	6.5k	DLB102, GCL111	2
6v (16C6 NA)	1.4	8.9k	DLB112	3

Typical 12v Sport	2.4	8.3k	DLB105	4
6v Sport	1.5	8.6k	DLB110, GCL132HP	5
32C5	0.8	5.8k or 7.2k	DLB125 or DLB198	6

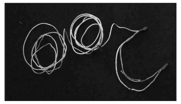
Notes:

1. Chrome bumper cars, resistance can measure from 3.1 to 3.5 ohms. DLB101 has the screw-in HT connector originally used on Mk1 positive earth cars, GCL101 and GCL110 the push-in used on Mk2 and later negative earth. Original positive earth coils with screw-in HT had SW and CB terminal markings and internally were wired differently to negative earth coils. These took account of the polarity difference and had '+' and '-' terminal markings. Note that new coils advertised as being for Mk1 cars have the terminals labelled '+' and '-' despite having screw-in HT connections (such as this one from Moss Europe), it's not known whether these wired internally for positive earth or negative earth.
2. Rubber bumper cars and all V8s, resistance can measure from 1.43 to 1.58 ohms, must be used with a ballast resistance (within the factory harness) of a similar value.
3. DLB112 was used with the 45DE4 electronic distributor.
4. Resistances for the 'Typical 12v Sport' are as measured from a coil (no part number) in my possession. DLB105 seems to be the current (ho ho) part number, and various places quote this as 2.8 to 3 ohms primary and 8.3 to 10.45 kilo-ohms secondary.
5. The DLB110/GCL132HP 6v Sport coil must be used with a ballast resistance on a 12v system such as the MGB. The original (in harness) ballast of the rubber bumper MGBs is 1.3 to 1.4 ohms, and I have seen external 'component' ballast resistances ranging from 0.9 ohms to 1.6 ohms recommended for use with this coil. This range will give a significant difference in current hence performance and coil temperature - higher resistances reducing performance, lower increasing coil temperature. (Whether there is a usable and measurable performance gain from 'sport' coils is another matter ...).
6. **The 0.8 ohm primary DLB125 or DLB198 coils must only be used with a variable dwell electronic ignition module or it will grossly overheat. On the MGB these were used with the 45DM4 distributor and no ballast resistance**.

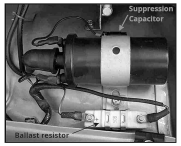
November 2009: Another useful test of whether you have the right combination of coil and ballast is to do a current test. The Leyland Workshop Manual quotes the 'ignition on' current at 3.9amps, which equates to 12v across a 3.1 ohm coil, and a 6v coil with harness ballast is very similar on my V8. If a sport coil is fitted this will rise to about 5 amps for chrome bumper and 4.5 amps for rubber bumper. If the current is higher than that, e.g. 8 to 10 amps, then you could have a 6v coil with no ballast, when you should have a 12v coil. If the current is 3 amps or lower then you could have a 12v coil plus ballast, when you should have a 6v coil. Of course you could have the correct combination, but a faulty coil, ballast or connections somewhere, which needs further investigation with a voltmeter.

However it also quotes a running current of 1.4 amps at 2000 rpm, but this doesn't equate to the calculated figure when you take the higher running voltage and the relative points closed and open times into account, which should be (say) 14.5v, 60 degrees closed and 30 degrees open i.e. 67% closed, which should give 3.1 amps. In fact 1.4 amps **is** what is displayed on my **analogue** voltmeter, which will be mechanically averaging 'ignition on'

current (points closed), zero current (points open), plus any other currents and voltages generated as the points open and close i.e. induced currents. A perfectly valid and useful test, but digital instruments may give a completely different figure, or may not 'settle' and give a steady reading at all. My V8 with 6v coil and harness ballast also gives very close to 1.4 amps running, it's only during cranking that the coil current on a ballasted system should be significantly higher.

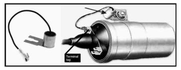


Click the thumbnail for information on the ballast resistance.



Whilst the MGB ballast resistance is a length of resistance wire contained in the harness and not an identifiable component other marques and models and some after-market coils for the MGB may use a discrete resistor in the shape of a rectangular block with two terminals mounted near the coil.

Is this a ballast resistor?



Quite a few cars will have a component that has a wire going to the coil +ve (or SW) terminal and a metal tag secured under a coil fixing bolt, but these are radio interference suppressors. They are capacitors that help to damp electrical noise spikes and can be found on the instrument voltage regulator, fuel pump, indicator flasher unit, alternator, electric screen washer pump i.e. anything with a motor or switch that can generate electrical noise. They are similar to the ignition condenser in a distributor in that both are capacitors, but whereas the condenser has values of about 0.2uF and 600v a suppression capacitor will be about 2uF and 100v and the two are not interchangeable. Originally cylindrical, they can also be rectangular.

Isn't the coil used on rubber bumper cars a 9v coil? No. This has come about from seeing the running voltage on the +ve terminal of a rubber bumper coil at about 9 or 10v on an analogue meter (digitals can be different or give no usable reading). But that voltage is switching between 12v with the points open and 6v with the points closed, and so averaging about 9v. To see the true picture you have to measure the voltage on the coil +ve with the engine stopped, points closed, and ignition on. The ballast resistance should be of a similar resistance to the coil, so with the correct coil and ballast resistance on a rubber bumper MGB you should see about 6v, not 9v, hence it is a 6v coil. If you **do** see something significantly different to that then there is something wrong with your coil, ballast resistance or ignition supply voltage.

