Ignition timing ("be a little retarded")

Written by Peter S30 at Aug 20, 2012 9:25 am

Here are some interesting reflections received from David Hine. Seems logical to me but I never thought about it before. Worth trying on your engine. Would be nice to have a rolling road around the corner..

Be a little retarded ! (Written by David Hine)

This article is intended as a thought for the day and not strictly accurate technical advice !

The very words “advance” and “retard” when related to ignition timing can be misleading because of other connotations relating to the development of our brains.

I studied petroleum refining at college so I know a little about how petrol is made but that was back in 1962 and technology has moved on a lot since then.

What I am now certain of, is that the timing marks that are beautifully engraved on your flywheel are probably in the wrong place.

When our cars were built the engine designers had to cater for the petrol available which, on the whole, was pretty awful stuff. It was distilled from crude oil and contained a huge mixture of hydrocarbon elements ranging from paraffin type through to light ether types. Things got even worse during hostilities when the more desirable elements were boiled off for use in aircraft engines leaving the residue as “pool” fuel for the ordinary motorist.

You may notice the hot spot designs on some of our cars where the fuel mixture is heated by the exhaust gas to help it evaporate. However the most common design feature was the very low compression ratio as the mixture was compressed into the relatively large combustion chamber. Ratios as low as 5 and 6 to 1 were the norm.

Any higher compression ratio and the fuel mixture heats it up too fast and it starts to burn and explode far too soon.

Pure Iso Octane, which is an eight carbon / hydrogen compound was considered the gold standard by which fuel quality was measured. Octane was not commercially viable but could stand compression ratios of up to 9 : 1 without compression ignition occurring.

Then there was the serendipitous discovery of tetra ethyl lead. A unique product which when added to the mix tended to eliminate compression ignition and even the crude fuel mixes with “lead” produced petrol which performed almost as well as octane.

The compression ratio has the major effect on the timing of the spark. Fuel of any kind does not burn instantaneously so it need to be ignited before the piston reaches top dead centre where the big bang is required to drive the piston back down again. With compression ratio of say 5: 1 the spark needs to be advanced to 45 degrees before TDC. With compression ratio of 6 : 1 the fuel burns faster so only 35 degrees of advance is required.

With the advent of “leaded” petrol we were all encouraged to plane our cylinder heads or fit domed pistons. This higher compression gave a faster burn so we could retard our ignition and get more power. Unless we had a rolling road facility, the finding of the optimum ignition advance was a matter of trial and error. Those who have cars fitted with an ignition lever could experiment under load. The advice is to advance the ignition until the knocking, thumping or “pinking” is felt and then retard the ignition until it just disappears when accelerating hard.

Did you actually register what I just wrote ! I said “retard the ignition and get more power”. This is a difficult concept when we have always seemed to do the manly thing and advance the ignition to get more power.

Sure, if you retard the ignition too much you will get sooty plugs and a very hot exhaust manifold. This is because the fuel is still burning as it is exhausted from the cylinder.. However if the ignition is too far advanced the fuel will be ignited too soon and the explosion will fight the piston as it is still rising to top dead centre and power will be lost.

The petrol now available to us is often much maligned and considered to be the cause of many engine malfunctions. However as an elderly technologist I am most impressed at the consistency obtained from pump to pump and the fact that it has been made possible to eliminate “lead” from the fuel by sophisticated petrochemistry.

However there is no gain without pain and the location of our petrol pumps under the hot bonnet is now likely to give rise to vapour lock on a hot sunny day. For high performance cars it is necessary to fit the petrol pump below the level of the petrol tank towards the rear of the car. With my touring car I have fitted a booster pump into the reserve petrol line below the seats and still pump through the existing pumps as well.

The modern fuel also burns much faster after ignition which means that the original timing marks on our flywheel are probably unnecessarily and undesirably too advanced .

It is difficult to be specific because every engine is different. But, for example, my M45 which is standard apart from flat top pistons and 100 thou” machined off the cylinder head, now runs at 22 degrees fully advanced.

My son Nick’s LG 45 also has the same raised compression ratio (approx 8 : 1)but , in addition, a high lift camshaft. This means it ingests more fuel mixture which in turn gives a bigger bang. We have retarded the ignition to 18 degrees for optimum high revolutions performance.

The M45 was arrived at by trial and error but Nick’s car was done using a rolling road and running the engine at 4000 rpm under full load. I had to have the twin Scintilla Vertex magnetos modified so the they do not advance more that 12 degrees as the engine speeds up.

