MGA and MGB Distributors

THE MYSTERY OF THE IGNITION ADVANCE CURVES

In submitting this article, much of it was written some time ago, I should point out that the assumption that mechanical points are used is not valid. At the time of writing, I was and still do, use an electronic means to activate the spark. Although I installed the original Pertronics module, I would only recommend the series 2 which has a safety feature: if the ignition is on with the engine stationary for more than 5 seconds, it switches off the current to protect the module from damage. Re-activation would occur with pulling the starter knob to start the engine, I presume.

The reason I mention an electronic module with magnetic sensing for ignition timing, is that it can never drift out of tune. In a points based system, the rubbing block following the cam for timing, slowly wears down the leading edge, thus retarding the timing. The static setting and the centrifugal advance timing curve was the result of calculations based on the 98/100 octane lead based fuel (the Company's recommendation for the high compression MGA or MGB motors), its burn rate characteristics and the inevitable rubbing block wear. The timing, starting with a static setting of 10 degrees, will reach full centrifugal advance of 20 degrees, taking the total advance to 30 degrees at a low 2200 RPM (under full throttle conditions and therefore, no vacuum advance). This rapid rate of timing advance was chosen because the combustion chambers were modified to reduce the turbulence of the incoming fuel, slowing the burn rate, whilst at the same time improving the flow rate. This increased the power output across the range of engine speeds. With use, the timing slowly retards (as mentioned above) but performance is not greatly affected nor is it noticeable on the standard engine.

The Company had chosen reliable operation and minimal maintenance (and minimal expenditure) with the points based system, over trying to squeeze out another 5 brake horsepower or so across the broad range of engine speeds. However, with today's different fuel formulations (98 octane unleaded) and the application of precision electronics using such measures as magnetic sensing to trigger ignition firing, we can now enjoy the full benefits of optimum ignition timing across a wide range of engine speeds. The only risk is in the electronics within the module itself, so carry a set of points and the capacitor, just in case. That way, you or a competent mechanic can fix the ignition if it fails when away from home.

This article to sounds both a warning about the precision required if you proceed to change the advance curve, and seeks to inform those members who do wish to improve their car's performance and fuel economy.

First the warning, if you have recently had the cylinder head modified to include hard valve seats and bronze valve guides for unleaded petrol, you may have succumbed to a "port and polish", higher compression and triple cut valve seats. These changes, especially the higher compression, put the engine into a higher performance category and increase the risk of engine damage as all areas concerning the combustion process become increasingly critical. The fuel / air mixture needs to be more accurately set, for instance, or else the exhaust valves may become overheated from running a lean mixture under high load. Ignition timing also becomes critical, all the way from idle to maximum revolutions, or else either over heating or detonation can result, the latter with ultimately destructive results.

After rebuilding my engine and completing the "running in" phase, I decided to carefully examine the distributor (a 25D model in my case from a MGB, rather the standard MGA type DM2). Years ago I had recalibrated ignition curve by tightening the weaker of the two springs by cutting off the loop at one end and bending out a coil to replace it – one less turn makes the spring "tighter".

This spring is referred to as the “primary”. The slack, heavier spring is called the “secondary” and wasn’t touched. Unleaded fuel had become available and required the auto advance to commence further up the rev range to eliminate pinking, more usually called “pinging”.

In rebuilding the device I made a shocking discovery. The auto advance mechanism had been “meddled with” at some time in its past. The 10 degree distributer advance stop was actually allowing 15 degrees! Also, a different pattern of rolling weights had been fitted and some wear had taken place on the “stop arm”. This 5 degree increase in the distributor amounts to an extra 10 degrees of crankshaft advance. The absolute maximum safe static setting that could be used would have been 4 degrees before top dead centre (BTDC). Naturally, for the running period, I had used 10 degrees BTDC, as per the factory ignition specification for 25D distributors in MGA/B motors. I was saved only by keeping the car well under 4,000 RPM during this time. Had I not checked the clearance gap and fixed the problem I would have experienced damaging fuel detonation at high engine speeds, gradually destroyed the engine bearings and piston crowns. Another rebuild and more expense!

