EMISSION CONTROL SYSTEMS

AN ASSESSMENT

of the

ECS SYSTEM

by

BIRMINGHAM CITY COUNCIL

February 1993 to December 1994

EMISSION CONTROL SYSTEMS

CONTENTS

GENERAL DETAILS

TRIAL AGENCY

The tests were carried out by the Environmental Services Department of Birmingham (England) City Council

TRIAL DURATION

The main core of the assessment was from February 10th 1993 to December 2nd 1994. The ECS module was fitted to the vehicle on February 10th 1994.

VEHICLE DETAILS

A front-line bulk loading refuse collection vehicle based on the Dennis 'Elite' (a six by two chassis) with a Dennis 'Phoenix' body and powered by a Perkins 'Phaser' turbo diesel engine.

Vehicle fleet number - 2054

TESTS PERFORMED

During the test period, smoke emission and fuel consumption figures were derived both before and after the unit was fitted.

FINDINGS

SMOKE EMISSIONS

Prior to Fitting ECS

Test on February 10th 1994	*K*	*Gas Temp. Range*
	2.40	20-26 deg. C

After Fitting ECS

Test Date	*K*	*Gas Temp. Range*
March 11th 1994	**2.84**	20-26 deg. C
March 14th 1994	**2.58**	22-26 deg. C
June 21st 1994	**3.51**	24-28 deg. C
July 28th 1994	**2.57**	30-32 deg. C
August 29th 1994	**2.39**	24-28 deg. C

At this point in the assessment we asked if an independent test could be performed, and to this end the vehicle was made available to us on the 31st of August 1994 at the

The test was performed following exactly the procedures laid down by the manufacturers of the test equipment.

The test equipment was exactly the same as that used by the Montague Street Garage, i.e. a SUN ASA 200 Advanced Smoke Analyser.

Particular care was taken to ensure that the sensor used was the correct one for Heavy Goods Vehicles.

The test was performed to the complete satisfaction of your Mr. T. Chalmers who witnessed and then signed the results sheet.

The results obtained were:

Test	*K*	*Gas Temp. Range*
August 31st 1994	**1.06**	34-56 deg. C

Also at this time a further test was performed using the Montague Street Garage's own test equipment.

The results obtained were:

Test	*K*	*Gas Temp. Range*
August 31st 1994	**2.06**	26-34 deg. C

Comments

All the above tests showed the vehicle to have emissions well below the legal requirement.

Of the results obtained by the Montague Street Garage, two were lower after the **ECS** unit had been fitted.

The independent test witnessed by your Mr. T. Chalmers showed a significant reduction in smoke emissions.

Test on February 10th 1994	*K*	*Gas Temp. Range*
(Before fitting the Unit)	**2.40**	20-26 deg. C
Test on August 31st 1994	*K*	*Gas Temp. Range*
	1.06	34-56 deg. C

i.e. a reduction of 55.8%.

FUEL CONSUMPTION

The figures obtained by Mr. Roy Gedes, as taken from the 'TRISCAN' for the period February 10th 1993 to December 1st 1993 (before fitting ECS) and February 14th 1994 to December 2nd 1994 (after fitting ECS) were copied to us.

Spurious Data

The figures supplied contain several extremely erratic readings which obscure the actual results, whether complimentary or derogatory with regard to the unit on test.

Appendix III plots the results over the whole period, and from this chart the obvious deviation of the figures listed below from the norm is apparent.