What about a coil with an internal ballast resistor? It matters not a jot whether a coil has an internal ballast or not - a coil is either a 12v coil or a 6v coil. Originally all coils were 12v and contained nothing but many thousands of turns of copper wire. Subsequently manufacturers produced 6v coils for 12v systems which when used with wiring that includes a ballast resistance in the circuit allow the spark to be boosted during cranking, and as a side-benefit they give an improved spark at high rpms. 12v coils for older systems are still needed of course and at some point someone had the bright idea of putting a ballast resistance inside the can with a 6v coil so making it a 12v coil! This meant they only had to produce one winding unit instead of two reducing production as well as material costs, and you end up with a 12v coil that also has the improved spark at high rpms - albeit much higher than a factory MGB ever produced. So if anyone starts talking about internal ballast ignore it. A coil is either a 12v coil of about 2.5 to 3 ohms or a 6v coil of about 1.5 ohms, and the only way to be sure what you have is to measure it - including newly purchased coils as suppliers descriptions and manufacturers packaging and markings can be confusing if not downright incorrect.

Why did they change to 6v coils anyway? The main benefit of the 6v coil is that it enables the ignition to generate a more powerful spark during cranking. Even a tip-top battery will have its voltage reduced during cranking, typically to around 10v, because of the very heavy load of the starter motor. On a 12v system this means the primary current and therefore the HT spark will be reduced. But by using a 6v coil and a special starter solenoid, the ballast resistor is bypassed during cranking and the maximum available battery voltage will be connected directly to the coil, i.e. 10v, which results in a **stronger** HT spark than when running. This is beneficial to all cars under extreme conditions i.e. very cold, thick oil, battery in less than perfect condition due to age or short journeys in winter with lights, heater etc. always on. The more powerful spark was even more important on North American emissions controlled engines which were harder to start. Note that all 18V engines had the 2M100 starter with the coil boost contact, but it was unused until the start of rubber bumper production. All V8s had the 6v coil system. There is also said to be another benefit of 6v coils and that is they have lower inductance than a 12v, and hence lower 'reluctance' to build up flux, therefore a shorter time to build up full flux for the next spark, and so a greater ability to supply a full spark at higher revs. However the rev limit of the MGB didn't change over its life and the change was more of an industry standard thing than aimed specifically at the MGB. Since the V8 with twice the cylinders, half the dwell, and hence half the reflux duration of the four cylinder has no problem delivering much the same peak rpm, Jaguar V12 engines even more so, this aspect is largely irrelevant. Whilst the plug gap was able to be increased from 25 thou to 32 thou with the introduction of 6v coils this may be much to do with the change from the 25D4 distributor to the 45D4 and perhaps an improved resistance to breaking down at high HT voltages, than greater energy from the coil. The special solenoid has an extra spade terminal which puts out a full 12v on the white/light-green (white/light-blue on factory V8s) wire to the coil when the solenoid is energised. This wire goes to the +ve terminal of the coil, together with the same coloured wire from the harness ballast. A 6v coil also generates half the heat of the 12v coil the other 'half' of the heat is generated in the wiring ballast resistor, but again this is neither here nor there. Many people replace the starter with a modern geared or 'Hi-torque' unit and many of these don't have the additional contact to boost the coil voltage on starting. Whilst under most condition the car should still start pretty well, under adverse conditions it can make the difference between starting and not starting. There are a number of ways to get round the lack of 'coil boost' contact, see here.

Should I reverse the coil connections when changing the car's polarity? *May 2010* It's often recommended, but is it really necessary? And what are the benefits and drawbacks? Early, positive-earth cars had coils with terminals labelled 'SW' and 'CB' and Mk2 negative-earth cars have coils with terminals labelled '+' and '-'. For connections of these and other variations read on:

- **I have an original positive earth car and a coil with SW and CB terminals:** Connect the SW terminal to the ignition **SW**itch using the white wire and the CB terminal to the distributor **C**ontact **B**reaker aka points using the white/black wire.
- **I have a positive earth car and have to replace the coil with a modern one:** If the coil has a push-in HT connection connect the white wire from the ignition supply to

