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A CONFIDENTIAL REPORT FOR

TECHNICAL DEVELOPMENT UK LTD.

THE EFFICIENCY OF AN ECOFLOW MAGNETIC DEVICE TO REDUCE VEHICLE TAILPIPE EMISSIONS.

C.A.SAVAGE. OCTOBER 1992

WARREN SPRING LABORATORY

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TESTS TO DETERMINE THE EFFECT OF INSTALLING AN ECOFLOW MAGNETIC DEVICE TO REDUCE EXHAUST PIPE EMISSIONS USING A STANDARD CARBURETTED 1.61 ENGINED VEHICLE

C A Savage.

EXECUTIVE SUMMARY.

This is a report for Technical Development UK Limited who requested Warren Spring Laboratory, Vehicle Emissions Group, to carry out a series of tests to determine the effect, if any, of fitting one of their magnetic devices to a standard petrol driven vehicle as a means of reducing tailpipe emissions and fuel consumption. The vehicle used was a normally aspirated Vauxhall Cavalier of 1.61 engine capacity. This vehicle is used every day by Warren Spring Laboratory and has accumulated nearly 110,000 miles.

The tests were carried out firstly without the device fitted to establish the base-line levels and then, after fitting the device according to the sponsors instructions, tested at "0" miles, 870 miles and 3257 miles without being removed.

The tests were steady state runs carried out on a chassis dynamometer set to correspond with the relevant test vehicle parameters. An E.C.E. approved constant volume sampler (CVS) was used for sampling and the analyses were carried out in the on-line mode.

Changes in the levels of exhaust pollutants were observed at the first test and were amplified as the mileage increased. The final results showed a decrease in carbon monoxide emissions at 70 kph but an overall average increase, at all other speeds, of 12.9%; an average increase in hydrocarbon emissions of 6.9% and an average decrease in NOX emissions of 18%5.

There was an improvement in fuel consumption of between 3 and 118. The emission results are consistent with a reduction in combustion efficiency but are contradicted by the improvement in fuel consumption and power.

After 3257 miles, there was a significant change in the idle (MOT Type test) CO emissions which was not consistent with the speed/loaded tests.

Over the speed range employed there was an average increase in power of 9.5%.

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ADDENDUM

Further tests were carried out in an attempt to understand/corroborate the previous results.

The results from both sets of tests show:-

No consistency in Carbon Monoxide or Hydrocarbon reduction either under load or at idle:

A reduction in fuel consumption (between 1 and 11%), Carbon Dioxide (between 1.5 and 11%) and Nitrogen Oxides (between 33 and 13%) were measured.

The power output increase was slightly improved to 11%.

These results do not follow conventional theories and the theory of the operation of the Ecoflow does not clarify why these deviations are seen. The variability of the high mileage engine may be a factor.

Tests carried out on a diesel engined Heavy Goods Vehicle showed a reduction in smoke output of 15%.

1. INTRODUCTION

At the request of Technical Development UK Ltd. the Vehicle Emissions Group at Warren Spring Laboratory carried out a series of tests to determine the effectiveness of a device to reduce tailpipe emissions. The device took the form of a powerful magnet that is fitted around the fuel line upstream of the carburettor.

2. OBJECTIVES

To devise a series of tests to determine the fuel consumption and emissions, in terms of grams per minute, of the following pollutants viz. carbon dioxide, carbon monoxide, total hydrocarbons and the oxides of nitrogen. The power output of the engine was also to be monitored and an MOT type test carried out at suitable mileage accumulation intervals.

3. TEST PROGRAMME

The vehicle used for these tests was a 1988 model Vauxhall Cavalier 1.61 naturally aspirated estate car with an accumulated mileage of 106,700 and was a pool car serviced and maintained by the local agents. One baseline test was carried out with the vehicle in its original condition and the device was then attached and a zero miles test carried out. According to the Sponsors instruction, the device gained in effectiveness the further the car was driven. To this end it was decided to test the vehicle at intervals of roughly 1000 and 3000 miles. In reality the vehicle, accumulating mileage on a random basis, was re-tested at 870 and 3257 miles. The tests consisted of steady state drives, controlled by fixing the throttle, to give target speeds of 70,80,90,100,110, and 120 kph.

The gaseous emissions were measured on-line through an ECE approved constant volume sampler. A power output test was also conducted to determine any change. This was achieved by driving the vehicle at wide open throttle and controlling the speed by increasing the load electronically. The control speeds were 70,80,90,100,110 and 120 kph. The power absorbed by the dynamometer and hence the power output of the engine was determined.

Emission tests in accordance with the prescriptions of the Ministry of Transport test were carried out before fitting the device and at 0, 870 and 3257 miles.

4. RESULTS AND DISCUSSION

4.1 Significance of the results,

The overall results are tabulated in Table 1 and shown graphically in Figures 1-7. One test was carried out at each mileage for both emissions and power. It should be stated here that quantifying the true effects of such a device normally requires a greater number of tests in order to determine the repeatability of the vehicle as an emissions generator and thus be able to calculate the significance of any changes found. Therefore the differences effected by the device found in these tests are stated "as found" i.e. with no statistical significance calculated.

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TABLE 1 EMISSIONS in g/minute

Mileage after fitting	Speed in kph	C02	CO	THC	NOX	NO	F/C.c-b in 1/100km
B/LINE	70	111.0	0.888	0.398	1.072	0.697	4.124
"0" Mi.		113.3	0.861	0.407	1.124	0.726	4.208
870 Mi.		109.1	0.794	0.376	1.117	0.714	4.049
3257 Mi.		101.7	0.642	0.430	0.732	0.452	3.778
%DIFF. B/L: 3257Mi.		-8.35	-27.64	+8.04	-31.69	-35.11	-8.40
B/LINE	80	131.2	0.645	0.427	1.648	1.063	4.243
"0" Mi.		132.0	0.703	0.417	1.694	1.094	4.269
870 Mi.		128.7	0.663	0.595	1.719	1.114	4.179
3257 Mi.		126.1	0.800	0.457	1.307	0.814	4.091
%DIFF. B/L: 3257Mi.		-3.91	+24.12	+6.92	-20.68	-23.41	-3.59
B/LINE	90	155.8	0.732	0.487	2.918	1.870	4.473
"0" Mi.		153.8	0.730	0.502	3.048	1.954	4.419
870 Mi.		159.8	0.962	0.647	3.401	2.183	4.611
3257 Mi.		150.7	0.858	0.543	2.425	1.524	4.342
%DIFF. B/L: 3257Mi.		-3.22	+17.10	+11.52	-16.90	-18.51	-2.93
B/LINE	100	186.5	0.944	0.555	4.026	2.569	4.821
"0" Mi.		186.5	0.977	0.570	4.137	2.641	4.823
870 Mi.		194.9	1.152	0.743	5.224	3.293	5.056
3257 Mi.		172.2	1.001	0.591	3.473	2.221	4.463
%DIFF. B/L: 3257Mi.		-7.66	+5.99	+6.51	-13.74	-13.54	-7.42
B/LIKE	110	224.6	1.178	0.582	4.680	2.996	5.273
"0" Mi.		228.8	1.167	0.588	4.821	3.022	5.369
870 Mi.		212.6	1.450	0.685	4.869	3.169	5.014
3257 Mi.		204.5	1.301	0.598	4.114	2.615	4.815
%DIFF. B/L: 3257Mi.		-8.94	+10.45	+2.64	-12.09	-12.72	-8.69
B/LINE	120	260.3	1.376	0.620	6.399	4.095	5.597
"0" Mi.		262.2	1.408	0.613	6.670	4.283	5.638
870 Mi.		255.1	2.016	0.719	5.593	3.629	5.516
3257 Mi.		230.5	1.469	0.656	5.583	3.525	4.973
%DIFF. B/L: 3257Mi.		-11.43	+6.78	+5.83	-12.74	-13.93	-11.15