These readings produce 'kilometres per litre per fill' figures which deviate so much from the normal vehicle performance over the complete test period that they have been removed from the consumption assessment, the figures concerned are,

Date	Fuel Litres	Distance (km)	*km/litre per fill*	
07-Sep-93	126.1	272.0	*2.157*	
14-Sep-93	92.8	18.0	*0.194*	
21-Sep-93	104.1	259.0	*2.488*	
22-Sep-93	51.3	112.0	*2.183*	
23-Sep-93	113.6	44.0	*0.387*	
Totals	**487.9**	**705.0**		**Before**
04-Apr-94	120.0	66.0	*0.550*	
06-May-94	73.4	52.0	*0.708*	
09-May-94	112.1	59.0	*0.526*	
Totals	**305.5**	**177.0**		**After**

Results before fitting ECS

From February 10th 1993 to December 1st 1993

km start = 1606, km finish = 11423, total kilometres covered = 9817

removing the spurious readings detailed above gives 9817-705 = **9112 km**

Total fuel used = 8955.9 litres less 487.9 from above = **8468 litres**

Fuel consumption before = 9112 km / 8468 litres = 1.076 km / litre

Results after fitting ECS

From February 14th 1994 to December 2nd 1994

km start = 14074, km finish = 25251, total kilometres covered = 11177

removing the spurious readings detailed above gives 11177-177 = **11000 km**

Total fuel used = 9845.8 litres less 305.5 from above = **9540.7 litres**

Fuel consumption before = 11000 km / 9540.7 litres = 1.153 km / litre

This demonstrates an improvement of

100 X (1.153-1.076)/1.076 = 7.165%

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Appendix I

RESULTS BEFORE ECS SYSTEM FITTED

DATE	ODOMETER	KILOMETRES	LITRES FUEL	KILOMETRES / LITRE
10-Feb-93	1,606	129.9	122	0.939
16-Feb-93	1,745	135.9	139	1.023
18-Feb-93	1,888	154.7	143	0.924
25-Feb-93	2,036	152.2	148	0.972
01-Mar-93	2,190	158.8	154	0.970
05-Mar-93	2,342	152.4	152	0.997
10-Mar-93	2,490	153.8	148	0.962
16-Mar-93	2,637	139.0	147	1.058
19-Mar-93	2,790	157.0	153	0.975
25-Mar-93	2,935	145.8	145	0.995
31-Mar-93	3,077	141.7	142	1.002
05-Apr-93	3,217	137.6	140	1.017
07-Apr-93	3,368	151.3	151	0.998
13-Apr-93	3,531	154.8	163	1.053
16-Apr-93	3,688	147.6	157	1.064
22-Apr-93	3,821	135.7	133	0.980
27-Apr-93	3,991	162.5	170	1.283
30-Apr-93	4,124	133.0	133	1.000
05-May-93	4,250	107.3	126	1.174
10-May-93	4,397	155.7	147	0.944
13-May-93	4,542	140.3	145	1.033
18-May-93	4,615	51.1	73	1.429
20-May-93	4,735	134.6	120	0.892
25-May-93	4,868	108.9	133	1.221
27-May-93	5,001	127.6	133	1.042
03-Jun-93	5,166	122.4	165	1.348
07-Jun-93	5,318	97.4	152	1.561
09-Jun-93	5,420	140.5	102	0.726
15-Jun-93	5,552	123.3	132	1.071
18-Jun-93	5,698	151.9	146	0.961
23-Jun-93	5,849	133.7	151	1.129
28-Jun-93	6,002	150.5	153	1.017
30-Jun-93	6,142	130.1	140	1.076
05-Jul-93	6,261	112.3	119	1.060
08-Jul-93	6,400	135.4	139	1.027
12-Jul-93	6,566	126.4	166	1.313
14-Jul-93	6,690	124.6	124	0.995

