



**INVESTIGATION OF THE EFFECTS OF THE USE OF
MAGNO-FLO MAGNETS ON EMISSION OF DIESEL ENGINES**

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SUMMARY

The objective of this report is to document an investigation undertaken by the School of Engineering, Bolton Institute for Magno-Flo Limited, to observe the effects of the use of the permanent magnets they supply on the emission of diesel engines.

The magnets used are N410A. The study is based on bench testing the emission of four different diesel engines, namely Perkin turbo diesel, Ford turbo diesel, Toyota diesel and Mercedes diesel. The emission was measured by the smokemeter supplied by VL Churchill Ltd. It is found that the magnets have a significant effect of reducing the emission of the Toyota and Mercedes diesel engines although there is no noticeable reduction of emission for the Perkin and Ford diesel engines. A reason for the latter findings might be that both the Perkin and Ford engines being tested were not run for a sufficient long period of time in comparison with that of the Toyota and Mercedes engines to allow the magnets taking effects before measurements were made. Since the sample size of vehicles being tested is comparatively small, the results reported here cannot be generalized and the company should be consulted for any potential benefits.

1. INTRODUCTION

Diesels were extolled five years ago as a “cleaner and greener” alternative to petrol and portrayed as a virtuous alternative for the public-spirited motorist since they emit less than a third as many unburnt hydrocarbons as a petrol engine, once percent of the carbon monoxide, and a third of the carbon dioxide, and are considerably more economical, even though it has long been recognised by the public that the fumes and smokes from diesel engines are unpleasant of their smell and look. However, by the end of 1995, reports were published by UK government scientists and the news spread nationally and beyond that diesel pollution is killing thousands of people each year, since diesel produces nearly two third more airborne particulates, tiny flecks of soot and metals, than petrol which especially the smaller particles having a diameter of less than ten micrometres and know as PM10, increase the risk of ill-health and premature death for people with heart conditions and breathing difficulties. The findings agreed with the previous American and European studies.

Since the announcement of the findings, UK government pledged to reduce diesel fumes as part of the Government’s overall strategy to clean up the air by 2005, including tighter emission standards for diesel lorries, vans and cars, and promoting anti-pollution technologies

Every attempt to reduce diesel emission is most welcomed and worth to be investigated. The power of magnetism has long been realized. Its applications range from a simple compass to complex electrical machine and medical equipment. Recently it has been reported with evidences that the use of magnets supplied by Magno-Flo Ltd (N410A) improves both fuel consumption rate and engine performance . The aim of this project is to observe whether the permanent magnets (N410A) supplied by Magno-Flo Ltd will have effect on the emission reduction of diesel engines. The method adopted in this study is sample testing some diesel engines. Due to the availability of diesel engines for testing purpose, four different engines – namely Perkin turbo diesel, Ford turbo diesel, Toyota diesel and Mercedes diesel, were tested. In each case, the emission was measured by standard MOT procedure for the situations of without and with the magnets mounted to the engine. There was no attempt to observe their effects on the size of particles emitted.

2. THE DEVICES AND EQUIPMENT

2.1 The Magnets

Each set of devices provided by Magno-Flo Ltd consists of a pair of magnets. The magnets are produced from iron, neodymium and baron by using the powder metallurgical process. The magnets are manufactured by uniaxial pressing to final shape. The typical tolerances of such sintered uniaxially pressed magnets are +1%. The typical physical and mechanical properties of the magnets are listed in Table 1.

Table 1 : Physical and Mechanical Properties of the Magnets

Curie temperature ($^{\circ}\text{C}$)	310
Hardness (HVS)	500 – 600
Tensile strength (N/mm^2)	80 – 100
Density (g/cm^3)	7.5
Electrical resistivity ($\mu\Omega\text{cm}$)	~140
Specific heat (J/kgK)	500
Magnetising field (kA/m)	2500

The particular magnets provided in this investigation are N410A. Their nominal values of remanence, coercivity and energy product are 1.15T, 870 Ka/M and 250 kJ/m^3 respectively. Each magnet is of cylindrical shape of approximately 27mm diameter and 15mm height, and is housed in a plastic case, which has a flange of 15mm x 27mm in each side. There is a 10mm channel for clamping onto a pipe.

