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Diesel Particulate and Fuel additive system overview

Introduction

Diesel particulate filters were introduced by vehicle manufacturers around 8 years ago to reduce the emission levels of common rail diesel engines through post combustion filtration. In essence the principle of diesel exhaust gas filtration seems simple; incorporate a particulate filter in the exhaust system to 'clean' the gases as they flow through, trapping carbon particles within the porous structure of the filter.

Filter structure

These filters are manufactured with an internal structure made up of porous channels of silicon carbide. These are arranged in such a way as to allow exhaust gasses to pass through their walls collecting carbon particles (soot) and any un-burnt chemicals from fuel additives.

Natural filter regeneration

Due to the nature of diesel soot particles there are obvious difficulties in creating a filter which has an acceptable service life; this led to the development of a particulate filter that has the ability to clean itself through 'regeneration'. Regeneration would normally occur when exhaust gas temperatures reach temperatures of around 550°C when soot deposits would be burnt off. By injecting a proportional amount of 'fuel additive' to the diesel tank combustion temperatures of the un-burnt particles can be reduced to around 450°C allowing natural regeneration to occur more frequently. It is for this reason that a fuel additive system is used in conjunction with a particulate filter.

Fuel Additive system

The fuel additive system comprises of an independent reservoir which will hold approximately 5 litres of fluid. The reservoir is connected to the main fuel tank via the additive pump and injector. This injector is generally controlled by a specific module which takes information from vehicle body controllers to determine when diesel has been added to the fuel tank and subsequently injects a proportional amount of fluid into the diesel tank. The additive module monitors the total quantity of fluid injected and will inform the driver when the calculated level becomes low. Generally fluid replacement frequency is between 40,000 miles and 60,000 miles depending on vehicle.

Assisted filter regeneration

Although the addition of a fuel additive increases the likelihood of natural filter regeneration certain driving conditions prevent this from happening. If exhaust temperatures rarely rose to the desired 450°C the filter would soon become blocked. To prevent this engine control systems will assist. By monitoring vehicle driving styles (vehicle speed, engine torque etc) and using information from exhaust temperature sensors and filter pressure sensors the engine control system can choose to assist by artificially increasing exhaust gas temperatures to a level where regeneration will occur. It can achieve this in a number of ways:

- Post injection
- EGR valve closing
- Activating high electrical loads (Heated screen, glow control etc)

Autodiagnos Ltd
Hopton Estate, London Road, Devizes, SN10 2EU
Tel: 0870 949 3799 Fax: 01380 732001 Email: info@autodiagnos.com
www.autodiagnos.com

Serial diagnostics
As can be expected these systems do not always behave as they were designed to. Being able to diagnose the fuel additive module, the diesel engine control module and any associated body controllers is essential when attempting to fault find these systems. Possibly more important is the requirement for diagnostic equipment to allow routine service functions to be completed. Functions such as:

- Filter replacement
  Although filter regeneration will remove the majority of the carbon particles retained on the walls of the filter some fuel additive chemicals are non-combustible and will therefore remain, this will eventually lead to the filter coming to the end of its serviceable life. Generally filter replacement frequency is between 50,000 and 100,000 miles depending on vehicle. Following filter replacement it is necessary to reset the system within the fuel additive module.

- Fluid replacement
  Following fuel additive fluid replacement it is necessary to reset the counter within the fuel additive module.

- Forced filter regeneration
  Many systems allow a 'forced' filter regeneration to be activated. This activation uses methods similar to that used in the systems own assisted regeneration. Vehicle speed is increased and engine load is increased to attempt to achieve necessary conditions to force filter regeneration.

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