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Summary of Table I

Table of % Change in Emissions after 3257 Miles (in g/minute)

SPEED	C02	CO	THC	NOX	NO	FC CORR
70	-8.35	-27.64	+ 8.04	-31.69	-35.11	- 8.40
80	-3.91	+24.12	+ 6.92	-20.68	-23.41	- 3.59
90	-3.22	+17.10	+11.52	-16.90	-18.51	- 2.93
100	-7.66	+ 5.99	+ 6.51	-13.74	-13.54	- 7.42
110	-8.94	+10.45	+ 2.64	-12.09	-12.72	- 8.69
120	-11.43	+ 6.78	+5 .83	-12.74	-13.93	-11.15
MEAN%	-7.25	+ 6.13	+6.91	-17.97	-19.54	- 7.03

4.1 Observations

As found, the CO and THC increased at all speeds (except the CO at 70kph) and the NOX, C02 and hence the fuel consumption, reduced at all speeds. The overall average increase in the CO emissions was 6%, and for hydrocarbons was 6.9%. The overall decrease in NOX emissions was nearly 18% for C02 it was 7.25% and the overall average reduction in fuel consumption was 7%.

4.2 Emissions from MOT type test

The following table, Table 2, shows the idle emissions obtained during the period of testing. It can be seen that there was no immediate improvement in the emission levels but after 3257 miles there was an apparent reduction in CO of 30%, although it must be stressed that this was a one-off test.

TABLE 2

TEST POINT	CO %	THC ppm	Engine rpm	Oil t°C
Baseline	1.42	240	846	87
0 Miles	1.44	235	831	91
870 Miles	1.56	230	825	93
3257 Miles	1.03	248	835	88

4.3. Power Output Tests

With the dynamometer correctly loaded, the vehicle was driven at wide open throttle and the speed controlled by adjusting the windage parameter of the dynamometer. The power absorbed at each predetermined speed and hence the power output of the engine was tabulated, Table 3 and Figure 7 refer.

TABLE 3.

SPEED	POWER 1	SPEED	POWER 2	SPEED	POWER 3
120.2	29.0	119.6	29.1	120.3	32.7
110.0	27.4	110.2	26.5	110.3	30.6
110.1	23.9	100.5	23.9	99.9	27.3
89.9	20.9	89.3	20.3	90.1	23.2
80.2	18.0	80.1	17.8	79.8	19.0
70.3	15.7	70.8	15.7	70.2	16.0

Notes: The speed is in kph.
The power is in kilowatts.
For the graph the mean speed was used.

Nominal Speed	% Increase 1:3
120	12.76
110	11.68
100	14.23
90	11.00
80	5.56
70	1.91
Mean	9.52%

5. CONCLUSIONS.

1. Fitting the Ecoflow device appeared to alter the tailpipe emissions.

2. The carbon monoxide emissions increased by an average 12.9%; the hydrocarbon emissions increased by an average 6.9% but the oxides of nitrogen decreased by an average 18%.

3. Fuel consumption improved by between 3 and 11%.

4. The average power increase, over the speed range, was 9.5%.

5. The carbon monoxide level at idle (MOT type test) decreased from 1.42% (Baseline) to 1.06% after 3257 miles, but the hydrocarbon emissions were unaffected.

6. Further investigation is required, with this device, to consolidate these findings.

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ADDENDUM TO

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ADDENDUM TO THE PRECEDING REPORT - STAGE 2 TESTS

1. INTRODUCTION

Due to the variability of the results the Sponsors requested Warren Spring Laboratories, Vehicle Emissions Group, to carry out a further series of tests using exactly the same procedures as for the first set of tests with the proviso that the mileage accumulated between each test was 1000 or greater.

Tests on a diesel engined HGV were also requested.

2. OBJECTIVES

The main objective was to attempt to confirm the apparent reduction in emissions, found in the first set of tests, and to establish the continuance of the increase in power previously measured.

Secondly, the effect on smoke output from a large diesel engine was required.

3. TEST PROCEDURE

The test drives on the dynamometer were conducted to exactly the same prescriptions as the first set of tests. Re-test 1 was carried out 7318 miles after the device was first fitted. These results acted as a bracket test to the first set of results and also measured the effectiveness of the device in the long term. The device was then removed and the vehicle allowed to accumulate a further 3000 normally driven miles. Re-test 2 was then carried out to establish a new baseline of power and emissions for the vehicle. The vehicle then accumulated a further 2315 miles of random driving and re-test 3 was carried out. The mileage test points are tabulated in Table 4. to be viewed in conjunction with the graphs etc.

TABLE 4 Identification of Test Points-By Mileage

TEST POINT	DESCRIPTION USED	STATUS	MILEAGE
1	BASE-LINE	NO DEVICE	ZERO
		DEVICE FITTED	
2	"0" MILES	WITH DEVICE	ZERO
3	870 MILES	WITH DEVICE	870
4	3257 MILES	WITH DEVICE	3257
5	7318 MILES	WITH DEVICE	7318
		DEVICE REMOVED	7318
6	NEW BASE-LINE	NO DEVICE	10318
7	2135 MILES	WITH DEVICE	12453

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4. RESULTS AND DISCUSSION

In keeping with the previous results, the measurements made at 7318 miles were fairly randomly spread but tended to show similar trends. The carbon monoxide and hydrocarbon emissions had increased, the oxides of nitrogen had decreased, there was a slight reduction in fuel consumption and the power increase had remained around 9%. The results from the second series of tests are given in Table 5 and shown graphically in Figures 8-14.

TABLE 5 EMISSIONS in g/minute

Mileage after fitting	Speed in kph	C02	CO	THC	NOX	NO	F/C.c-b in 1/100km
7318 Mi.	70	115.8	0.509	0.450	0.637	0.332	4.283
NEW B/L		121.2	0.539	0.641	1.350	0.877	4.503
2135 Mi.		108.7	0.588	0.423	0.794	0.495	4.026
%DIFF. NB/L: 2135Mi.		-10.33	+9.10	-33.93	-41.20	-43.59	-10.58
7318 Mi.	80	127.1	0.587	0.466	1.017	0.646	4.114
NEW B/L		141.2	2.044	0.767	2.100	1.322	4.664
2135 Mi.		123.2	0.683	0.542	1.650	1.078	4.002
%DIFF. NB/L: 2135Mi.		-12.75	-66.58	-29.29	-21.42	-18.50	-14.20
7318 Mi.	90	154.1	0.806	0.670	1.900	1.205	4.508
NEW B/L		164.9	1.498	0.864	3.478	2.248	4.799
2135 Mi.		148.7	1.354	0.740	3.246	2.049	4.323
%DIFF. NB/L: 2135Mi.		-9.86	-9.62	-14.33	-6.68	-8.86	-9.93
7318 Mi.	100	180.3	1.131	0.768	3.072	1.933	4.700
NEW B/L		201.6	1.185	1.021	6.092	3.893	5.251
2135 Mi.		173.4	1.119	0.818	5.194	3.161	4.515
%DIFF. NB/L: 2l35Mi.		-14.00	-5.35	-19.90	-14.75	-18.80	-14.02
7318 Mi.	110	213.9	1.218	0.705	3.540	2.251	5.037
NEW B/L		220.9	1.392	1.008	6.497	4.173	5.227
2135 Mi.		193.1	1.257	0.747	6.358	3.878	4.560
%DIFF. NB/L: 2135Mi.		-12.59	-9.70	-25.82	-2.13	-7.06	-12.75
7318 Mi.	120	256.0	1.727	0.668	3.763	2.371	5.523
NEW B/L		248.3	1.629	1.046	8.245	5.314	5.380
2135 Mi.		237.1	1.505	0.803	8.978	5.518	5.123
%DIFF. NB/L: 2135Mi.		-4.51	-7.60	-23.24	+8.89	+3.85	-4.79
MEAN OF % DIFFERENCE							
NEW BASELINE: 2135 Mi.		-10.67	-14.99	-24.42	-12.88	-15.49	-11.05

As can be observed from Table 5, there are a few outlier results (the carbon monoxide baseline emission at 80kph for instance) but the underlying reduction in emissions between the new baseline results and the tests at 2135 miles cannot be dismissed as variations in the system and must therefore be considered valid.

