

Rotary Fuel Injection System to Meet European Stage IIIA Emission Norms in Diesel engine

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ABSTRACT: In diesel engines, various systems like fuel injection system, lubrication system, and cooling system were present. Due to stringent emission standards some catalytic exhaust after-treatment devices like diesel catalysts and diesel particulate filters are used. However, the most important system which determines the engine performance is fuel injection system. The fuel injection system includes both fuel injection pump and injectors. The FIE system play a vital role in engine power, Brake Specific Fuel Consumption, Emission Standards etc. In this project, we are focusing on meeting of emission standard of European Stage IIIA based on optimization of Rotary Fuel Injection System. Optimization in FIE system includes hardware experiment like plunger diameter, cam ring, rate shaping nozzle & injection rate rig analysis. Based on test result, hardware combinations are finalized which are met the emission standards of EU STAGE IIIA.

KEYWORDS: Plunger, Cam ring, Rate shaping nozzle & Rate rig.

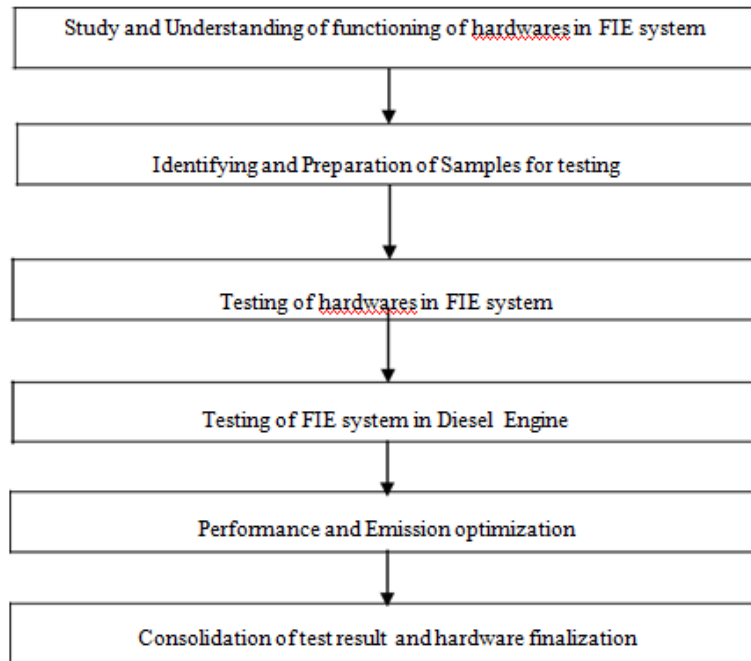
1. INTRODUCTION

The performance of diesel engines is heavily influenced by their injection system design. In fact, the most notable advances achieved in diesel engines resulted directly from superior fuel injection system designs. While the main purpose of the system is to deliver fuel to the cylinders of a diesel engine, it is how that fuel is delivered that makes the difference in engine performance, emissions, and noise characteristics.

Here to meet the performance and emission level of EU STGAE IIIA, following investigation has to be carried out like preparation of hardware configuration like CAM RING, PLUNGER, NOZZLE, testing of hardware variants, selection of suitable hardware configuration.

II. METHODOLOGY & EXPERIMENTAL SET-UP

The present work aims at the optimization of DI Rotary Fuel Injection Pump to meet EU STAGE IIIA. For this, hardware configuration to be tested and evaluated. The methodology of selection of hardware variants is discussed in this chapter.



Experimental Set-up:

The following experimental set-up is used for calibration of rotary fuel injection system in the test bench.