Attachments:

Be a little retarded.pdf (filesize: 55.75 KB)

Re: Ignition timing ("be a little retarded")

Written by Colin M34 at Aug 20, 2012 12:26 pm

Hello Peter,

A very good topic to kick off a technical discussion! Let me add my thoughts to David's great article.

My old 1925 12/24 Lagonda - now in the enthusiastic hands of Lagonda Club member P49 who calls "Connie" - has a very low compression ratio, along with an Overhead Inlet Side Exhaust (OISE) arrangement. Very Edwardian. The advance-retard lever is very handy on the steering column. First rule, as David says, is to ignore the timing marks, though in Connie's case, they are hopelessly retarded. This is because with a low compression engine, modern fuels burn too slowly and they need to be "lit" much earlier than fuels of the 1920's and 30's. This is even more of an issue with the 12/24 engine because the combustion chamber of the OISE engine is eccentric to say the least. The block has a non-detachable head with the exhaust valve set to one side, with the inlet valve above it. This is in a cage complete with the seat and whole unit screws in above the exhaust valve. The spark plug sits between the two valves which communicate with the cylinder via a slot. Distinctly odd but in 1913 was probably the latest thing!

Driving the car is fun. You have such modest power that the ignition advance lever has to be used all the time to get the most pull from the engine in certain conditions. What amazed me was that some times I had to ADVANCE to the ignition at low revs to maximise the power from the engine. Heaven knows what strange gas flows through the slot are taking place under these conditions but apparently the car ran very well on pool petrol during the war.

They stopped making the 12/24 in 1926. A mere 12 years later the V12 was born. What a huge technology change took place during this time - including fuels.

Cheers

Colin

Re: Ignition timing ("be a little retarded")

Written by Julian at Aug 20, 2012 4:31 pm

Hi Collin, an interesting subject and the more one learns the more one realizes we know far less than we think!

It is actually a massive subject as you must take in so many variables that affect our engines efficiency.
For example, you are surprised to have to advance the engine in the lower rev range. Think thus.

Our engine runs in a constant variable efficiency range.
Therefore a constantly changing CR must take effect.
The more unstable our efficiency (generally the worse designed older engines) the more we find our "effective" CR to be varied.
Therefore we need to Advance (in general) for our low efficiency and even lower than static CR in order to achieve maximum combustion pressure just past TDC.
As our efficiency gets toward its peak we use the least advance and as it passes this point more advance again.
Hence the Vacuum "advance" unit on 50s to 80s cars that is actually advancing ignition under heavy inlet vacuum (poor engine efficiency) and letting the ignition go back to its normal position when vacuum is released when you press the throttle to accelerate or drive at WOT positions. And then the mech advance adds more again as the engine speeds up.

Heat is also a factor.

People mostly do not realize that Detonation is not necessarily caused by too much CR or spark advance etc., but usually by poorly designed combustion chambers, poor assembly of engines, wrong fuel air ratios etc. etc. Detonation is actually the result not of the fuel/air mixture being ignited on its own before the spark, but of the Spark ignited mixture burning and travelling across the combustion chamber at a speed not fast enough for all the fuel/air mixture to be ignited before the temperature rise in the un-ignited portion spontaneously explodes like a diesel. as you can imagine a flame only travels at a certain speed, and if the combustion chamber is badly designed for instance and the spark plug is at one side of a large chamber, the "flame front" needs to move over a large distance, all the time this is travelling the un-ignited gasses are increasing in temperature dramatically, if the flame front is not fast enough then BANG this portion of gasses go off well in advance of its correct time and not only do you get "effectively" a pre-ignition but you have two flame fronts hitting each other very hard and causing a massive rise in combustion pressure before TDC and with nowhere to go as the space in the combustion chamber above the piston is still shrinking. Bad for bearings! etc.

Obviously a cold engine won't have the same problem as a hot one!

An engine with a poorly designed cooling system may read cool on the gauge but yet be boiling in some areas! Again, bad for the detonation limit. V12 Lagondas for example with std designed engines are terrible for this. All this needs to be considered and about 500 other points like the difference in flame front speed between weak and rich mixtures etc. The list is endless.

When deciding what settings your engine needs, Never be surprised but always be prepared to adjust yourself and your understanding to your findings. Theory is great but practical "reality" is the ultimate teacher.

"If it is, it is! Even if you don't sometimes think it should be!"

Fun subject Collin and I hope people can understand what I'm trying to say and how deep this subject is.
