



Frank Massey, Autoinform

# Petrol Injection systems explained

While there has been a significant swing to diesel engines, both diesel and petrol engines have been changing, as more restrictive emissions standards come into effect. Autoinform's Frank Massey explains some aspects of petrol injection, which is set to become more common in the near future.

**I** was surprised, if not shocked quite recently, during a direct injection training course when I asked delegates how often they deal with petrol injection problems, more specifically problems with direct injection. The common consensus indicated that very rarely if not at all.

This concerned me on several counts, did customers avoid bringing such problems due to poor marketing, or a previous inability to resolve problems of that nature. Or did the technicians deliberately avoid or discourage taking on such work due to a lack of knowledge or confidence?

Whatever the reason, it was clear that developments in petrol injection systems had evolved to such an extent, that a genuine fear or reluctance to take on such work demanded a redress.

Around 80% of our garage's work related to diagnosis and repair of diesel systems. I feel a little like one of those American storm chasers that you see in the movies, chasing after tornados for no apparent reason. The reason being I feel a storm coming in the industry for a number of reasons, which I hope this topic will illustrate, or warn you to take shelter.

## Higher status

Fun apart, lots of good things have developed in recent years, most of which I believe have elevated the use of petrol powered vehicles into a clear advantage over diesel vehicles. To that extent my current petrol powered vehicle has replaced a previous diesel variant. This is mainly due to the better performance, cost, maintenance, and Euro 6 Selective Catalyst Reduction (SCR).

So where is the forthcoming storm coming from in relation to direct injection? Well I hate to say it, but it will pretty much be the same reason and direction; emission reduction related regulations. I have made this statement before and will reinforce it again, I am in total favour of harmful

emissions reduction regulations. In fact, I believe it is not robust enough or enforced proficiently in its current form.

Where is direct petrol injection currently at? Pressure control, like common rail diesel, is either volume or pressure regulated, by an actuator mounted on a mechanically driven hydraulic high pressure pump, that is usually ground switched.

Pressure regulation is independent of engine speed, this excludes some crude mechanical systems, and follows an increasing technical demand for ever more power and lower emissions. Pressures vary between 50 bar at idle, to 180 bar at full load. Fuel transportation is a complex variation, taking into account some or all of the following control modification.

The point of delivery may vary from the bottom of the intake stroke around 300 degrees BTDC, to approximately 60 degrees BTDC. This, in effect, determines if the engine is under the control of homogenous or stratified fuelling.

Additional to this are split or dual injection strategies, which employ both of the above within the same intake charge events. This is used to quickly heat the catalyst, reducing the formation of harmful emissions or compensating for flexible fuelling strategies.

The intake air or swirl is modified to enhance efficient combustion, mix EGR and

form stratified charge control.

The piston crown, fuel delivery pressure and injection timing determine penetration.

## Service regime

Ignition angle is matched for a number of reasons, not just

simply to avoid detonation, or to satisfy poor combustion properties when running on ethanol based fuels, but it is also modified to regenerate the NOx accumulator and saturation due to sulphur contamination. Yes, I have just stated the need to regenerate the NOx accumulator using serial control and dynamic drive cycles

Flexible fuelling also demands a modified servicing regime, due to an increased contamination of the lubricants, a modified high pressure fuel pump, inlet manifold, cold start injector and an even more complex dual injection regime! Why? Well petrol evaporates at temperatures ranging from 40 to 200 °C. Ethanol however, only evaporates at 78°C and only at this temperature due to its molecular structural behaviour. At all other temperatures, it becomes a contaminate, especially on the cylinder walls.

How does the engine PCM know ethanol fuel is used, and just as important what percentage ethanol is present? Another sensor of course, mounted under the floor pan after the in-tank pump and before the injectors, that employs a small current across a sensor which is effected by the dielectric reaction of the fuel. This reaction is converted into a frequency, which represents the ethanol content.

