Rolls-Royce Owners' Club of Australia

Unleaded Petrol for all Rolls-Royce Cars?

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I recently read an article in PRÆCLARVM, written by a retired Rolls-Royce engineer that gave advice to owners regarding the use of unleaded petrol in engines originally designed for leaded petrol. He covered the two main areas of concern when considering using unleaded petrol, these being valve seat recession and compression ratio.

As a motor Engineer myself, I would like to express a contrary opinion drawing on my own experience in the field. Whilst giving my opinion I would like to explain the practical and technical reasons behind them.

In the article it is suggested that the overhead inlet side exhaust valve engine cars will at most need more regular checks of inlet valve clearances. Rather, it is known in practice that in fact it is the exhaust valves that need regular monitoring since the exhaust valve seats suffer from valve recession when not protected by the lubricating properties of lead, when these seats are cut directly into the cast iron of either the cylinder head or the block.

When the exhaust valve seat is not lubricated by lead it becomes overheated and each time the valve opens, molten particles of the seat are removed by the valve head, and the rotating action of the valve produces abrasive wear on the seat and effectively lowers the valve head into the seat. This action rapidly reduces valve clearance.

The results of this reduction in valve clearances will cause the exhaust valve opening time to be advanced exposing the exhaust valve head to the high temperature heat flash of the still expanding combustion stroke. It will also decrease the time the exhaust valve head is in contact with the seat which is the main area of heat dissipation for the valve to the cooling system. Both the early opening of the exhaust valve and the decreased time that the valve remains on the seat dramatically increase the temperature of the exhaust valve which in turn accelerates valve recession problem.

This cycle continues until there is no valve clearance and the valve head can no longer discharge its heat to the cooling system. This results in a burnt valve and a total loss of compression. It is very likely that engines that have travelled many thousands of miles on leaded petrol will be afforded some protection because the valve seat will be impregnated with lead, but if a valve regrind job becomes necessary, and the valve seat is recut this protection will be removed.

My advice, if you are going to use unleaded petrol in this type of engine, would be to check exhaust valve clearances every 3000 miles and when a valve job is required, fit hardened exhaust seats as per S1/Cloud 1 engines.

The second area of concern is advice given regarding compression ratio. It is suggested in the article that it is possible to run all V8 engines on unleaded petrol as long as the ignition timing is adjusted to suit the lower octane rating of the unleaded petrol. The procedure advised is to retard the ignition timing by 1degree per octane number reduction.

This means that for a 9 to 1 compression engine that was designed to run on 100 octane petrol and now to be run on 96 octane leaded petrol should have the ignition timing retarded by 4 degrees to a setting at idle speed of 1 degree Before TDC from its standard setting of 5 degrees Before TDC, and if the same engine was to be run on unleaded petrol of 92 octane the ignition timing would have to be retarded by 8 degrees, resulting in it being set at 3 degrees After TDC. Setting the ignition timing to this formula would result in substantial decrease in engine performance, idle quality, engine overheating and possible mechanical damage. It could also be illegal, as exhaust emission would be dramatically increased.

Engines with 8 to 1 compression are on the border line for use with 92 octane unleaded petrol and if in good mechanical condition may just tolerate unleaded petrol.

It is generally accepted by most motor engineers, that retarding ignition timing is not an acceptable method of tuning an engine to run on low octane unleaded petrol. In my opinion, the major flaw in the advice to retard ignition timing to suit low octane petrol, is that the assumption is made that the octane requirements of an engine that has been in service for several years will be the same as it was when it left the factory. In practice this is not the case and in fact it is likely to have increased.

There are many things that can occur during the life of an engine that will increase its octane requirement, these are compression increase due to carbon build up, cylinder head surfacing, cylinder block surfacing and cylinder over boring, inoperative exhaust gas recirculation equipment, increased inducted air temperature, lean petrol mixture, engine oil leaking into the combustion chamber and a worn distributor giving excessive mechanical or vacuum advance.

When a distributor is tested with an ignition oscilloscope a worn distributor will not only change the mechanical centrifugal advance curve (the rate of ignition advances relative to engine speed) but also the ignition timing of individual cylinders by several degrees. Since ignition timing is only checked on one or two cylinders, there is no guarantee that the ignition timing settings will be the same for the remaining cylinders. Added to this, it is quite common for compression pressure tests on individual cylinders to be ten p.s.i above the rest. It will be appreciated that the octane requirements of individual cylinders can be very different, much less individual engines.

Owners of carburetted turbo cars would not be advised to follow the ignition retard advice as these engines already find it difficult to run on 96 octane petrol and would suffer severe detonation if run on 92 octane unleaded petrol, although some may say that the compression ratio is only 8 to 1 and should tolerate unleaded petrol. It should be remembered that the compression ratio stated by the manufacturer is the theoretical ratio and is very different to the running or dynamic ratio. The theoretical ratio is calculated and assumes that the cylinder will be 100% filled at atmospheric pressure, but in practice a normally aspirated engine will only manage approx 75 to 80 per cent filling of the cylinder at maximum torque. Turbo charged or forced induction engines achieve far greater than 100%-cylinder filling and therefore have much higher dynamic compression ratio when running under boost conditions and have a compression ratio of approx 11 to 1. Owners of these carburetted turbo cars would be advised to continue using leaded petrol while it's available and consider converting to lower compression pistons in the future.

My advice for owners of 9 to 1 engine would be to continue to use leaded petrol until an engine overhaul is required and then rebuild it using lower compression pistons.

Owners with 8 to 1 engine should firstly make sure that all systems are working correctly, clean combustion chamber deposits by using Redex upper cylinder lubricant or similar and have ignition distributor advance curve checked before changing to unleaded petrol, and when overhaul is required convert to lower compression pistons. Owners with 7.3 to 1 engine need only ensure that their engines are in good tune, and that all systems are working correctly.

The only other alternative to the octane requirement problem of all these engines is the use of L.P.G which has an average octanex rating of 110, contains no lead and has much lower pollution levels than both unleaded and leaded petrol.

This article is intended as information only and should not be taken as a recommendation by the author or the Club of any particular course of action.

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