Comparing the results from the first set of tests,(to 3257 miles) with those from the second set, (new baseline: 2135 miles), the oxides of nitrogen decreased by 18% c.f 12.9%, and the fuel consumption improved by an average 7% c.f.11% but the greatest change was in the carbon monoxide and hydrocarbon emissions which in Test 1 both increased but in Test 2 have been reduced by an average 15 and 24% respectively.

However, the results from the first set of tests cannot be discounted and are as meaningful as the second set of results. Therefore, to obtain a true overall picture, the two sets of results plus the bracket test results, at 7318 miles are combined in Table 6.

TABLE 6. Combined Results.

Pollutant	CO2	CO	THC	NOX	NO	F/C Corr.
Mean of % Diff. OLD B/L: 3257 Miles.	- 7.25	+ 6.13	+ 6.91	-17.97	- 19.54	-7.03
Mean of % Diff. OLD B/L: 7318 Miles.	- 1.59	+ 1.20	+21.17	-33.82	- 36.47	- 1.12
Mean of Above	- 4.42	+ 3.67	+14.04	-25.90	- 28.01	- 4.08
Mean of % Diff. NEW B/L: 2135 Miles.	- 10.67	-14.99	-24.42	-12.88	- 15.49	-11.05
Combined Mean of Means	- 7.55	- 5.66	- 5.19	-19.39	-21.74	- 7.76

As can be seen, there is extreme variability in the results obtained; both the carbon monoxide and the hydrocarbons changing from positive to negative values. The only consistency is in the carbon dioxide emissions, and hence the fuel consumption figures and the reduction in the oxides of nitrogen emissions. This is most likely due to the variability of the vehicle as an emissions generator, however, a high mileage vehicle was required by the sponsors as being the type of vehicle most likely to show a benefit with this device.

4.2 Emissions from MOT type test.

The Following table, Table 7, shows the idle emissions obtained throughout the two periods of testing. The engine was adjusted before the new baseline test because the idle emissions had drifted up during the mileage accumulation period to 3.5% CO and 400 ppm hydrocarbons and it was felt that this increase was not entirely due to the Ecoflow being removed.

During Test 1 the CO idle emissions reduced but at 7318 miles had increased to nearly the original value. The Hydrocarbons increased.

During Test 2 the CO idle emissions increased and the hydrocarbons decreased

TABLE 7. Idle emissions for both series of tests

TEST POINT	CO %	THC ppm	ENGINE rpm	Oil t°C
Old Baseline	1.42	240	846	87
"0" Miles	1.44	235	831	91
870 Miles	1.56	230	825	93
3257 Miles	1.03	248	835	88
7318 Miles	1.38	288	842	91
7318+3000 Miles	3.50	400	845	90
Reset	1.62	295	850	89
New Baseline	1.97	323	840	88
2135 Miles	2.12	235	852	90

4.2 Power Tests.

The following table, Table 8, compares the new baseline test with the test at 2135 miles.

TABLE 8.

ECOFLOW REMOVED AND VEHICLE DRIVEN 3000 MILES WITHOUT DEVICE FITTED		
NEW BASELINE	SPEED kph.	POWER kW
	121.0	34.8
	110.1	30.6
	100.2	27.3
	89.8	23.0
	80.0	19.6
	70.2	16.7

ECOFLOW INSTALED AND 2135 MILES DRIVEN WITH DEVICE OPERATING		
2135 MILES	120.0	34.9
	109.9	30.6
	99.9	27.1
	90.1	22.9
	79.9	19.5
	70.0	16.4

4.2 Mean Power Results.

The following table, Table 9, shows the last three sets of results obtained along with the initial baseline results for comparison.

TABLE 9. Comparison of the Power Tests in kW.

SPEED	BASELINE	7318 MILES	NEW B/LINE	2135 MILES
120	29.0	32.8	34.8	34.9
110	27.4	30.7	30.6	30.6
100	23.9	27.2	27.3	27.1
90	20.9	23.3	23.0	22.9
80	18.0	18.9	19.6	19.5
70	15.7	15.8	16.7	16.4

As shown, an average power increase of 11% c.f. 9.5% has been sustained.

5. Heavy Goods Vehicle Tests and Procedures

In addition to the programme of exhaust gas and power measurements made on the light duty vehicle, detailed above, a limited test programme of smoke measurements were made on a heavy goods vehicle.

The test vehicle was a Volvo FL10 tractor unit of 10 litres engine capacity. At the time of the tests the unit was considered by its' owners to be in good condition having had a major engine overhaul some 10,000 miles previously.

The test programme consisted of three sets of smoke measurements:-

1. Baseline tests without the device fitted.

The device, designed specifically for HGV use, was then installed by the vehicle owners and the vehicle returned to its normal duties.

2. First test with the Ecoflow after 2000 miles of operation.

3. Second test with the Ecoflow after 5000 miles total operation.

The vehicle was delivered to Warren Spring to be tested when it was in the area as part of its normal operations. With prior warning of the vehicle's arrival, a Hartridge Mk 3 smoke-meter was switched on and allowed to reach operating temperature. When the vehicle arrived, and was positioned to take the exhaust probe, the smoke-meter was zeroed and calibrated.

The smoke-meter exhaust probe was locked into the vehicle exhaust pipe and a series of free acceleration smoke tests were carried out. The first two acceleration tests were used to clear the engine and discarded; the remaining tests were used to calculate the mean result.

The results are shown in Table 9.

TABLE 9. HGV Smoke Tests in Hartridge Smoke Units.

TEST	1	2	3	4	5	6	7	MEAN
BASELINE	86	83	81	82	79	80	80	82
ECOFLOW + 2000Mi.	70	73	71	75	72	75	69	72
ECOFLOW + 5000Mi.	69	67	66	68	68	68	68	68
%DIFF. B/L: 5000	-	-	18.5	17.1	13.9	15.0	15.0	15.0

Disregarding the first two results, it can be seen that an average reduction in Hartridge Units of 15% has been achieved during the mileage accumulation period.

5. CONCLUSIONS

1. The effect of the Ecoflow, on this vehicle, was not consistent for Carbon Monoxide and Hydrocarbons between the first and second series of tests. This was probably due to the variability of the vehicle as a source of emissions. A high mileage vehicle was selected for these tests as being the most likely to show any benefits of the Ecoflow.

2. Both series of tests showed consistent reductions in Carbon Dioxide, fuel consumption and the Oxides of Nitrogen and when the Ecoflow was removed the trend was reversed. The calculated mean per cent reduction for the two sets of tests was Carbon Dioxide 7.55, fuel consumption 7.76 and the Oxides of Nitrogen 19.39%.