Therefore, if you are rebuilding the MGA/MGB engine with compression ratios of 9:1 or more, check the distributor’s auto advance mechanism. The vital measurement is the clearance (as a chord) for 10 degrees arc of advance, between the stop arm and the adjacent stationary spring post, is 166 thousands of an inch. The formula for chord in inches is 2 times sin of half the angle times radius of arc (2sin50.950). Take care measuring the gap; an error in measurement of 9 thou inches equals 1 degree variation at the crankshaft.

The standard design for a 25D distributor involves two springs. As mentioned above, the primary spring (weak) is under tension and determines centrifugal advance as the revolutions rise in the distributor and engine. The secondary spring (strong) is loose at rest but as the revolutions rise, the slack is taken up as the weights oppose the primary spring tension and swing outwards, and at the “knee” point on the advance curve, it contributes jointly with the primary spring to “slow” the advance rate as the engine speed continues to increase. At high engine speeds, the end stop (on the moving arm of the advance mechanism) reaches the adjacent spring post. Full centrifugal has been reached at this speed and at higher engine speeds this advance setting remains constant.

At lower engine speeds with almost complete cylinder filling, the rate of the combustion process remains fairly constant for a given compression ratio, independent of engine speed, it follows that the automatic advance must set off the ignition spark at increasingly earlier intervals as the engine speed rises. However, a point is reached at much higher engine speeds, when, depending on a number of factors such as engine tune, compression ratio, heat build up, camshaft profile and incomplete filling of the cylinder (probably just beyond the speed at which maximum torque is developed), any further increase in auto advance will not be required. The combustion “burn rate” now roughly increases at the same rate as the engine speed increases. Of course, this assumes the full throttle being applied has prevented the operation of the vacuum advance mechanism to influence the ignition timing. The engine speed, allowing for higher compression with standard or “mild” fast road camshafts, should be around 3,500 RPM with modern 98 octane fuel. Apparently, the figure need not be that precise, a range of 300 RPM either side may be close enough. However, I favour the high side at around 3,700 RPM with the compression ratio around 9.5 : 1 and 34 degree BTDC maximum advance as this is the highest setting advisable for the heart shaped combustion chamber used in the MGA and early MGB engines.

A word of caution, at very high compression ratios (around 10:1 or higher), the experience of others seems to suggest that the maximum advance should be limited to 30 degrees BTDC. The fuel burn rate will become increasingly faster due to the greatly increased pressures and resultant heat build in the combustion chamber. Thus, a static setting of 10 degrees BTDC is recommended and maximum advance closer to 3,000 RPM and the vacuum module may have to be removed.

Please note, anyone using the early “standard” MGB 25D distributor, specification number 40897, with its very fast auto advance curve (reaching full advance at 2,200 RPM), would appear unsafe to use at any setting above 10 degrees BTDC on modern 98 octane fuels, unless the auto advance curves are modified along the lines suggested above.

The same maximum static setting of 10 degrees BTDC applies to the MGA distributors (DM2) as they have a 12 degree auto advance mechanism reaching a 34 degrees BTDC maximum at 4,400 RPM. This is quite acceptable for the relatively low compression ratio of 8.3:1 and slower burn rate of the fuel using 95 octane fuels.

To implement the changes to the ignition curve for a 25D distributor with a 10 degree auto advance plate, the design of the springs must meet the following criteria. In order to remain at 14 degrees BTDC at idling speeds, the primary spring requires a tension of 8 ounces, measured at the radius (0.950 inches) measurement. Using 25 thou inch diameter spring wire with a coil diameter of 0.200 inches, the number of coils is 6 (or for a coil diameter of 0.230 inches, 5 coils). The length of the spring and its hooks must be manipulated by bending or “tweaking” the hooks to bring the tension to 8 ounces at the start of movement. Start with a free length between hooks (internal measurement) of 0.600 inches. The secondary spring wire should ideally be 40 thou inch diameter with a coil diameter of 0.200 inches and 5 coils (or for a coil diameter of 0.230 inches, 4 ½ coils). The length between hooks must be tweaked to allow two thirds of free movement of the stop arm towards the post before the spring comes under tension. Start with 0.700 inches in internal length. This allows about 14 degrees of advance under only the primary spring. The remaining 6 degrees is controlled by both springs. From my measurements and derivations, the primary spring rate of advance is 14 degrees per 1,000 RPM and the primary and secondary combined gives 4 degrees per 1,000 RPM.