18-Jul-93	6,857	133.8	167	1.248
22-Jul-93	7,000	136.4	143	1.048
26-Jul-93	7,144	135.3	144	1.064
30-Jul-93	7,295	134.1	151	1.126
04-Aug-93	7,447	141.7	152	1.058
09-Aug-93	7,596	123.2	149	1.209
11-Aug-93	7,746	143.5	150	1.045
17-Aug-93	7,887	134.8	141	1.046
23-Aug-93	8,021	119.9	134	1.118
26-Aug-93	8,181	134.2	160	1.192
30-Aug-93	8,335	124.1	154	1.241
07-Sep-93	**8,607**	**126.1**	**272**	**2.157**
10-Sep-93	8,745	145.4	138	0.949
11-Sep-93	8,835	69.3	90	1.299
14-Sep-93	**8,853**	**92.8**	**18**	**0.194**
21-Sep-93	**9,112**	**104.1**	**259**	**2.488**
22-Sep-93	**9,224**	**51.3**	**112**	**2.183**
23-Sep-93	**9,268**	**113.6**	**44**	**0.387**
29-Sep-93	9,445	157.0	177	1.127
04-Oct-93	9,615	124.1	170	1.370
12-Oct-93	9,770	145.1	155	1.068
15-Oct-93	9,899	127.2	129	1.014
19-Oct-93	10,071	127.2	172	1.352
21-Oct-93	10,169	113.5	98	0.863
25-Oct-93	10,312	92.1	143	1.553
27-Oct-93	10,404	101.0	92	0.911
01-Nov-93	10,556	148.2	152	1.026
04-Nov-93	10,687	139.4	131	0.940
08-Nov-93	10,885	132.3	198	1.497
11-Nov-93	11,017	133.5	132	0.974
15-Nov-93	11,173	147.6	156	1.057
18-Nov-93	11,322	129.1	149	1.154
01-Dec-93	11,423	113.2	101	0.892

Summary figures before fitting ECS:

Total distance covered = 9817 kilometres

Fuel consumed = 8955.9 litres

Erratic figures (shown in bold type above) that have been removed from the analysis constitute 705 kilometres and 487.9 litres

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Appendix II

RESULTS AFTER ECS SYSTEM FITTED

DATE	ODOMETER	KILOMETRES	LITRES FUEL	KILOMETRES / LITRE
14-Feb-94	14,074	95.1	97	1.020
16-Feb-94	14,180	121.0	106	0.876
21-Feb-94	14,361	127.0	181	1.425
23-Feb-94	14,469	114.7	108	0.942
25-Feb-94	14,600	100.7	131	1.301
01-Mar-94	14,759	134.2	159	1.185
03-Mar-94	14,894	144.5	135	0.934
07-Mar-94	15,016	88.4	122	1.389
09-Mar-94	15,136	135.4	120	0.886
11-Mar-94	15,267	100.6	131	1.302
15-Mar-94	15,419	146.6	152	1.017
17-Mar-94	15,514	76.9	95	1.235
21-Mar-94	15,634	101.8	120	1.179
30-Mar-94	15,840	151.2	206	1.362
02-Apr-94	15,993	141.7	153	1.080
04-Apr-94	**16,059**	**120.0**	**66**	**0.550**
06-Apr-94	16,189	100.7	130	1.291
08-Apr-94	16,313	100.6	124	1.233
13-Apr-94	16,418	100.6	105	1.044
15-Apr-94	16,526	100.6	108	1.074
19-Apr-94	16,624	100.6	98	0.974
21-Apr-94	16,712	100.6	88	0.875
25-Apr-94	16,871	142.6	159	1.115
27-Apr-94	16,997	102.2	126	1.233
29-Apr-94	17,137	100.6	140	1.392
03-May-94	17,265	100.7	128	1.271
05-May-94	17,338	79.0	73	0.924
06-May-94	**17,390**	**73.4**	**52**	**0.708**
09-May-94	**17,449**	**112.1**	**59**	**0.526**
11-May-94	17,570	126.6	121	0.956
16-May-94	17,746	160.1	176	1.358
17-May-94	17,868	157.1	122	0.777
20-May-94	17,971	51.0	103	2.020
23-May-94	18,093	125.3	122	0.974
27-May-94	18,233	100.6	140	1.392
31-May-94	18,376	155.2	143	0.921
02-Jun-94	18,538	119.1	162	1.360