the '-' terminal and the points wire to the '+' terminal. This will adversely affect the HT spark slightly but unless you can get a good SW/CB coil from somewhere you may have no choice. Note that new coils advertised as being for Mk1 cars have the terminals labelled '+' and '-' despite having screw-in HT connections (such as this one from Moss Europe), it's not known whether these wired internally for positive earth or negative earth. This method may show you, failing that try the connections first one way then the other, and if one way seems to work better then go with that.
- **I have a positive earth car that has been converted to negative earth:** Ideally fit a modern +/- coil, otherwise the wiring to an original SW/CB coil should be reversed i.e. the white wire from the ignition supply should go to the CB terminal and the points wire to the SW.
- **I have a positive earth car that has been converted to negative earth and need to fit a modern +/- coil:** This is a better option than reusing the original SW/CB coil - connect the white wire from the ignition supply to the '+' terminal and the white/black points wire to the '-' terminal.
- **I have an original chrome bumper negative earth car and need to fit an SW/CB coil:** Ideally don't, get the correct +/- coil for your car, but in an emergency connect the white wire from the ignition supply to the CB terminal and the white/black wires to the SW terminal.
- **I have a rubber bumper car and need to fit an SW/CB coil:** As above ideally don't, get the correct +/- coil for your car. In an emergency it can be done but using the existing wiring will halve the HT spark energy and you may have problems starting and running because of the ballasted ignition system on those cars. To avoid that, and if you can do so, connect a temporary wire from the white or white/brown terminals on the front of the fusebox, second fuse up, to the CB terminal on the coil and the white/black wires to the SW terminal.

Some cars had factory-fitted radio interference suppression capacitors fitted at the coil, these should be connected as described here. Some cars may have had after-market ignition conversions involving an external ballast resistance, typically as here, these are completely different to and independent from suppression capacitors.

This Lucas document (p11) states that a negative polarity should be presented to the insulated plug terminal with positive to the plug body. This is because electrons (which travel from negative to positive, unlike conventional current or charge flow) would rather jump from the hotter central electrode to the cooler body than the other way round, which requires about 10% more HT voltage to get the spark started. Negative HT also results in less erosion of the rotor, as one quarter of the amount of metal is transferred from each cap contact to the rotor over a given length of time, instead of all of it being transferred from the rotor to the cap contacts. Remember HT voltage will rise until the plug fires, then more-or-less stops there for the duration of the spark. Typical measured HT voltage for a 25 thou plug gap will be 6 to 10kV, 10% being 600v to 1000v of course. So it would make sense to reverse the coil LT connections when reversing the battery. But another feature of the coil is that the 'other' end of the HT winding doesn't go to the can as you might suppose, but is connected to one end of the LT winding. Originally this would have been the points terminal (CB), and the reason is that when the collapsing flux generates the HT voltage in the HT winding it also generates 200-300v in the LT winding. Connected as originally this voltage is added to the HT voltage to boost it, known as the auto-transformer effect. Reverse the LT connections to correct the HT polarity and you lose this boost. So which to do? As reversing the coil connections when reversing the battery adds 600 to 1000v, but loses 200-300v auto-transformer effect, it is better to reverse the LT connections. But it would be better still to buy a negative earth coil and retain both effects, which is what the Lucas document recommends.

How can you determine the polarity of a coil? You could measure from the HT terminal to each LT terminal, and the one with the lower resistance i.e. the junction between the two windings should go to the points. But that is looking for 3 ohms difference in over 5000 ohms, which would need a digital instrument with at least 4.5 digits to reveal. You could do an open-circuit bench-test and see which LT polarity jumps the largest gap (a cold gap, so HT polarity difference won't matter), but that will result in some very high voltages in the coil which probably isn't wise. A test with a controlled gap in the HT circuit is no good as the voltage will stop rising when the gap fires. You **may** be able to tell by looking at the two induced voltages on an oscilloscope. If that on the HT lead is negative with respect to earth (as it should be), and the LT terminal connected to the points is also negative with respect to the LT terminal connected to the ignition supply, then the implication is that the required auto-transformer effect is also present, but I have not tested this. I did wonder whether you could use the effect mentioned above whereby the auto-transformer action tends to reduce the current displayed on an analogue instrument, but because the induced voltage in the LT winding will always be opposite to the battery current, no matter what coil you have on what polarity car or which way round, the reduction will always be present. You can probably assume that an original coil from a positive earth car marked SW and CB is a positive earth coil, and that from a late car marked + and - is a negative earth, but that doesn't help one jot with replacement coils, where even if you can get one marked SW and CB there is no guarantee it's internal connections are for positive earth. Note that at least one edition of 'MGB Electrical Systems' is incorrect in that it states "On negative earth cars as long as the distributor is connected to the + terminal (of the coil) the test should be unnecessary". On a negative earth car the distributor (i.e. the earth supply to the coil) should be connected to the - terminal of the coil, and the 12v ignition supply (the positive supply to the coil) should be connected to the + terminal. A number of sources talk about using a graphite pencil tip held in a spark gap, and when the polarity is correct there will be a brighter spark or 'flare' from the pencil tip to earth.

However having tried that I found it very inconclusive, there is a much better way using an analogue meter between the HT lead and earth. You still need a spark gap e.g. a spare plug connected to the HT lead laying on the block and not just an open-circuit lead, then remove the distributor cap and flick the points open and closed by hand. With the correct polarity the meter (with -ve connected to the coil lead and +ve to earth) should show an upward flick as the points are opened, and a downward flick as they are closed again. This opposite flick is because the coil is a transformer, which will generate a voltage in the output when current commences flowing just as it will when it ceases, but only when it ceases and the condenser is in circuit because the points are open will it generate the higher voltage needed to fire the plug. One source recommends connecting the meter across a plug in the engine and cranking, but with the upward and the downward flicks being so close together it may not be clear whether it is the opening of the points or their closing that is causing a downward flick.

