BACK TO SCHOOL!

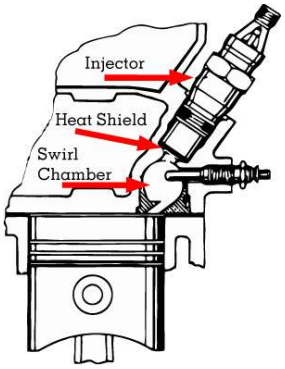
Diesel powered urban commuters have become the normal in recent times. They are more reliable, more economical and have more torque than their petrol counterpart. But they are factory tuned to a price point, not a driver experience.

You cannot buy a factory tuned individual driving experience, less face it, we all have different reasons for our purchase and all with a different outcome in mind. So why not have our driving experience tailored for how and what we want.

Over the years there have been many different opinions surrounding Diesel Tuning. As complicated as the manufactures like to make it, it really comes down to simple drivability and user experience.

Diesel tuning is more important than we think… So let's look at it in depth and dispel some common myths surrounding common rail with common sense.

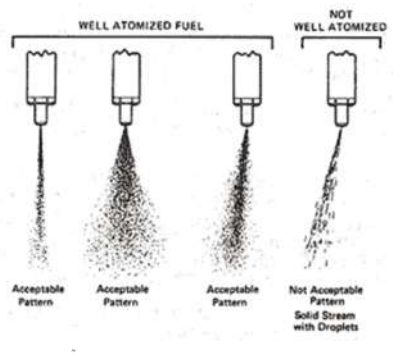
Firstly some background on the OLD V's the NEW



Diesels of old relied on a simple and effective, but not altogether efficient or accurate method of distributing fuel to the engine's combustion chambers.

The fuel pump and injectors on early diesels were completely mechanical, and though precision machined and ruggedly built, the working pressure of the fuel system was not sufficiently high enough to render a sustained and well-defined spray pattern of fuel. In these old mechanical indirect systems, the pump had to do double the work.

Not only supplying fuel system pressure, but also acting as the timing and delivery device (pump pressure forced the mechanical injectors to open). Additionally, these very basis systems relied on simple mechanical inputs (no electronics here as yet) such as fuel pump RPMs and throttle position to meter their fuel delivery.



Quite often these older oil burners delivered a shot of fuel with a poor and ill-defined spray pattern that was either too rich (most often) or too lean. This resulted in either a rich belch of sooty black smoke or insufficient power or a struggling vehicle. To make matters worse, the low pressure fuel had to be injected into a pre-chamber to insure proper atomisation of the before it could mosey into the main combustion chamber to do its work.

BACK TO SCHOOL!

Our modern diesels owe their resurgence in popularity to advances in fuel delivery and engine management systems which allow the engines to return power, performance and emissions equivalent to their petrol counterparts, while also generally producing better fuel economy.

Prior to the introduction of electronically controlled injection systems, fuel injection timing was typically fixed at a constant value over the entire engine operating map. However, variable injection timing systems were used in the late 1980 and continued through the 1990's for additional flexibility and to compensate for this shortcomings in engine performance, but it's primarily function acted as a means of reducing exhaust emissions rather than power.

Programs aimed towards developing a fuel system for the future diesel powered passenger car continued and it soon became apparent that future diesel cars would utilise a direct injection combustion system, a clear advantage in fuel economy and power density relative to the then prevalent indirect injection combustion system.

The driving forces behind these developments were producing a comfort level comparable to that of petrol fuelled cars, compliance with future emission limits and improved fuel economy.

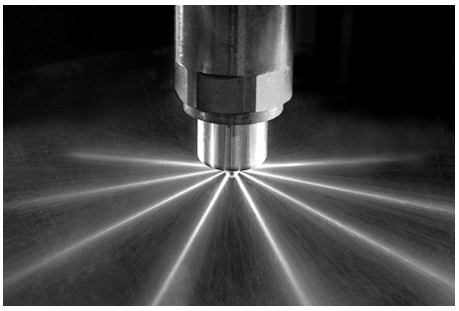
Although there were different system architectures developed, and each of these approaches lead to commercial fuel systems for production vehicles, the *common rail* system provided a number of advantages which would eventually dominate as the primary fuel system used in light-duty diesel vehicles.