3. The power increase found in the first series of tests was sustained throughout the second set of tests and marginally increased to 11%.

4. The idle emissions showed no distinct trends, possibly because the vehicle was not a very high emitter when normally tuned.

5. The Ecoflow fitted to the heavy goods vehicle had the positive effect of reducing the smoke, measured in Hartridge Units, by 15%.

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APPENDIX

The attached apendix is a printout from the computer work-sheet, of the combined results used in the calculations, for this report.

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	Speed	C02	CO	THC	NOX	NO	FC_cvs	FC CORR
B/LINE	70	111	0.888	0.398	1.072	0.697	4.812	4.124
"0" Mi.	70	113.3	0.861	0.407	1.124	0.726	4.909	4.208
870 Mi.	70	109.1	0.794	0.376	1.117	0.714	4.724	4.049
3257 Mi.	70	101.7	0.642	0.430	0.732	0.452	4.407	3.778
7318 Mi.	70	115.8	0.509	0.450	0.637	0.332	4.997	4.283
NEW B/LINE	70	121.2	0.539	0.641	1.350	0.877	5.253	4.503
2135 Mi.	70	108.7	0.588	0.423	0.794	0.495	4.697	4.026
% DIFF. B/L: 3257Mi.		-8.35	-27.64	8.04	-31.69	-35.11	-8.40	-8.40
% DIFF. B/L: 7318Mi.		4.33	-42.64	13.06	-40.53	-52.30	3.85	3.85
% DIFF.B/L:NEW B/L:		9.20	-39.33	60.80	25.99	25.87	9.18	9.18
% DIFF. 2135Mi.		-10.33	9.10	-33.93	-41.20	-43.59	-10.58	-10.58
% DIFF. B/L: 2135Mi.		-2.08	-33.81	6.24	-25.92	-29.00	-2.38	-2.38
B/LINE	80	131.2	0.645	0.427	1.648	1.063	5.658	4.243
"0" Mi.	80	132.0	0.703	0.417	1.694	1.094	5.692	4.269
870 Mi.	80	128.7	0.663	0.595	1.719	1.114	5.572	4.179
3257 Mi.	80	126.1	0.800	0.457	1.307	0.814	5.455	4.091
7318 Mi.	80	127.1	0.587	0.466	1.017	0.646	5.485	4.114
NEW B/LINE	80	141.2	2.044	0.767	2.100	1.322	6.219	4.664
2135 Mi.	80	123.2	0.683	0.542	1.650	1.078	5.336	4.002
% DIFF. B/L: 3257Mi.		-3.91	24.12	6.92	-20.68	-23.41	-3.59	-3.59
% DIFF. B/L: 7318Mi.		-3.13	-8.96	9.10	-38.27	-39.26	-3.05	-3.05
% DIFF.B/L:NEW B/L:		7.61	217.11	79.64	27.38	24.38	9.93	9.93
% DIFF. 2135Mi.		-12.75	-66.58	-29.29	-21.42	-18.50	-14.20	-14.20
% DIFF. B/L: 2135Mi.		-6.12	5.99	27.03	0.10	1.37	-5.69	-5.69
B/LINE	90	155.8	0.732	0.487	2.918	1.870	6.709	4.473
"0" Mi.	90	153.8	0.730	0.502	3.048	1.954	6.628	4.419
870 Mi.	90	159.8	0.962	0.647	3.401	2.183	6.916	4.611
3257 Mi.	90	150.7	0.858	0.543	2.425	1.524	6.512	4.342
7318 Mi.	90	154.1	0.806	0.670	1.900	1.205	6.762	4.508
NEW B/LINE	90	164.9	1.498	0.864	3.478	2.248	7.199	4.799
2135 Mi.	90	148.7	1.354	0.740	3.246	2.049	6.484	4.323
% DIFF. B/L: 3257Mi.		-3.22	17.10	11.52	-16.90	-18.51	-2.93	-2.93
% DIFF. B/L: 7318Mi.		-1.08	10.04	37.70	-34.90	-35.60	0.78	0.78
% DIFF.B/L:NEW B/L:		5.88	104.57	77.54	19.18	20.19	7.30	7.30
% DIFF. 2135Mi.		-9.86	-9.62	-14.33	-6.68	-8.86	-9.93	-9.93
% DIFF. B/L: 2135Mi.		-4.56	84.89	52.10	11.23	9.54	-3.36	-3.36

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	Speed	CO2	CO	THC	NOX	NO	FC-cvs	FC CORR
B/LINE	100	186.5	0.944	0.555	4.026	2.569	8.034	4.821
"0" Mi.	100	186.5	0.977	0.570	4.137	2.641	8.039	4.823
870 Mi.	100	194.9	1.152	0.743	5.224	3.293	8.427	5.056
3257 Mi.	100	172.2	1.001	0.591	3.473	2.221	7.438	4.463
7318 Mi.	100	180.3	1.131	0.768	3.072	1.933	7.833	4.700
NEW B/LINE	100	201.6	1.185	1.021	6.092	3.893	8.751	5.251
2135 Mi.	100	173.4	1.119	0.818	5.194	3.161	7.525	4.515
% DIFF. B/L: 3257Mi.		-7.66	5.99	6.51	-13.74	-13.54	-7.42	-7.42
% DIFF. B/L: 7318Mi.		-3.30	19.74	38.28	-23.69	-24.74	-2.50	-2.50
% DIFF.B/L:NEW B/L:		8.08	25.43	83.94	51.33	51.55	8.93	8.93
% DIFF. 2135Mi.		-14.00	-5.53	-19.90	-14.75	-18.80	-14.02	-14.02
% DIFF. B/L: 2135Mi.		-7.05	18.50	47.34	29.01	23.05	-6.34	-6.34
B/LINE	110	224.6	1.178	0.582	4.680	2.996	9.667	5.273
"0" Mi.	110	228.8	1.167	0.588	4.821	3.022	9.844	5.369
870 Mi.	110	212.6	1.450	0.685	4.869	3.169	9.192	5.014
3257 Mi.	110	204.5	1.301	0.598	4.114	2.615	8.827	4.815
7318 Mi.	110	213.9	1.218	0.705	3.540	2.251	9.234	5.037
NEW B/LINE	110	220.9	1.392	1.008	6.497	4.173	9.583	5.227
2135 Mi.	110	193.1	1.257	0.747	6.358	3.878	8.361	4.560
% DIFF. B/L: 3257Mi.		-8.94	10.45	2.64	-12.09	-12.72	-8.69	-8.69
% DIFF. B/L: 7318Mi.		-4.76	3.46	21.09	-24.35	-24.85	-4.48	-4.48
% DIFF.B/L:NEW B/L:		-1.64	18.23	73.04	38.82	39.28	-0.87	-0.87
% DIFF. 2135Mi.		-12.59	-9.70	-25.82	-2.13	-7.06	-12.75	-12.75
% DIFF. B/L: 2135Mi.		-14.03	6.75	28.37	35.87	29.45	-13.51	-13.51
B/LINE	120	260.3	1.376	0.620	6.399	4.095	11.195	5.597
"0" Mi.	120	262.2	1.408	0.613	6.670	4.283	11.277	5.638
870 Mi.	120	255.1	2.016	0.719	5.593	3.629	17.031	5.516
3257 Mi.	120	230.5	1.469	0.656	5.583	3.525	9.946	4.973
7318 Mi.	120	256.0	1.727	0.668	3.763	2.371	11.045	5.523
NEW B/LINE	120	248.3	1.629	1.046	8.245	5.314	10.761	5.380
2135 Mi.	120	237.1	1.505	0.803	8.978	5.518	10.245	5.123
% DIFF. B/L: 3257Mi.		-11.43	6.78	5.83	-12.74	-13.93	-11.15	-11.15
% DIFF. B/L: 7318Mi.		-1.63	25.55	7.76	-41.20	-42.10	-1.34	-1.34
% DIFF.B/L:NEW B/L:		-4.61	18.41	68.65	28.85	29.75	-3.88	-3.88
% DIFF. 2135Mi.		-4.51	-7.60	-23.24	8.89	3.85	-4.79	-4.79
% DIFF. B/L: 2135Mi.		-8.92	9.42	29.46	40.31	34.75	-8.48	-8.48
MEAN OF %DIFF.								
NEW B/L: 2135Mi.		-10.67	-14.99	-24.42	-12.88	-15.49	-11.05	-11.05
MEAN OF %DIFF.								
OLD B/L: 7318 Mi.		-1.59	1.20	21.17	-33.82	-36.47	-1.12	-1.12
OVERALL								
MEAN of MEANS		-6.13	-6.89	-1.63	-23.35	-25.98	-6.08	-6.08