When all is said and done, whilst when some documents were written ignition systems may have needed every volt they could get, in an MGB ignition system there should be more than enough energy to be able to ignore all these variations. However it could just possibly make the difference between starting and not starting if any one or more of points, plugs,

condenser, rotor, cap or leads are in poor condition. It's even less of an issue with modern electronic HV systems, for a start 'wasted spark' ignition systems fire two plugs at the same time (both being fired when either plug needs a spark hence the spark to the other plug is 'wasted') but these systems always fire one plug one way and the other plug the other, so plug polarity with this system can't be an issue. Some manufacturers apparently fit different plugs for +ve HT than to -ve, but this is more about saving money in terms of the amount of platinum on each electrode than plug performance. Yet another source claims that on a system with dual polarity HT i.e. wasted spark you can double the life of the plugs by rotating the plugs between positive and negative HT positions. If that really is the case, then we could do the same simply by reversing the coil LT leads every now and again! But it doesn't seem to be worth the bother against a few quid for new plugs every 10k. Speaking of which, I bought a set of Bosch Super 4 4-electrode plugs way back in February 1999, since when they have done about 34k miles (April 2016), and still show no signs of electrode erosion. Double the price of 'conventional' plugs, but since they have done 3.5 times the recommended life and still look as good as new, good value.

What is an oil-filled coil? *November 2018:* Originally coils were 'dry', then at some point oil was added. Two possible reasons - the first being better heat transference from the winding to the coil case and thence away from the coil altogether, the seconds probably to do with preventing internal breakdown as will be seen below. In my experience an 'oil-filled' coil clearly makes a sloshing noise when shaken, so only partly filled and not completely filled as the description implies. I've seen a claim that Bosch coils are completely filled and don't slosh, but that would mean the oil would expand as it heats up and put pressure on the seal between the case and the end that carries the connections, which seems unlikely. *November 2022:* Some manufacturers have gone back to 'dry' coils using a resin compound. And that leads on to:

Should the coil point up or down? *January 2011* From time to time this question crops up, and there are various comments about oil-filled coils being used pointing downward so the oil cools the HT connection. On one recent discussion someone who should know better roundly castigated everyone saying they should read the Workshop Manual, because the answer is in there, when it isn't - directly at least. What **is** in the WSM that is interesting is a description of a test-rig, where it says the coil must be mounted at 45 degrees, with the CB terminal uppermost, so that it's internal connection is **not** covered with fluid and any internal tracking between the iron core and the primary lead will be revealed. One would have to know that oil is used in HV systems to resist tracking (a spark will jump an air-gap more readily than it will jump an oil-filled gap) to work out that if the CB internal connection must be uncovered during testing to reveal any faults, then it should be covered in use to resist any tracking developing. Thus, the coil when mounted on the inner wing of 4-cylinder cars or radiator mounting panel of V8s should point downwards. Early MGBs (possibly just 3-bearing) have the coil mounted horizontally to the engine, so perhaps the terminals of the coil should be vertical with the CB (-ve for later coils) in the lower position. Again I have seen a claim that Bosch oil-'filled' coils should be mounted terminals uppermost or they leak when they get hot! Seems very unlikely to be correct, on several levels. Incidentally engine-mounted coils will get hotter than inner-wing mounted coils, as they will be picking-up significant mechanical heat as well as electrical. Which brings me on to:

Hot coils: *January 2013:*

There has been some discussion on this in various places for a while now, and it's a fascinating and complex subject given the apparent simplicity of the points/condenser/coil ignition system. Coils, like alternators and many other components, do run hot to the touch and are designed to be able to cope with it. The question is, how hot is normal, and how hot is too much? I'd say that if the average person can keep their hand on it, it's probably not too hot. If they can't, it probably is too hot. But that's very subjective, and the real arbiter should be whether there is a problem with the running of the car or not. If not, and it just seems hot when you touch it, then ignore it. If there IS a problem with running then there is definitely something wrong somewhere, but it might not be the coil. One thing for us in the UK to remember is that these cars run perfectly well in desert states in America at ambient temperatures of well over 100 degrees Fahrenheit. The coil is behind the radiator (if not bolted to the engine), and so is obviously expected to work correctly at the highest engine compartment temperature that Abingdon expected. If someone in the UK is having a problem, especially at the moment, then it's being caused by a definite fault.

Contrary to what one person writing elsewhere is insisting, the minimum resistance of a 12v coil is **not** 3.5 ohms. The Leyland Workshop Manual specifies 3.1 to 3.5 ohms (i.e. 3.5 ohms is the **maximum**), Sport coils can be as low as 2.4 ohms, and coils for electronic ignition systems can be much lower than that. The writer is getting hung-up on the fact that if you connect 12v to a 12v coil then with about 4 amps flowing through it developing 48 watts of heat it **will** overheat. But all that means is that you shouldn't leave the ignition switched on with the engine stopped. If you need to do that for diagnostic purposes on other components then disconnect one side of the coil, remembering to reconnect it afterwards.