Now On To the Interesting Stuff

The modern *common rail* direct injection diesel engine is quieter, more fuel efficient, cleaner, and more powerful than the indirect mechanical injection units they have replaced.

It's fundamentally the high pressure fuel rail and the computer controlled electronic injectors that make all the difference.

In the common rail system, the fuel pump charges the fuel rail at a pressure of up to 27,000 psi, but unlike indirect injection pumps, it is not involved in fuel discharge. Under the control of the on board computer, this fuel quantity and pressure accumulates in the rail independently of engine speed and load conditions.



This allows for flexibility in controlling both the fuel injection quantity and injection timing and enables better spray penetration and mixing even at low engine speeds and loads.

This feature differentiates the common rail system from other injection systems, where injection pressure increases with engine speed, this characteristic also allows engines to produce higher torque at low engine speed. A feature exploited by manufactures when coupled with the addition of a variable geometry turbocharger (VGT).

It should be noted that while common rail systems could operate with maximum rail pressure held constant over a wide range of engine speeds and loads, this is rarely done.

RAIL PRESSURE and INJECTOR DURATION

Diesels engines are a simple beast, regardless of the age, old or new. Fundamentally they are a constant volume engine, relying upon unrestricted air intake but controlled by the volume of fuel injected.

Sure you can increase the volume of air with the addition of air induction components, and you can cool the air intake down with the addition of further components. But without adding fuel to the mixture the benefit is minimal.

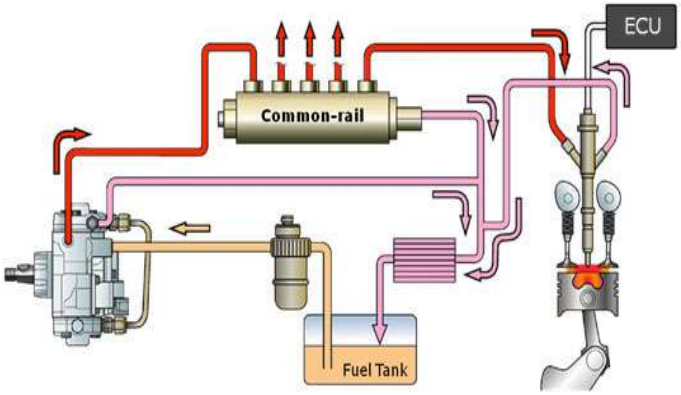
Fuel and fuel alone is the key.

How that fuel is delivered will determine the difference between a *good tuner* and a very poor one.

Diesel injectors have the job of spraying fuel proportionally throughout the combustion chamber at the correct timing to create an even burn pattern, the result being a clean, efficient use of the diesel fuel and of course power.

BACK TO SCHOOL!

Modern diesel are feed via Common Rail fuel delivery systems at extremely high pressures. The injectors are controlled by the engine computer and can be fired in rapid succession several times during the injection cycle. This precise control over injector firings, smaller, staggered quantities of fuel delivery can be timed over the course of the power stroke to promote complete and accurate combustion.



In addition to timing control, the short duration, high pressure injections allow a finer and more accurate spray pattern that also supports better and more complete atomization and combustion.

Valve timing generally doesn't change in current modern diesels, and the amount of time the injector is open (injector duration) varies only a small amount from idle to redline.

A charged common rail will comfortable sit around 3000psi at idle and rise to as much as 27000psi at redline. This charged pressure rail negates the need for longer injector opening durations. (In fact, with increased RPM, combustion has effectively less time to happen, so opening the injector longer will simply be inefficient in increasing power.)

A *knowledgeable diesel tuner* has the ability to alter the fuel delivery mapping correctly with digitally controlled accuracy, much in the same way the manufacture intended it to be. In this controlled environment, modifications are within manufactures specification without compromising the on board systems feedback regulators.

Manufactures spend millions on perfecting and protecting their assets. They have built in safety regulators but rarely use the power their asset was initially designed to produce. Preferring to opt for comfortable and upgradable.

Don't be blinded by the hype. Manufactures are in the business on making money too. Would you like steak knives with that? This model has red trim and 20% increase in power…..

Glen Hadden.