The result I was aiming for was: static setting to 14 degrees crankshaft advance, auto advance starts at 1,200 RPM, reaches 2,200 RPM in a straight line at 28 degrees BTDC (7 degrees distributor auto advance), then after the “knee” point of transition, a shallower straight line advance to 34 degrees BTDC (full 10 degrees distributor advance) at 3,700 RPM.

After several goes at spring tweaking, I had to shorten the primary to 5 ½ coils (coil dia = 0.200) to achieve the static tension of 8 ounces. Now the rate of crankshaft advance has dropped to 12.5 degrees per 1,000 RPM. To compensate, the secondary required 5 ½ coils (coil dia = 0.200) to increase the combined rate to 5 degrees per 1,000 RPM. Apparently, these engines are not highly sensitive to advance curves so “close”, within 2 degrees, (crankshaft) will be close enough. As the geometric compression of my engine approaches 9.5:1, this slightly slower rise rate may preferable. If your engine’s compression ratio is higher, the advance curve probably should be closer to a straight line from start to finish, as outlined below.

An alternative, simpler approach to spring selection, proposed by Des Hammill in his book on power tuning contact breaker distributors, is to use two springs, both under tension. I recommend you make or find suitable springs from 25 thou. inch diameter spring wire with a coil diameter of 0.230 inches and 6 coils (or 7 coils of a diameter of 0.200 inches). This should have an advance rate of about 8 degrees per 1,000 RPM in a straight line. From the experience of others working with very high compression ratios, this straight line curve would appear to be an improvement over a convex or “knee” shaped curve. With a starting tension at 8 ounces and a free length (internal hook to hook) of 0.620 inches the auto advance hopefully starts at 1,000 to

1,200 RPM and finishes at 3,500 to 3,700 RPM. You need to confirm this with testing. If the full advance with vacuum disconnected is much later than 3,700 RPM, say at 4,000 RPM or above, increase the free length slightly of both springs and try again. If the full advance is reached much earlier at say 3,300 RPM, shorten the free length and have another try. It may take several attempts as the distance between posts in the stationary position will not be the same for each distributor. Shortening or lengthening over the very small range can be achieved by bending the spring hooks in or out with small round nose pliers. If you do not have suitable springs to hand or some wear has take place in the auto advance mechanism, look for worn out distributors from BMC vehicles generally, as a source for the parts. There are many parts in common with the MGA / MGB.

In conclusion, check for pinking at full throttle at 2,000 RPM in top gear. This usually finds it. The sound has been described as shaking a tin can half full of marbles. If you hear this sound at any speed, back off the ignition timing by at least 2 degrees and check again. If still there, back of some more. If you go below a static setting of 10 degrees for the 25D distributor, you have a problem. There are any number of possible causes including the octane rating of the petrol in relation to the compression ratio of your engine, vacuum take off point and the characteristics of the vacuum module itself. Note, the vacuum module take off point is "up-stream", at the throttle base of the rear carburettor. The "down-stream" manifold vacuum point is not suitable. It should be plugged and the carburettor base modified to take the vacuum port. The vacuum module you should be using is identified by markings indicating its parameters: shown as "5-13-10". This means at 5 inches of mercury the advance commences, 13 inches it is at the maximum of 10 degrees distributor advance with the vacuum take off coming from the rear carburettor's base plate, as mentioned above. This amounts to 20 degrees crankshaft advance under high vacuum in cruise mode, so the total advance of the distributor at more than 3,500 RPM could be as much as 54 degrees BTDC! Makes you think, doesn't it.

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