As an electrical component it will will generate heat when it is powered and its temperature will rise. It has to be able to dissipate that heat somewhere or it would get hotter and hotter until the component was destroyed, and in the case of the ignition coil that heat is dissipated to the surrounding air i.e. in the engine compartment. But it can only start dissipating heat when it gets hotter than its surroundings, and so it will always be hotter than the ambient air in the engine compartment. Therefore it follows that on a winter's day with icy air blowing through the radiator that it will be much cooler to the touch than in high summer when the radiator is pumping out masses of heat.

I've checked both mine - V8 with a ballasted system and roadster with an un-ballasted - and after running for about 20 minutes in 8 to 10C ambient they were only round 40C, which is only warm to the touch. On one day with an ambient of about 15C the V8 coil was 52C, and on another with an ambient of 21C it was 58C. So with each increase in ambient there is a similar increase in coil temperature, as expected.

July 2013: In the midst of this heatwave I've been checking both cars again. The V8 at an ambient of 27C saw the lower part of the coil at 62C (the upper was a little cooler), so again a correlation between the increase in the ambient temperature and the increase in the coil temperature. Whilst 40C (10C ambient) is only warm, 62C is very much hotter to the touch. The engine compartment temperature varied between 40C bowling along the M6 round Birmingham at 9:30am, 45C coming back at 1:30pm, and in some stop-start traffic round Solihull with the fans on it got up to 58C. With the roadster at 26C ambient the upper part of the coil was at 67C (in this case the

lower part was a little cooler). Higher than the V8 as before, but a slightly smaller difference than at lower ambients. The engine compartment in stop-start traffic round Solihull got up to 50C.

July 2016: Over the last two days of 30+C ambients I've been checking the V8 (the roadster is part-way through a clutch change). On both afternoons the engine compartment got up to 64C (measured closed with a probe through a grommet) and stopped with the bonnet open the coil measured 68C. No problems hot starting - either immediately or after a few minutes, so what the problem was in 2014 (intermittent problems in May, June and July even though it wasn't as hot as it is at the moment) I don't know.

If you think your coil IS too hot, or you have running problems, then you might like to read on for some specific tests you can do.

Some have wondered if a faulty tachometer could cause it. It's highly unlikely, with either early or late versions. It would have to be capable of injecting additional current into the ignition system, which given the internal circuitry is not possible, without showing some effect at the tach at the very least. Whilst both tachs can affect the ignition system under certain fault conditions, they would cause a significant misfire or stop the engine running altogether, and it would show on the tach. Neither would another cause be the condenser going short-circuit, as the most obvious indication of that again would be misfiring at best (with an electronic tach jumping around all over the place) or complete failure of the ignition at worst.

There are two factors involved in how hot a coil gets. The first is how much energy is being put into it which is a factor of its resistance, the voltage being applied to it, and hence the current flowing through it - the heating effect. The second is how fast it is dissipating that heat. How hot the coil will get over time depends on the temperature difference between the coil casing and the surrounding air in the engine compartment. On starting a cold engine they are both the same, so no dissipation, so the coil starts to heat up. As it does so it starts to dissipate heat, and the hotter it gets with respect to its surroundings the faster it will dissipate heat. Eventually the dissipation rate equals the heating effect from the current, and it reaches a stable temperature. A coil with a massive finned heat sink in arctic conditions will probably barely get warm. Wrap it in foam or fibre-glass insulation and it will almost certainly overheat. Under normal circumstances the coil is always capable of dissipating more heat than is being generated, if it didn't it would just get hotter and hotter until it burst into flames or burnt out.

But how should you measure it? Metal probes will only be picking up heat from the part of the probe that touches the surface of the coil, the rest of the probe surface will be radiating it and averaging the reading, so things like oven and personal thermometers are unsuitable, although you could put a piece of polystyrene insulation over the probe and a small area of the coil surface. You could use junior's ear thermometer perhaps, but I have no experience of those. You could also use an infra-red thermometer with laser pointer, but bear in mind the temperature is not being taken at the laser dot but over a much wider area, so the lens of the infra-red detector will have to be pretty-much on the coil to avoid picking up lower-temperature objects around it and averaging the result downwards. Perhaps those LCD strips would be the most consistent, but then they seem to have a relatively low range of a dozen or so degrees Centigrade, you would need to know which 'ball park' you were in to start with. The ultimate coil temperature will also depend on the air around it, i.e. the engine bay temperature. All in all not very conducive to getting comparable readings from different people using different methods on different cars. I measured mine with an infra-red thermometer placed right on the coil.

The Workshop manual says chrome bumper cars have coils of 3.1 to 3.5 ohms (cold, higher when hot), and with a switch-on voltage of 12v Ohms Law gives us 3.9 amps with an average coil, which is what is specified in the Workshop Manual, and this current is the first thing to check. This would generate 50 watts of heating effect (voltage squared divided by resistance) and **is** going to generate too much heat in the coil over a long period and can damage it. (If you need the ignition on for a long period with the engine stopped for any reason, remember to disconnect the coil as the points are usually closed when a running engine is switched off and allowed to come to rest on its own). If the current is significantly higher than 3.9 amps you need to measure the coil primary resistance, with the wires removed from the terminals. A low resistance coil will carry more current and get hotter than it should. If the current is lower, then you could have bad connections or bad points which will be causing a low HT voltage, but the coil itself will be running cooler than normal.