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Fig.1 CO EMISSIONS ECOFLOW

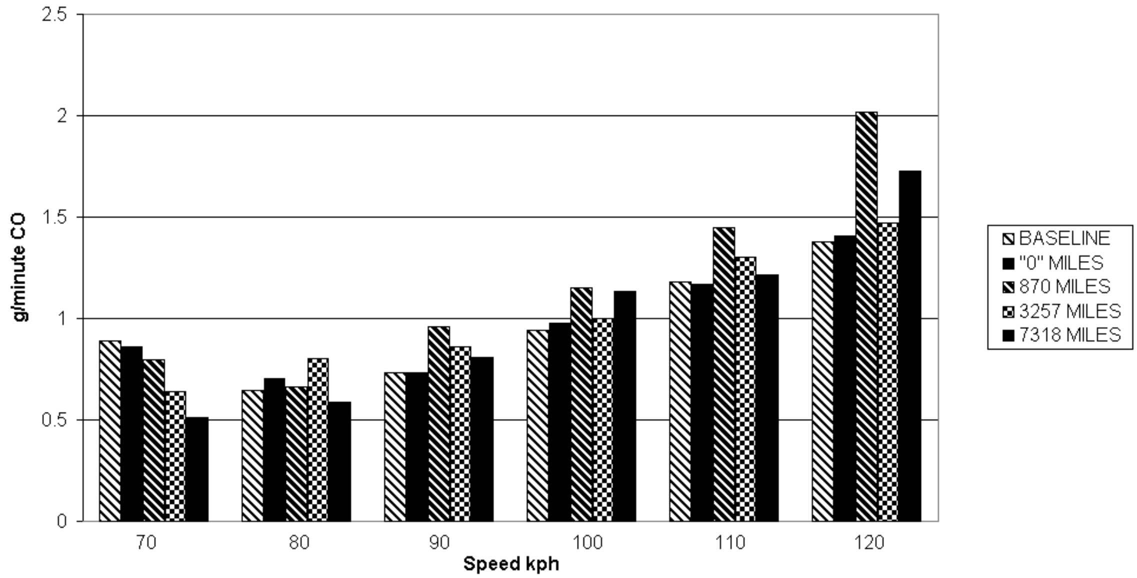

Fig.2 THC EMISSIONS ECOFLOW

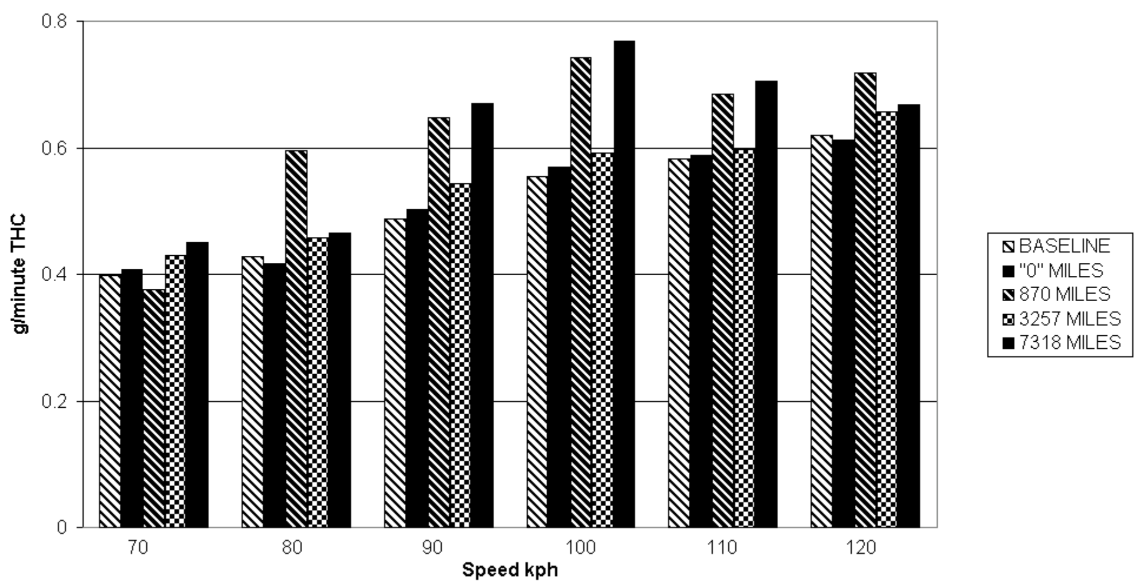

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Fig.3 CO2 EMISSIONS ECOFLOW

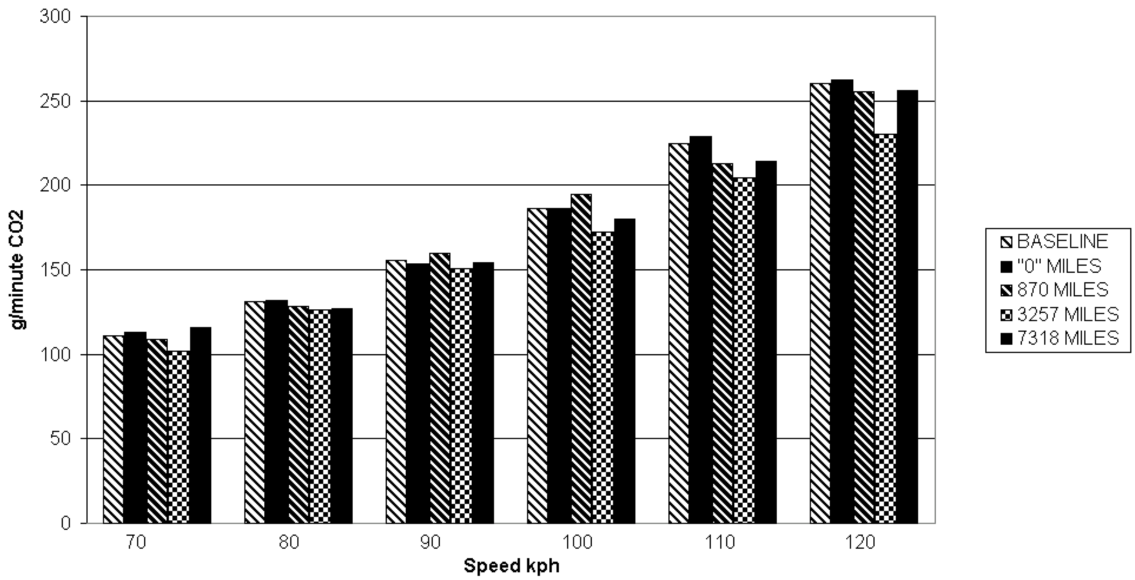

Fig.4 FUEL CON. (c/b) ECOFLOW