2.2 The Smoke Tester

The smoke tester used in this investigation is DX210 diesel smokemeter provided by VL Churchill Ltd which is approved by the Vehicle Inspectorate Executive Agency for MOT testing of the following classes of vehicle :

Category A - Cars and light commercial vehicles (MOT classes 4 and 7)

Category B - Buses (MOT classes 5 and 6 PSV vehicles), heavy goods vehicles

The smokemeter, , consists of three main components – sampling head, sampling pipe and display unit . The display unit is connected to the sample head by a cable, and the sampling pipe is fitted to the sampling head.

The smoke meter is an opaccimeter device working on the partial flow principle, as opposed to full flow and free flow principles, where a sample of smoke is taken from the tailpipe for analysis in the chamber. The sample head has a green LCD and a photo which mounted at opposite ends of the smoke sampling tube such that the physical light path length through the smoke is 250mm. The smoke tube is heated to approximately 100⁰C. The smoke sampling head contains a fan to draw the smoke sample into the smoke tube via a by-pass system head. This ensures that the pressure inside the smoke tube cannot exceed ambient by more than 7.5 mbar. This method also provides for rapid response during testing, fast clearance of the smoke sample after testing and helps to prevent sooting of the lenses. This machine has an automatic and 100% calibration system built in.

3. TEST PROCEDURE

Four vehicles/engines were tested : Perkin turbo diesel, Ford pick-up with turbo diesel, Toyota Cruiser and Mercedes van. The procedure of the test for each vehicle/engine was as follows :

1. Without the magnets, the engine was started and allowed to run until normal operating temperature was achieved.
2. Set-up and switched on the smokemeter, and allowed it to warm up until "hold" is displayed.
3. Selected 'MOT class 4/7' since the vehicle/engine belonged to class A, and selected 'km⁻¹' for UK MOT unit measurement.
4. Press 'Reset'. This initiated a self calibration check.
5. When 'Pipe' was displayed, clamped and sampling pipe to the vehicle exhaust. Precaution was taken to ensure that the sampling head was not located in a smoky area at any time to avoid false reading.
6. Pressed 'Reset'.
7. When the 'Ready' lamp was on, fully depressed the accelerator pedal/throttle and held it at maximum speed.
8. As soon as 'Ready' lamp went out, released the accelerator pedal/throttle and allowed engine to idle.
9. Repeated step 7 and 8 six times.
10. When 'Pipe' was displayed, removed the sampling pipe from the exhaust and pressed 'Print' to obtain printout of results where the valid average value is calculated by subtracting the zero check value from the average value of the last three test values.
11. Repeated step 4 to 10 for a number of times.
12. The magnets were then mounted to the vehicle/engine and the test step 1 to 11 were repeated a week (at least) later.

4. RESULTS AND OBSERVATIONS

4.1 Perkin T4.236

This engine which has four cylinders with capacity of 3.86 litre, turbo charged injection, and low pressure pump and injectors was used in the previous investigation on fuel consumption and performance .

Table 2 Results for Perkin

		Coeff. Of Light Absorption, m^{-1}			
		Without magnets			With magnets *
Date of Test		18/9/95			29/9/95
Test	4	0.82	0.66	0.94	0.84
	5	0.76	1	0.68	0.74
	6	0.78	0.72	0.68	0.8
Average		0.78	0.79	0.76	0.79
Zero check		0.02	0.01	0.02	0.01
Valid average		0.76	0.78	0.74	0.78
Ave. of valid average		0.76			0.78

* One pair of magnets were fitted to each injector

Remarks :

1. There is no sign of reduction of smoke by using magnets
2. The duration between the two sets of testing (without and with magnets) was 11 days, and the engine was not run often during this period.

4.2 Ford

The vehicle was Ford, P100 Pick-up, 1.8L Turbo, with low pressure pump and injector, 4 cylinders and was manufactured between 1992 and 1993.

Table 3 Results of Ford

		Coeff. Of Light Absorption, m^{-1}						
		Without magnets			With magnets *			
Date of Test		6/10/95			13/10/95			
Mileage on clock		44,435 miles			45,131 miles			
Test	4	0.78	0.86	0.74	0.7	0.79	0.84	0.88
	5	0.72	0.92	0.86	0.75	0.84	0.92	0.87
	6	0.86	0.88	0.66	0.78	0.86	0.94	0.89
Average		0.78	0.88	0.75	0.74	0.83	0.9	0.88
Zero check		0	0	0	0	0	0	0
Valid average		0.78	0.88	0.75	0.74	0.83	0.9	0.88
Ave. of valid average		0.8			0.83			
Visual observation		Black smoke not noticeable			Black smoke not noticeable			

* One pair of magnets were fitted to each injector

Remarks :

1. There is no sign of improvement on smoke by using magnets
2. The duration between the two sets of testing (without and with magnets) was 7 days, and the mileage during the period was 696 miles i.e. 99 miles/day on average.