However, that's at switch-on. When running with points (electronic ignition systems are usually very different) the 25D4 distributor is only energising the coil for 67% of the time (derived from a dwell angle of 60 degrees in a 4-cylinder distributor i.e. 90 degrees per open/closed cycle). But now we have typically 14v as the system voltage so the heating effect is 42 watts (voltage squared divided by resistance times percentage energised divided by 100), but even that is not the full story. The coil is a transformer and has inductance and the effect of inductance is to cause the current to rise over a short period of time when voltage is connected, not instantaneously, so the heating effect is reduced still further. The Workshop Manual quotes a running current (i.e. the average of no current for some of the time, partial current for some of the time, and full current for some of the time) of only 1.4 amps at 2000 rpm which implies only 9 watts heating effect. However the readings in the Workshop manual will have been made many years ago, and hence on an analogue meter, and the reverse EMF generated as the points open tends to kick the needle back a bit and give an artificially low reading. Nevertheless if you connect an analogue meter on its current scale in series with the coil and run the engine, this **is** the current you should see. If the static current was correct but the running current is too high or too low, you need to check the points gap or dwell. If your points gap is too small you will get a high dwell, higher current reading and the coil running hotter. If too large you will get a low dwell, lower current reading and the coil will run cooler. Dwell is a dynamic (i.e. with the engine running) method of measuring points gap and avoids putting feeler gauges that might be oily against the points contact surfaces. With the correct gap you should get the correct dwell, and vice-versa, but there are some faults that means this isn't the case. Going back to current, on a running engine a digital meter may well show something completely different or no usable reading at all, depending on model and type. That's for a 25D4 distributor. With a 45D4 the points are only closed for 57% of the time, giving a slightly lower average current and hence lower heating effect.

Rubber bumper cars are significantly different. They have a lower resistance coil of 1.4 to 1.6 ohms i.e. half that of the chrome bumper, but it is in series with a ballast resistance of a similar value which means the current through the coil ends up being much the same as on a chrome bumper car. So with the same current, but half the resistance, you get half the heating effect in the coil. The other half of the heating effect is being developed in the external ballast resistance so not contributing to coil temperature. You should see more or less the same static and running currents in the ballasted system as in the unballasted, with the same causes if the current is higher or lower. There could also be faults in the ballast resistance so this should be measured from the white or white/brown at the fusebox to the white/light-green at the coil +ve, again with the wires removed from the coil terminals.

I did a bench test, with a 12v coil in series with a 6v coil and its ballast, connected to 12v. This is a static test i.e. no points making and breaking the circuit, but having the two in series halves the static current and makes it similar to that in a running engine. After an hour or so in an ambient temperature of 10C the coils had stabilised, with the 12v coil at 30.3C, and the 6V at 21.9C. Subtract the ambient, and you end up with the 12v coil having gained 20C and the 6v coil 12C. This verifies that the 6v coil has about half the heating effect of 12v coils, but more importantly my running tests indicate that the engine bay temperature in summer is going to have significantly more effect on coil temperature than the current flowing through it.

This table compares the coil energising time and hence heating effect for various points ignition systems found on the MGB:

	25D4		45D4 CB		45D4 RB		35D8	
RPM	1000	5000	1000	5000	1000	5000	1000	5000
Dwell degrees	60.00	60.00	51.00	51.00	51.00	51.00	27.00	27.00
Heating effect (Watt/seconds)	43.56	43.56	37.02	37.02	19.15	19.15	20.28	20.28

Note that if you use a rubber bumper coil without a ballast you will get almost 100 watts of heating effect.

That's for points. A number of electronic ignition systems have what's called a 'variable dwell' feature, which gives a shorter coil energising time than points over most of the rev range, and hence the coils run significantly cooler at anything other than peak rpm. This is the heating effect in a 0.8 ohm 32C5 coil with the North American 45DM4 variable dwell electronic ignition system:

45DM4			
RPM	990	3990	6000
Heating effect (Watt/seconds)	4.41	17.76	23.74

It can seen clearly that at anything other than high revs the heating effect of this system is significantly less than that of a rubber bumper points system, and far less than a chrome bumper system at any likely rpm to be encountered. However the 32C5 coil originally provided with this system should really only be used with a 'variable dwell' electronic ignition system or it can overheat. If a points distributor is substituted the heating effect will rise to 26 watts if a ballast is in circuit which should be OK, but if unballasted it will rise to 180 watts which almost certainly won't be.

Other electronic systems may not be 'variable dwell' but still give a shorter 'on' time, and hence less heating effect, than points. However I've seen a claim that fixed dwell ignition systems actually have a **higher** dwell than points, and in December 2013 someone on the MG Enthusiast bulletin board posted that he measured his Lumenition Magnetronic at 72 degrees. This is 15% longer than a 25D4 and 40% longer than a 45D4, which will increase coil temperature significantly, perhaps to the point where it does start causing problems in very hot weather. It's said to be so there is still a good spark at maximum revs. But the V8 has half the dwell i.e. coil recharge time of the 4-cylinder and has no problem revving into the red, which is the equivalent of 10,400 rpm on a 4-cylinder! Also Lucas state in their Fault Diagnosis Manual that the points system is perfectly adequate for a 6-cylinder engine up to 8000 rpm, so a higher dwell certainly isn't needed for any likely 4-cylinder MGB.