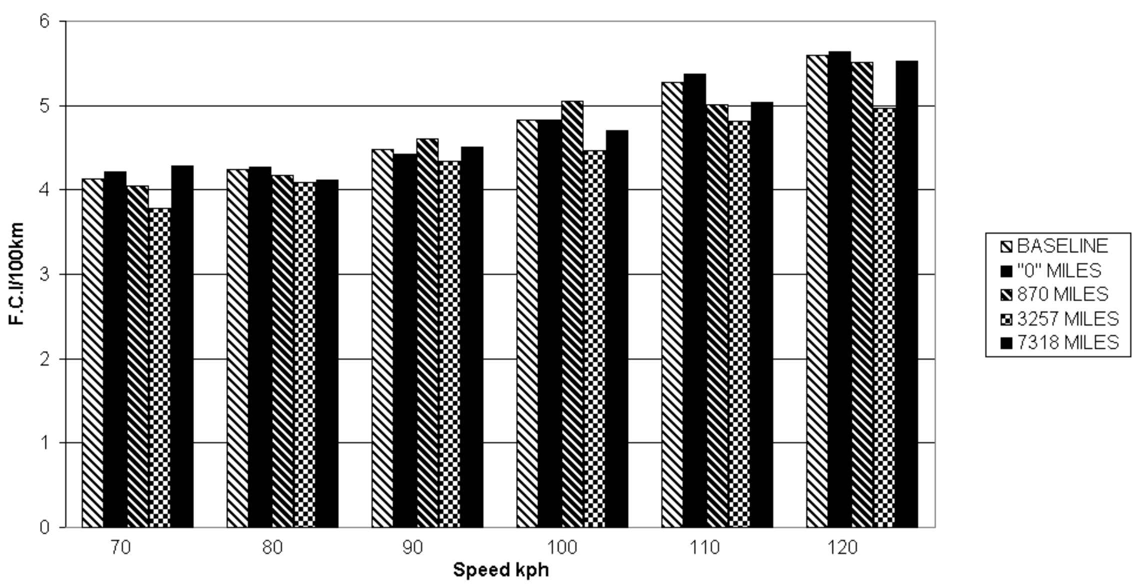

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Fig.5 NOX EMISSIONS ECOFLOW

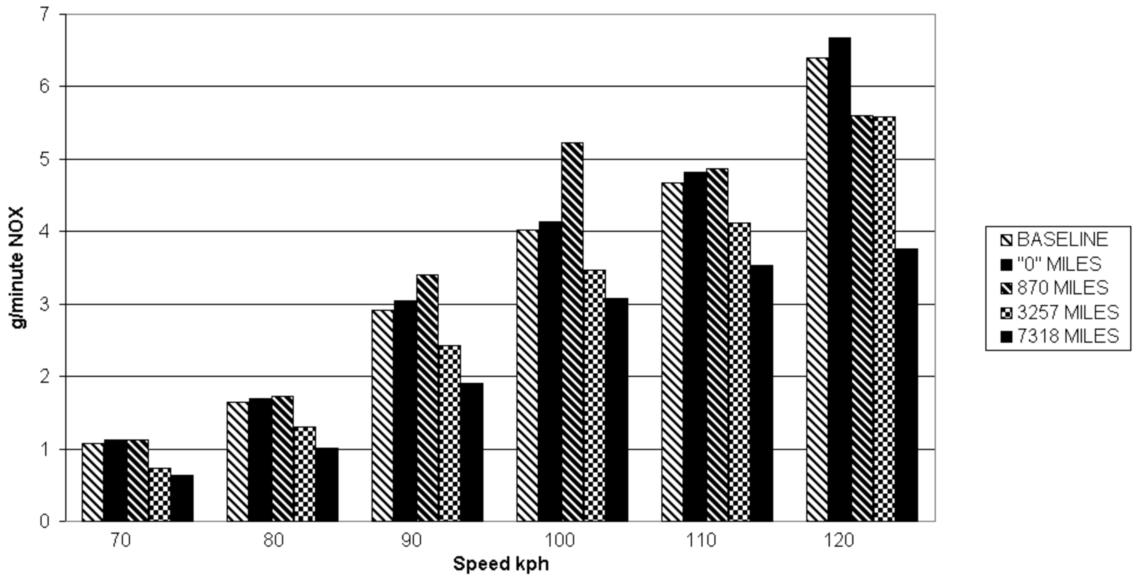

Fig.6 NO EMISSIONS ECOFLOW

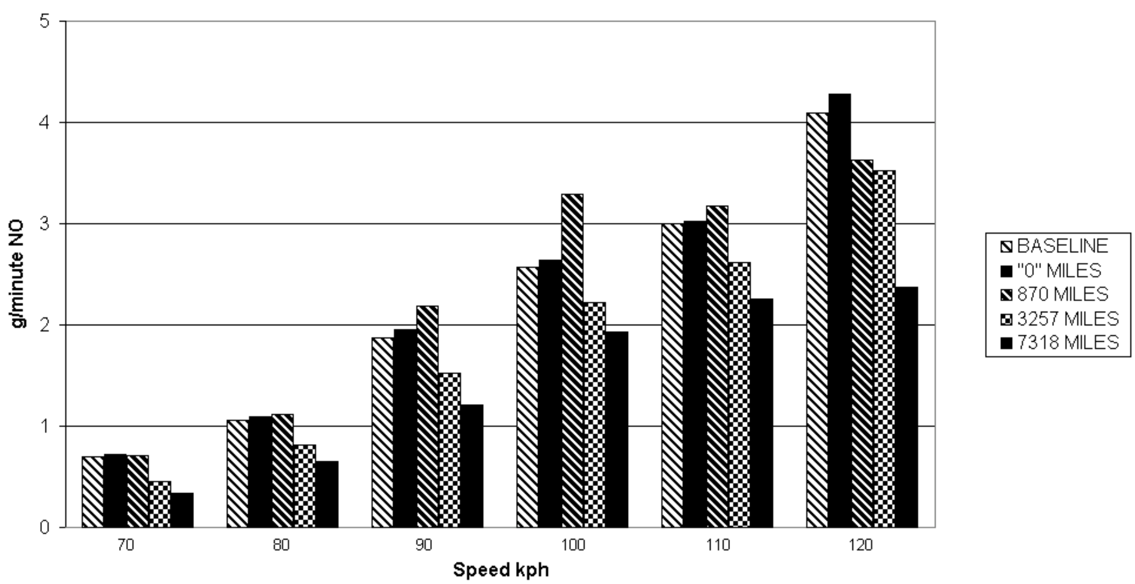

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Fig.7 SPEED vs. POWER ECOFLOW