4.3 Toyota

The vehicle was Toyota, Cruiser with overhead cam, 4.2 litre, 6 cylinders, high pressure pump and injectors, and was manufactured in 1994.

Table 4 Results for Toyota

		Coeff. Of Light Absorption, m ⁻¹											
		Without magnets						With magnets *					
Date of Test		22/11/95						12/12/95					
Mileage on clock		28,864 km						31,250 km					
Test	4	1.14	1	0.98	1.26	1.7	0.24	0.18	0.2	0.18	0.14	0.2	0.2
	5	1.04	0.94	1.12	1.48	1.82	0.2	0.32	0.56	0.28	0.18	0.22	0.2
	6	1.1	1	1.12	1.56	1.76	0.2	0.34	0.28	0.2	0.14	0.2	0.28
Average		1.09	0.98	1.07	1.43	1.76	0.21	0.28	0.34	0.22	0.15	0.2	0.22
Zero check		0	0	0	0	0	0	0	0	0	0.02	0	0
Valid average		1.09	0.98	1.07	1.43	1.76	0.21	0.28	0.34	0.22	0.13	0.2	0.22
Ave. of valid average		1.26						0.22					
Visual observation		Black smoke noticeable						Black smoke not noticeable					

* One pair of magnets were fitted to each injector

Remarks :

1. Use of magnets reduced smoke
2. The percentage of reduction is 82.5%
2. The duration between the two sets of testing (without and with magnets) was 20 days, and the mileage during the period was 2386km (1481 miles) i.e. 120 km/day (74 miles/day) on average.

4.4 Mercedes

The vehicle was Mercedes 207 Diesel Van 2.4 litre, with four cylinders, low pressure pump and injectors and was manufactured between 1987 and 1988.

Table 5 Results for Mercedes

		Coeff. Of Light Absorption, m ⁻¹									
		Without magnets					With magnets *				
Date of Test		19/12/95					5/2/96				
Mileage on clock		137,443 miles					141,763 miles				
Test	4	1.1	0.9	0.38	0.5	0.34	0.6	0.38	0.46	0.34	0.44
	5	0.74	0.58	1.42	0.64	0.46	0.4	0.4	0.34	0.34	0.4
	6	0.6	0.38	0.9	0.56	0.34	0.64	0.4	0.4	0.4	0.38
Average		0.81	0.62	0.9	0.56	0.38	0.54	0.39	0.4	0.36	0.4
Zero check		0.06	0	0.02	0	0	0	0	0	0.02	0
Valid average		0.75	0.62	0.88	0.56	0.38	0.54	0.39	0.4	0.36	0.4
Ave. of valid average		0.7					0.41				
Visual observation		Black smoke noticeable					Black smoke not noticeable				

* One pair of magnets were fitted to each injector

Remarks :

1. Use of magnets reduced smoke
2. The percentage of reduction is 41%
2. The duration between the two sets of testing (without and with magnets) was 48 days, and the mileage during the period was 4320 miles i.e. 90 miles/day on average.

5. CONCLUSIONS

In the wake of the disclosure of the findings of the effects of diesel fumes on health, the UK Government has pledged to take measures in an attempt to reduce diesel emission. One would expect that a more stringent and tighter standard would be drawn out for diesel vehicle emission test in the near future.

While evidences have been presented previously that the use of magnets could reduce fuel consumption and increase performance of diesel engine, this report documents the findings of the effect of the use of Magno-Flo magnets on diesel fumes. The results suggest that the use of the magnets can reduce the smokes of both the Toyota and Mercedes engines and the percentage of reduction is very substantial. A reason for the unnoticeable reduction in smokes in both Perkin and Ford engines might be that the engines being tested were not run for a sufficient long period of time in comparison with that of the Toyota and Mercedes engines to allow the magnets taking effects before measurements were made. Since the investigation was only based on four engines which is a small sample size, the results presented here can by no means be generalised and extended to other types of diesel engines, and the company should by fully consulted for any potential benefits.