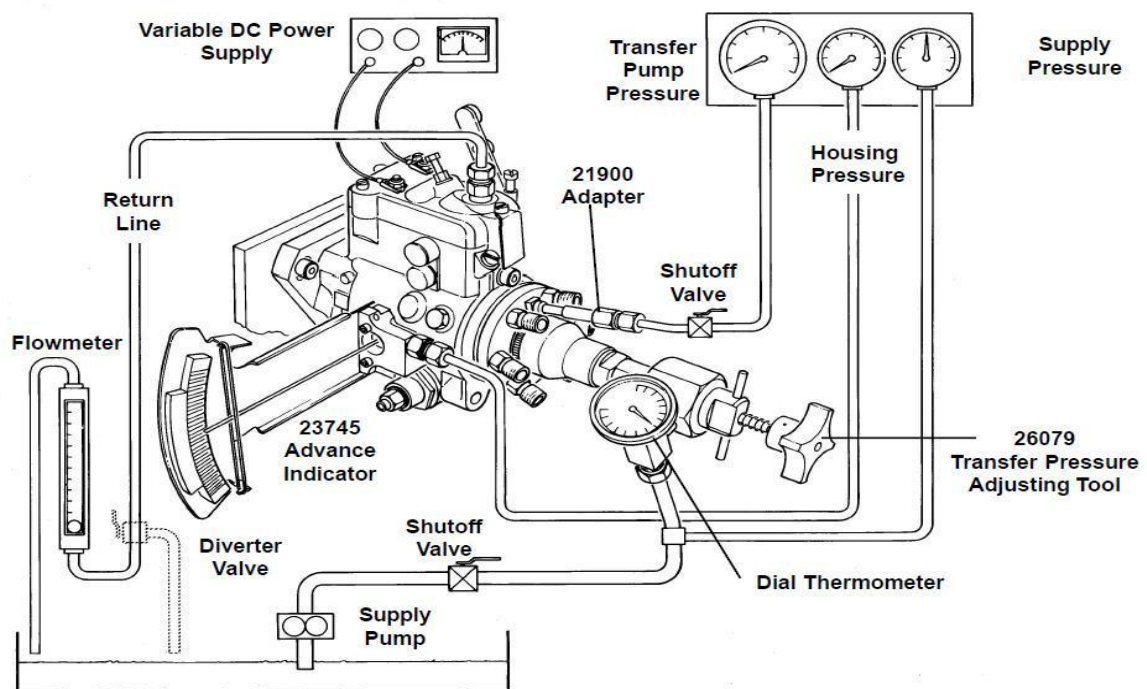


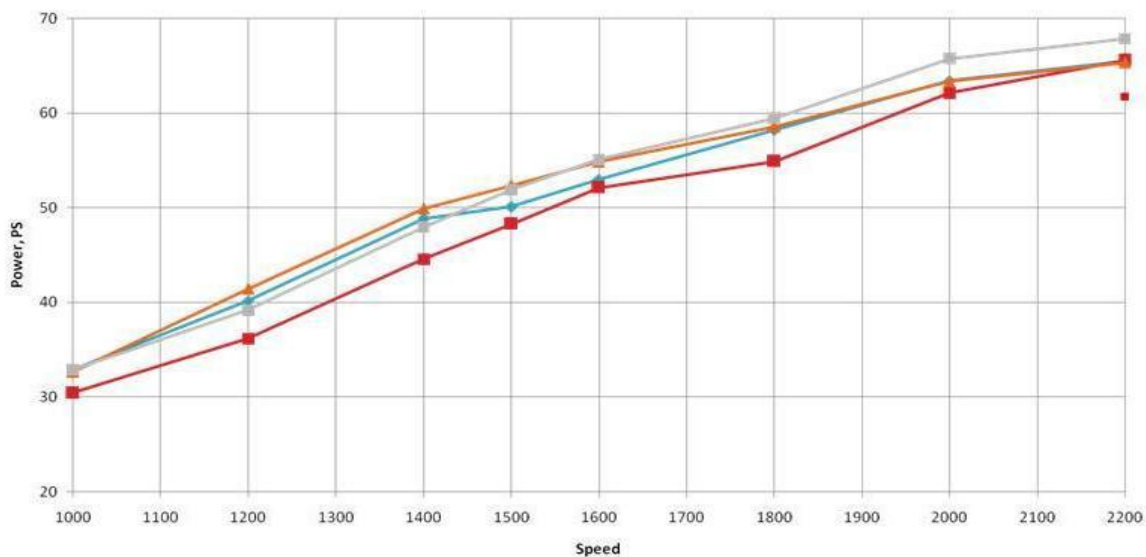
Fig.1

III. ENGINE TESTING & PERFORMANCE OPTIMIZATION

In this chapter, various results of engine testing and emission optimization was discussed. In engine testing, results like power curve, torque curve, sfc curve, boost curve and smoke curve are recorded. Whereas in emission point of view, we recorded emission gas concentration like NO_x, CO, HC & PM also measured.