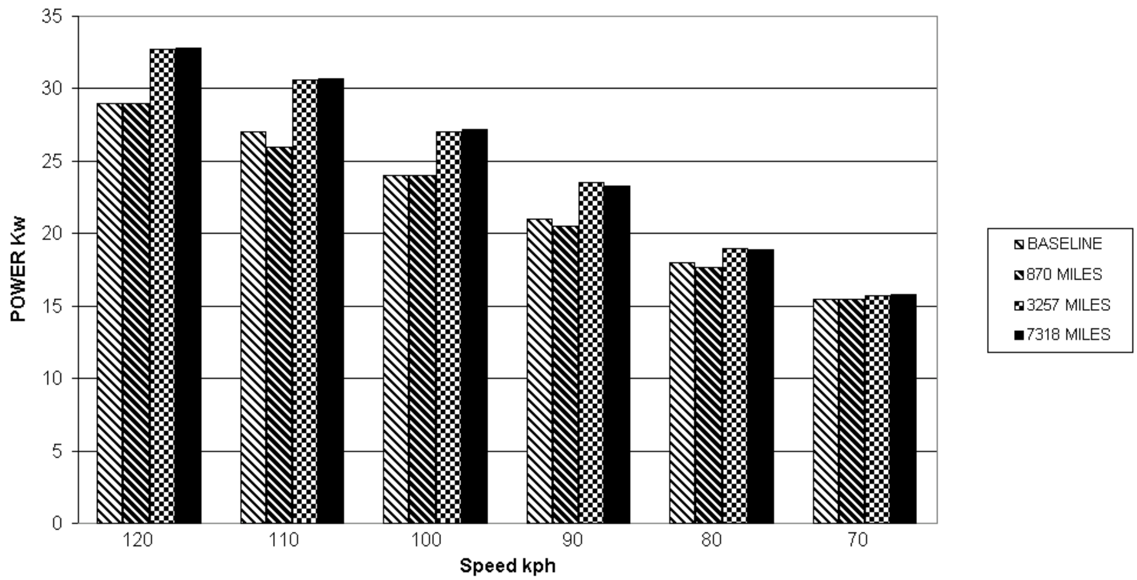

Fig.8 NEW CO EMISSIONS ECOFLOW

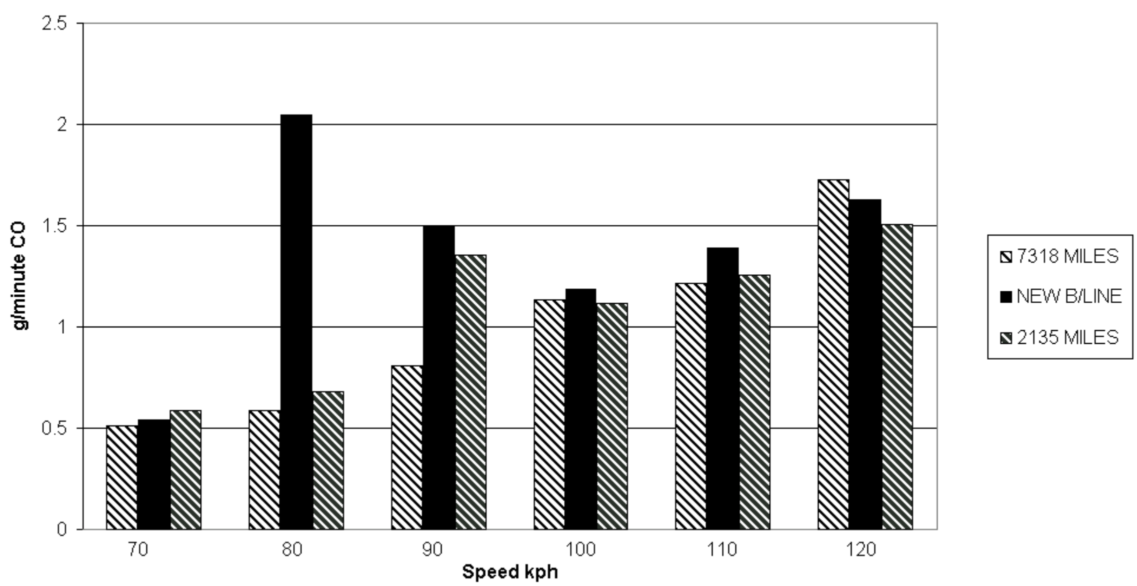

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Fig.9 NEW THC EMISSIONS ECOFLOW