I've also seen a claim that variable dwell saves horsepower. Well, yes, but if you do the maths at mid rev range that works out at 0.015HP! And that reduces with higher revs.

Intermittent misfire/cutting-out:

Originally MGB coils had riveted spades and over time these can work loose and cause a misfire or cutting-out accompanied by the tach dropping, later coils have threaded studs and nuts and overcome this - at least when your nuts are tight! My 73 roadster had this in 2001 - varying in length but never completely dying and it has cropped up again on the MG Enthusiasts website. From a report of 'tach dropping' Nat found his 1972 (riveted) -ve spade terminal was loose and with an ohmmeter the resistance was at best 4.3 ohms (instead of nominally 3 ohms) but when the spade was wiggled it would rise to about 200 ohms and sometimes infinity. Replacement needed - be sure to measure the resistance between the spades before you fit it. Suppliers and even manufacturers do not always have the correct information and previous owners may have changed things. Get the wrong coil for your wiring and you can end up with weak sparking or an overheating coil.

A similar thing can happen with original spade connectors being a bit loose on the spades, in that case pinching up the connectors a little with a pair of pliers is cheaper than a new coil ...

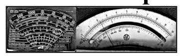
Diagnosing ignition LT problems with a voltmeter:

A tachometer (as opposed to a rev counter) is a useful diagnostic tool if your engine suddenly cuts out or starts misfiring while driving along - look at it before you do anything else including dipping the clutch in preparation to pulling over. If the tach has suddenly dropped to zero while the momentum of the car is still spinning the

engine, or starts jumping up and down with the misfire (often accompanied by backfiring in the exhaust), then it's a good indication you have an ignition LT problem. The problem could be loss of ignition voltage to the coil, a failed coil, or loss of the switched earth through the points or electronic trigger but they will all have the same effect on the tach whereas a voltmeter will allow you tell which of those three scenarios you may have. Intermittent problems - that clear rapidly before you can do any testing - can be particularly difficult to track down and you can wire in a voltmeter positioned where you can see it in the cabin and look at that as soon as the problem occurs, having previously done the following tests and noted what the 'normal' conditions are for your car.

I'll start with chrome bumper cars for their relative simplicity as well as logically as they came first. For both chrome and rubber what follows relates to how they came out of the factory - including using points and condenser not how they might have been messed about with since including the fitting of after-market electronic ignition or different coils as the voltages can be very different. The two types of factory electronic ignition systems are not covered here, but you can still do as advised above and note what the normal conditions are for your car to compare against when you have a problem.

Certain voltages will be present on the LT terminals when the ignition is on and the engine stopped but that varies according to whether the points are open or closed and whether it is a chrome bumper or rubber bumper, and the voltages are different again when the engine is running. The following voltages were read on an analogue instrument, digital voltmeters can display differently depending on the internal design i.e. when the engine is running you may see these voltages, or something different, or the display may be jumping all over the place with no usable reading.

- **Chrome bumper:**
  
  These used a 12v ignition system i.e. a 12v coil measuring about 3 ohms between the spade terminals running at full system voltage i.e. 12v engine stopped (ignition on) and around 14v engine running. This means that the voltage on the coil +ve (SW terminal on positive earth cars) will always be system voltage. The voltage on the coil -ve (CB) (ignition on, engine stopped) will be 0v with the points closed and 12v/14v with the points open. When a running engine is switched off compression usually stops two of the pistons half way up the bores which means the points will be closed so the voltage will be close to 0v. If the engine has been turned manually then the points could be either open or closed.

  When cranking the load of the starter will reduce the voltage from a good battery to about 10v (lower with a weak battery or poor connections anywhere in the cranking circuit) and you will see this reduced voltage on the coil +ve. The points are opening and closing - the length of the 'closed' time is determined by the dwell setting and is longer than the 'open' time. The voltage on the coil -ve (CB) will be switching between the lowered system voltage (points open) and 0v (points closed) and an analogue voltmeter will display an average between the two which depends on the dwell value. The 25D4 distributor as used on all chrome bumper cars has a nominal 60 degree dwell which means they are closed for 60 degrees of the 90 degree ignition cycle of a 4-cylinder 4-stroke engine i.e.

closed for 60/90ths or 66.7% of the time. Therefore they are open for 33.3% of the time and an analogue voltmeter on the coil -ve (CB) will show about 3.3v with a cranking voltage of about 10v.

When a chrome bumper engine is running being a 12v system again you will see system voltage on the coil +ve (SW), which should now be around 12-14v depending on engine speed and electrical load. You may see the lower voltage for a dynamo if the idle speed is low, but should be towards the higher voltage for an alternator or when the dynamo is charging at a higher idle. The voltage on the coil -ve (CB) will be switching between that system voltage and 0v as before, an analogue meter will display the average of the two which for a 25D4 should be about 4.7v at a system voltage of 14v.

Did I say chrome bumper is simple? What I actually said was *relatively* simple!