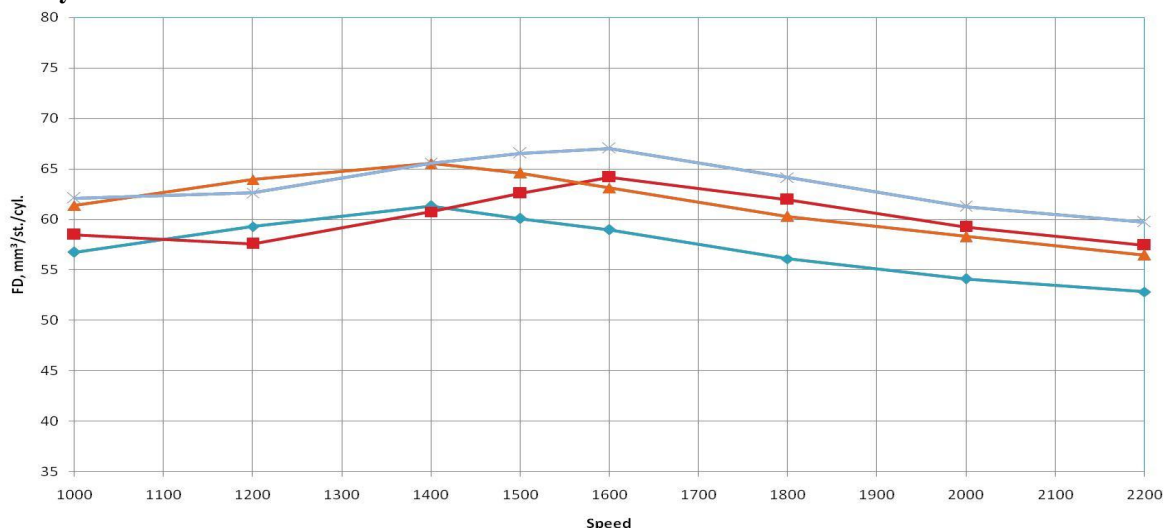
ISO 8178 is an international standard for exhaust emission measurement from a number of non-road engine applications. It is used for emission certification and/or type approval testing in many countries, including the United States, European Union and Japan. The ISO 8178 Test cycle or its 8-mode schedule C1 is also referred to as the Non-Road Steady Cycle, NRSC.

Power Curve



Graph 1

Fuel Delivery Curve



Graph 2

EURO STAGE IIIA Limit

S.NO	NET POWER kW	CO	HC+NOx g/kWh	PM
1	130 ≤ P ≤ 560	3.5	4.0	0.2
2	75 ≤ P < 130	5.0	4.0	0.3
3	37 ≤ P < 75	5.0	4.7	0.4
4	19 ≤ P < 37	5.5	7.5	0.6

Table 1

FIE system features and Emission Values

S.NO	FIE FEATURES						Emissions (in g/kW-hr)				
	Plunger Size	Roller Size	Cam	Dynamic Timing	Nozzle	Injection Pressure / duration	NOx	HC	NOx+HC	CO	PM
1	0.270"	5/16"	10° regular	4 deg BTDC @ rated speed	1155 cc/min	630 bar / 23°	4.11	0.12	4.23	1.51	0.361
2	0.290"	3/8"	10° regular	4 deg BTDC @ rated speed	1155 cc/min	600 bar / 22°	4.55	0.09	4.64	1.16	0.319
3	0.290"	3/8"	17° ARC	4 deg BTDC @ rated speed	1155 cc/min	650 bar / 23°	4.5	0.08	4.58	1.16	0.307
4	0.290"	5/16"	17° ARC	4 deg BTDC @ rated speed	1155 cc/min	680 bar / 22°	4.46	0.12	4.89	1.05	0.253

Table 2

IV. CONCLUSION

The functioning and effect of various hardware of rotary fuel injection system (plunger diameter, cam ring, nozzle through flow) in diesel engine performance is experimented. And also the suitable hardware were optimized which met the European emission standard of EUSTAGE IIIA.

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