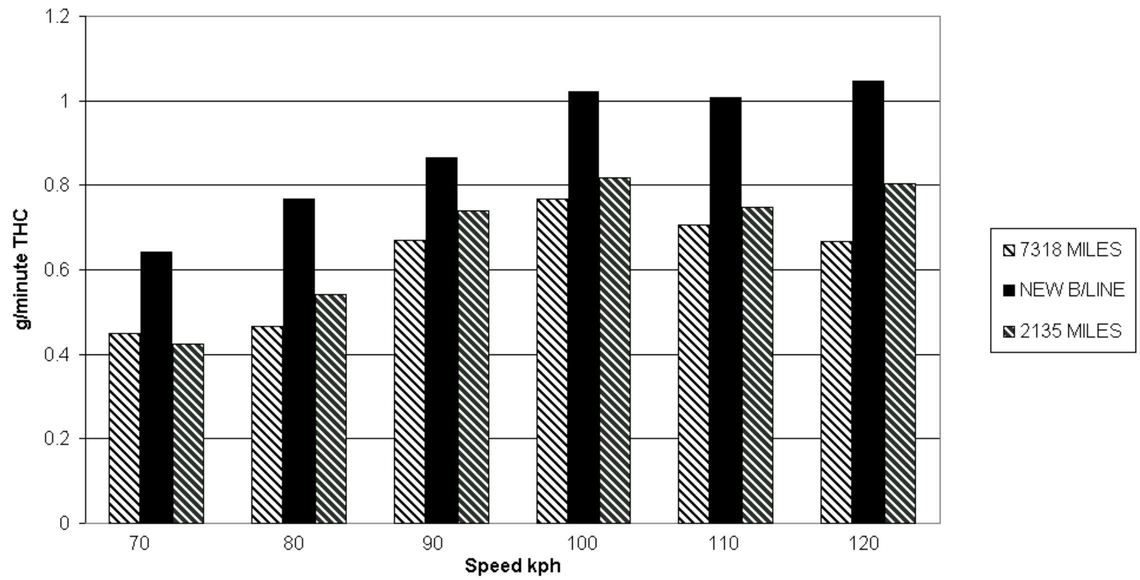

Fig.10 NEW CO2 EMISSIONS ECOFLOW

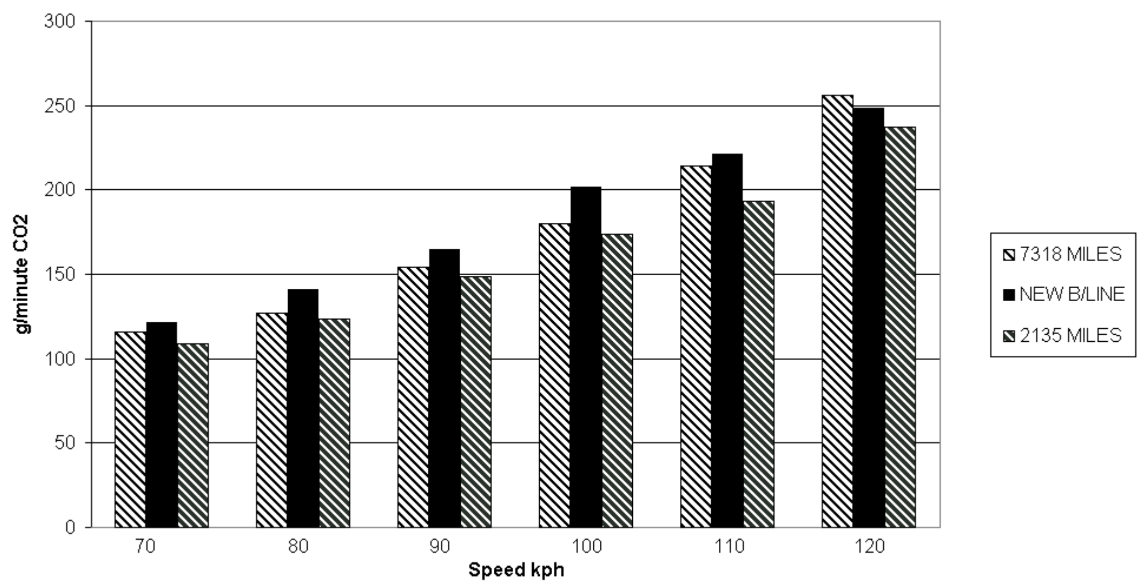

Fig.11 NEW FUEL CON. (c/b) ECOFLOW

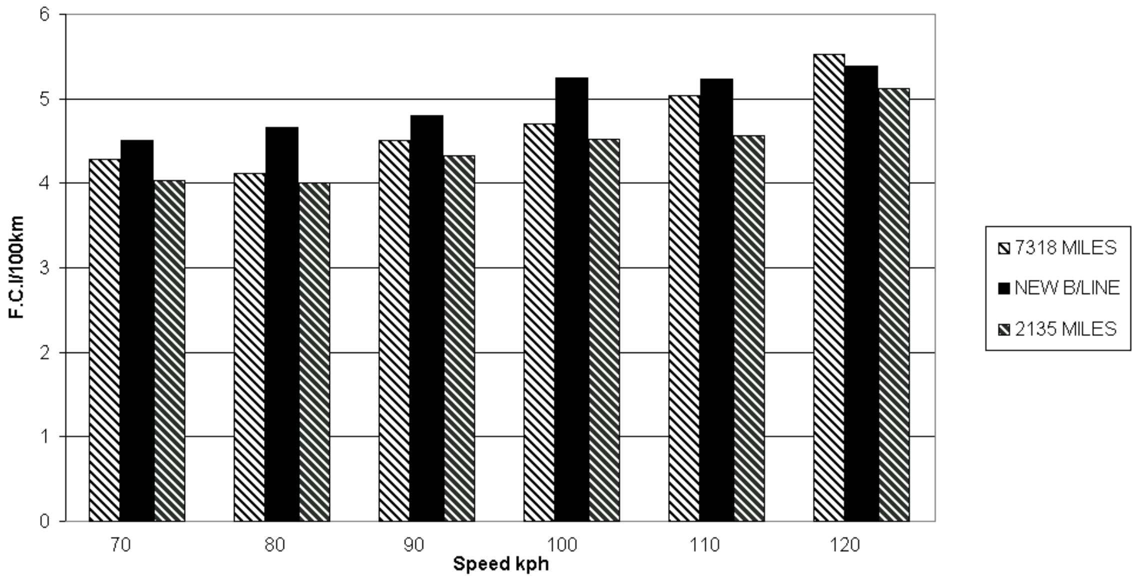

Fig.12 NEW NOX EMISSIONS ECOFLOW

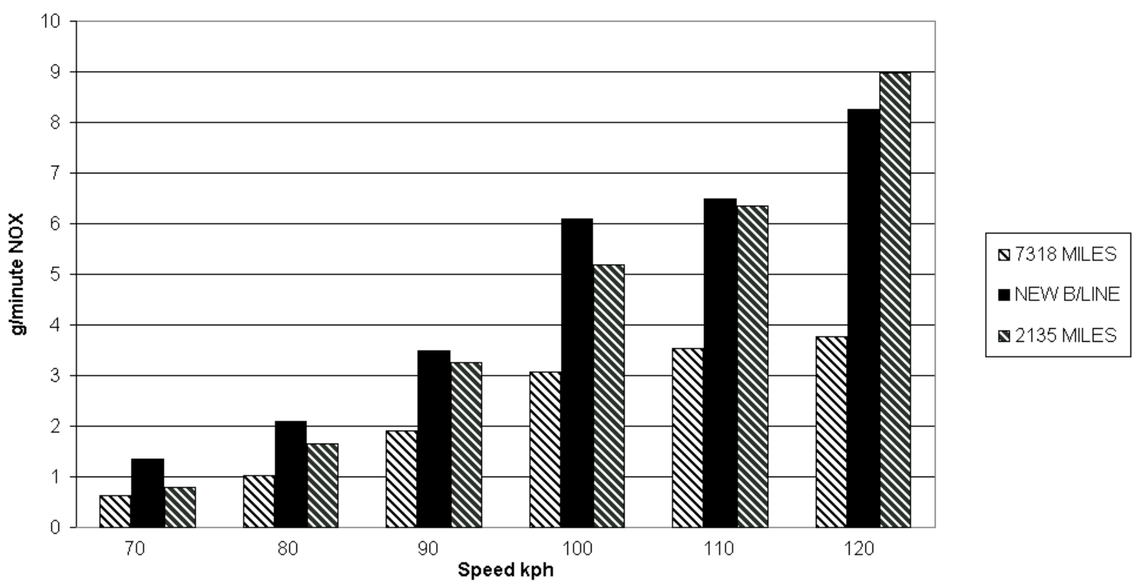

Fig.13 NEW NO EMISSIONS ECOFLOW

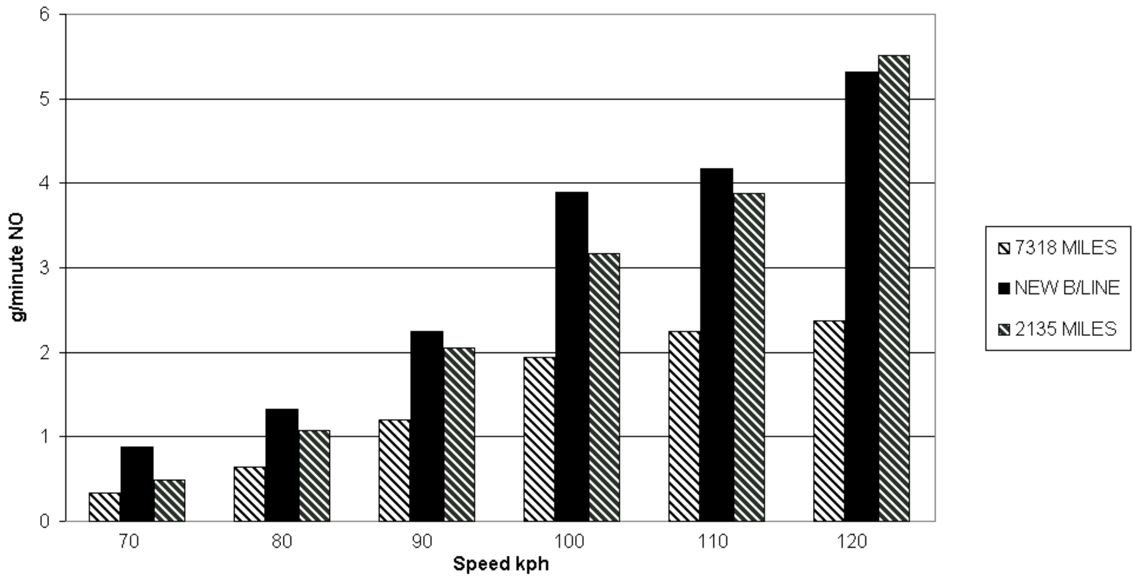

Fig.14 Speed vs. Power