07-Jun-94	18,700	100.6	162	1.610
09-Jun-94	18,830	139.9	130	0.929
14-Jun-94	18,979	100.7	149	1.480
16-Jun-94	19,078	120.6	99	0.821
20-Jun-94	19,197	81.6	119	1.458
21-Jun-94	19,326	104.3	129	1.237
24-Jun-94	19,446	113.8	120	1.054
28-Jun-94	19,612	147.6	166	1.125
01-Jul-94	19,794	152.7	182	1.192
06-Jul-94	19,980	142.5	186	1.305
09-Jul-94	20,136	135.5	156	1.151
13-Jul-94	20,300	151.6	164	1.082
18-Jul-94	20,473	157.4	173	1.099
21-Jul-94	20,641	136.9	168	1.227
23-Jul-94	20,781	105.0	140	1.333
26-Jul-94	20,931	149.6	150	1.003
29-Jul-94	21,072	109.7	141	1.285
01-Aug-94	21,220	123.7	148	1.196
04-Aug-94	21,334	103.6	114	1.100
08-Aug-94	21,449	94.7	115	1.214
10-Aug-94	21,609	100.1	160	1.598
12-Aug-94	21,698	105.9	89	0.840
13-Aug-94	21,763	38.8	65	1.675
15-Aug-94	21,877	110.0	114	1.036
25-Aug-94	22,038	108.4	161	1.485
29-Aug-94	22,148	104.5	110	1.053
30-Aug-94	22,196	41.8	48	1.148
01-Sep-94	22,299	87.3	103	1.180
03-Sep-94	22,453	91.5	154	1.683
06-Sep-94	22,581	150.8	128	0.849
09-Sep-94	22,739	157.1	158	1.006
14-Sep-94	22,912	141.9	173	1.219
16-Sep-94	23,018	100.5	106	1.055
20-Sep-94	23,141	111.2	123	1.106
22-Sep-94	23,286	139.7	145	1.038
24-Sep-94	23,431	113.1	145	1.282
28-Sep-94	23,548	108.4	117	1.079
30-Sep-94	23,659	107.1	111	1.036
03-Oct-94	23,841	150.0	182	1.213
06-Oct-94	23,949	116.9	108	0.924
11-Oct-94	24,108	156.2	159	1.018
14-Oct-94	24,268	72.8	160	2.198
15-Oct-94	24,275	87.7	7	0.080
18-Oct-94	24,431	97.2	156	1.605

20-Oct-94	24,555	124.9	124	0.993
24-Oct-94	24,679	129.5	124	0.958
03-Nov-94	24,802	73.4	123	1.676
07-Nov-94	24,939	122.9	137	1.115
29-Nov-94	25,117	138.7	178	1.283
02-Dec-94	25,251	191.5	134	1.019

Summary figures after fitting ECS:

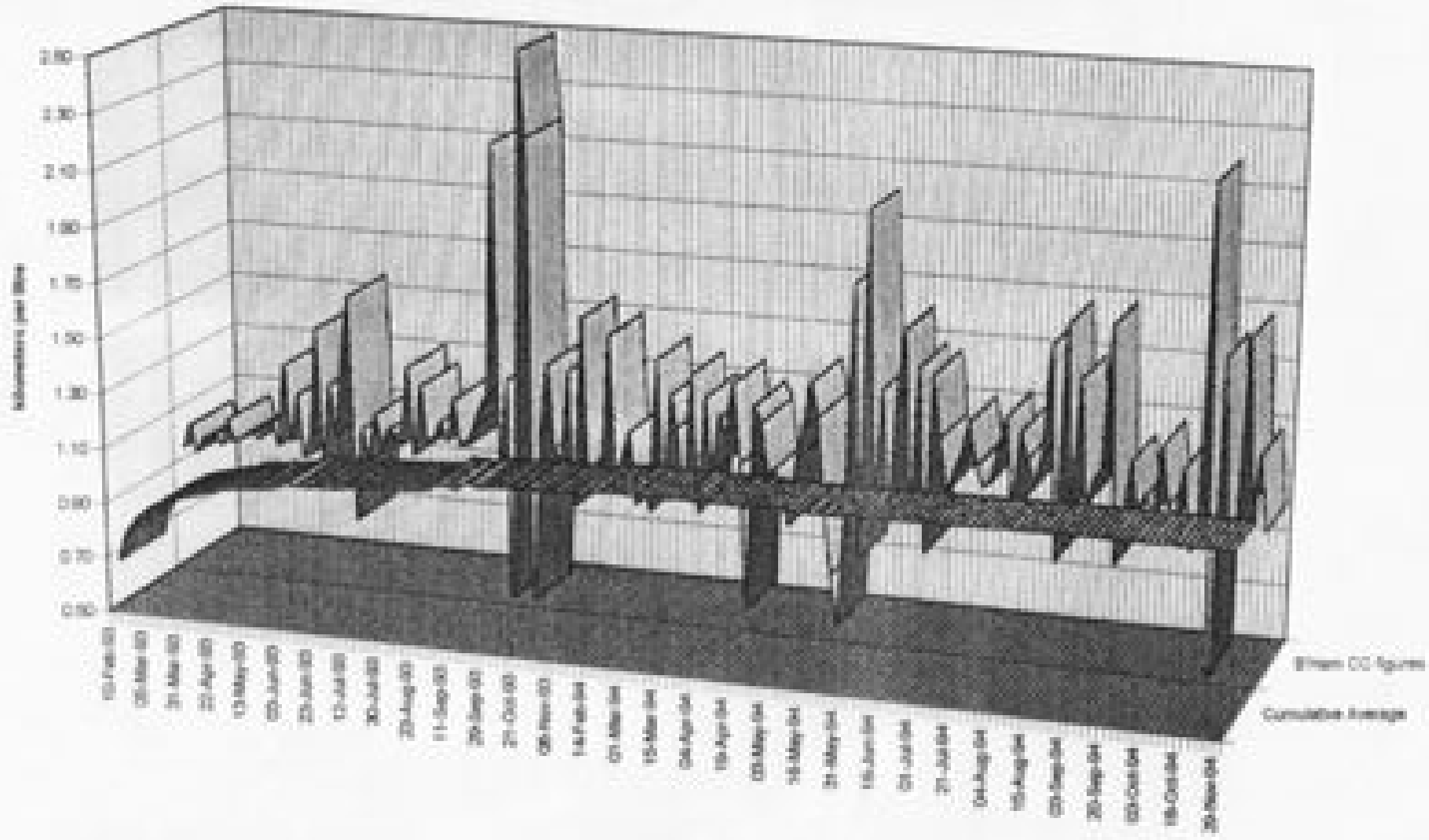
Total distance covered = 11177 kilometres

Fuel consumed = 9845.8 litres

Erratic figures (shown in bold type above) that have been removed from the analysis constitute 177 kilometres and 305.5 litres.

Appendix III

GRAPHICAL ANALYSIS FOR PERIODS SELECTED BY BCC



Appendix IV

ECS SYSTEM COST SAVING ANALYSIS

Individual ECS system cost	£590.00p
Cost each per hundred units (-10%)	£531.00p
Fuel cost at time of assessment	£0.372p per litre
Distance driven 14/2/94 to 2/12/94 (288 days)	11177 km
Fuel consumed 14/2/94 to 2/12/94 (288 days)	9845.8 litres
Fuel cost at £0.372p per litre	£3662.64
Annual fuel cost = £3150.10 X 365/288	£4641.89p
Saving of 7.16% produced by ECS	£332.36p
Simple recovery period (£590.00p / £332.36p)	**1.78 years**
Recovery period if more than 100 units ordered (£531.00p / £332.36p)	**1.60 years**

REPORT UPDATE

Since the trial period there has been a significant increase in duty imposed on diesel fuel resulting in even shorter payback periods and larger continuous savings of hundreds of pounds per vehicle per annum continuously accruing thereafter.