- **Rubber bumper cars:**

This section excludes later North American spec with factory electronic ignition. Other markets used a points distributor with a ballasted ignition system which comprises a ballast resistance of about 1.5 ohms primary resistance in series with a 6v coil of a similar value. Together they measure about 3 ohms so the same coil current flows as in the 12v chrome bumper system. With the engine stopped and the ignition on the voltage on the coil +ve (unlike the chrome bumper system) depends on whether the points are open or closed, as does as the voltage on the coil -ve. As before when a running engine is switched off the points will usually be closed and on the ballasted system you will see 12v divided pretty-well equally between the ballast and the coil i.e. about 6v on the coil +ve. However if the points happen to be open on a stopped engine then you will see full battery voltage on the coil +ve even though there is a ballast resistance in series with the coil, see how voltage varies between drawing current and not drawing current here.

The voltage on the coil -ve is the same as for chrome bumper 12v system in that it also depends on whether the points are closed or open. If closed (as they will normally be having switched off a running engine) you will see close to 0v, but if they are open i.e. the engine has been turned manually you will see full system voltage here as well as on the coil +ve.

Again the load of the starter will reduce the voltage from a good battery to about 10v when cranking. However the rubber bumper ballasted system has a 'boost' connection from the solenoid which puts this full cranking voltage on the coil +ve to increase the power of the spark which can make the difference between starting and not starting under adverse conditions. The points are opening and closing, the original distributor for a rubber bumper 4-cylinder car is a 45D4 which has a nominal dwell of 51 degrees and 51/90ths means the points are closed for 62% of the time and open for 38%. Therefore during cranking the coil -ve is switching between (say) 10v and 0v and an analogue meter will average the two at about 4v.

On a running engine the boost connection is removed and the ballast resistance is in series with the coil again. The coil +ve voltage is switching between

charging voltage of about 14v (points open) and 6v (points closed) and an analogue meter will again average the two based on the dwell and is about 9v (this is probably where the misconception that ballasted systems uses a 9v coil comes from). For the coil -ve it's at system voltage for 38% and 0v for 62% so at 14v the average is about 5.3v.

Note that cranking and running voltages (except for chrome bumper coil +ve) depend on the dwell setting of the points. As above the nominal dwell of a chrome bumper 25D4 is 60 degrees but allowable tolerance is +-3 degrees so percentages can vary between 64% and 70%, you may well find it beyond even those and the engine still run perfectly well. The rubber bumper 45D4 has a nominal dwell of 51 degrees +-5 degrees so percentages can vary between 51% and 62%, and again can be beyond those and still run perfectly well.

The V8 35D8 has a nominal dwell of 27 degrees i.e. half that of the four cylinder (eight lobes have to be fitted onto the shaft) but that points closed duration is still more than enough to fully recharge the coil at peak revs, 27 degrees equates to 60% closed and 40% open. However the tolerance is only +-1% which gives a small range of 58% to 62% hence the voltage figures for the V8 - which has a ballasted ignition system - will be similar to the 45D4.

On both 12v and ballasted systems if the engine is running but misfiring with periodic drops in the coil +ve (SW) voltage that indicates a loss of 12v supply to the coil. Periodic drops in the coil -ve (CB) could either be the same, or a coil intermittently going open-circuit so test the +ve first, or the points circuit intermittently shorting to earth. If the coil -ve periodically rises then that indicates the path through the points or trigger to earth is failing.

There are several variables in these calculations such as dwell has a tolerance of +- 3 degrees for the 25D4 and +- 5 degrees for the 45D4, coils have resistance tolerance of +-2%, ballast will be similar, and the nominal system voltage depends on engine speed and how much electrical load there is. But the resulting coil voltages should all be in the area of the figures given here. You can also expect to see some variation with changing revs and throttle opening as with a wider throttle there is a higher cylinder pressure which makes it harder for the spark to jump the plug gap, which means the HT voltage increases, and that is reflected back into the coil primary as a higher voltage.

But those variations can be ignored for the purposes of fault diagnosis, as what you are interested in is how the indication varies when a misfire or other problem becomes apparent, compared to when it's running correctly. If you do see a significant change then the implication is that the problem is in the ignition LT circuit although an open-circuit condenser won't give much of a change but will affect running. There is a very easy way of determining if the condenser is the problem and that is by temporarily connecting an additional, known good one between the coil CB or -ve and earth. If the condenser inside the distributor is the problem the problem will go away. If it isn't then the problem will continue, and having effectively two condensers in parallel with each other will have no noticeable effect on ignition performance.

Basically if the -ve(CB) voltage goes up to 12v when the engine cuts out you have lost the circuit to earth through the points or electronic trigger. But if it drops to zero then you have either lost the ignition supply through the coil (test the coil +ve or SW for 12v), or the points or trigger have shorted to earth. In this latter case disconnect the points or trigger wire from the coil -ve and see if you then have 12v on the coil -ve, and if you do the points or trigger are shorting to earth.

I have both conventional multi-meters and an automotive one with dwell and tach as well as voltage, resistance and current ranges - both analogue - and the latter meter has peculiarity that when I'm trying to measure voltage on the coil -ve it displays a much higher value than it should, higher even than the system voltage, because it is actually displaying the dwell value! So that is something to bear in mind.

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