FuelGems Test Report

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Scope

A series of tests to investigate the effect of 3 different additives Gems 1, Gems 2 and Gems 3. These additives were to be dosed to a control EN590 diesel fuel sourced from control fuel supplier Carless.

The engine used was a Jaguar Land Rover (JLR) Unit

DW12 BTED4 177 PS (130 kW; 175 hp) Common rail Turbo-diesel 16-valve

Three Load Points were selected to simulate steady cruise and idle and the following output parameters recorded.

Load Points

1. 1300 rpm, 22Nm 3 kW
2. 2000 rpm, 160Nm 33.5 kW
3. 2500 rpm, 190 Nm 49.75 kW

New 25 Litre Metal Drums, Tinplate with Screw Lids were obtained for mixing and a fuel mixer was fabricated from steel. To ensure an even mix with no loss of the additive the drums were half filled with 10lt, the additive dosed into the drum (using glass measuring and decanting equipment) then a further 10lt was added before mixing for 5mins using a battery drill. The measure of the fuel in the can was achieved by a digital fuel decanting gun and this was cross checked by weighing the drums before and after filling and correlating with the measured density of the fuel. Correlation achieved was between 50g – 100 g in 20 lt of fuel.

Tests Procedure

Two series of tests were conducted with 3ml of each of the additive per lt of fuel. To ensure consistent atmospheric conditions and results each series of tests were conducted on one day. ABAB testing protocols was used with each AB carried out on one day. Further tests were carried out using 5ml / lt of additive and the results are show as test series 3.

Fuel transfer to the dyno tank was carried out using dry break connectors to avoid contamination. A new hand driven fuel transfer pump was used after modifying to remove plastic elements from the design. Fuel was drained down from the tank to ensure the tank was empty to avoid cross contamination. All dosed fuel was recovered and is stored in individual sealed UN drums secured in the dyno cell. All fuel was temperature conditioned in the cell for 72 hrs before any tests were carried out and the fuel had obtained ambient cell temperature.

After fuel transfer was carried out the engine was started and after the initial start phase it was brought up to running temperature. The engine was then stabilized for 8 minutes before logging and averaging the results for 5 minutes. The time was chosen to give a long logging time and avoid any inaccuracies of the AVL fuel flow meter having to refill (2l of fuel absolute maximum).

Pressure Measurements

In cylinder pressure traces were captured using an in cylinder AVL pressure transducer, at 3 times during each test along with the number, position and magnitude of the fuel injection pulses during the recorded pressure trace.

1. Pre-Run, warm up and steady phase

2. Pre-Log, Just before the 5 min log period

3. Post-Log, immediately after the 5 min log period

Each of these graphs are shown in Appendix 1 Pressure traces and the maximum pressures are shown in table 8 Averaged maximum pressure readings pressure.

Engine motoring friction

Following the tests, the fuel injectors were turned off (disabled), and the dyno was used to "motor" the engine and to be able to measure the load required to turn the engine at various RPM. The results for these tests are in table 9.

All dosing was to be carried out with avoidance of plastics in case of migration of agents into / out of the fuel for the tests into the fuel.

The series of test was based on additive Gems 1, Gems 2 and Gems 3. The dosing of the premixed additive was 3ml / lt for test series 1 and 2 and 5ml / lt for series 3.

Engine Behaviour

During the test series no engine anomalies or behaviour was noted. No adverse engine effects of the additive were apparent, the engine returning to standard conditions when returned to the control EN590 fuel. The engine was not dismantled at any stage during or after these tests.

Conclusions

Looking at the data in some detail the three additives appear to have a significant positive influence on the unburnt hydrocarbon portion of the exhaust gasses. (UHC ppm). The largest magnitude of change using 5ml / lt at 2000 rpm (a reasonable 70mph cruise rpm) was of the order of 49.5% almost halving this undesirable emission. The average change at 3ml / lt dose was around 16% suggesting that the increase in dosing produced an over geared response. See Table 5 Series 3 Emission readings Load Point 2 2000 160 Carbon Monoxide showed reduction of 14% at concentration of 3m / lt. Nm. See Table 4 Series 2 Emission readings Load Point 2 2000 160 Nm.

Load point 2 2000 rpm 160Nm 33.5kw

	NOx ppm	CO Ppm	CO2 %	UHC ppm	BMSF g/kWh
Control EN590	113	596	11.2	86	256.1
Gems 1 3ml/lt	120	520	11.1	86	254.4
Gems 2 3ml/lt	119	507	11.1	77	254.3
Gems 3 3ml/lt	122	514	11.1	77	254.6

Table 4 Series 2 Emission readings Load Point 2 2000 160 Nm

Load point 2 2000 rpm 160Nm 33.5kw

	NOx ppm	CO Ppm	CO2 %	UHC ppm	BMSF g/kWh
Control EN590	112	551	10.9	93	255.8
Gems 1 5ml/lt	117	588	11.2	62	256.6
Gems 2 5ml/lt	125	584	11.2	51	256.5
Gems 3 5ml/lt	129	565	11.2	47	256.8

Table 5 Series 3 Emission readings Load Point 2 2000 160 Nm

Engine Motoring torque

RPM	Motoring Torque EN590 Std Fuel Nm	Motoring Torque Gems dosed fuel Nm
1300	35	35
2000	35	35
2500	36	36

Table 9 Engine Motoring torque