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Interlink Express Final Report Field Trial of of FPC-1 Fuel Performance Catalyst

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I. Introduction

FPC-1 Fuel Performance Catalyst is a burn rate modifier or catalyst proven to reduce fuel consumption and increase engine horsepower in several recognized, independent laboratory tests, and dozens of independent field trials. The catalyst also has a positive impact upon the products of incomplete combustion, primarily soot (smoke).

The intent of the current trial at Interlink Express is to determine the degree of fuel consumption, and smoke reduction resulting from the addition of the FPC-1 catalyst to the # 2 diesel fuelling a select fleet of lorries. The test methodology for determining fuel consumption is the carbon mass balance (cmb). The cmb method measures the carbon containing products of the combustion process (CO_2, CO, HC) found in the exhaust, rather than directly measuring fuel flow into the engine.

This report summarizes the results of the fuel consumption and emissions data, and computes the mass flow rates, known as engine performance factors (PF) for the fleet before (baseline) and after FPC-1 fuel treatment.

II. Discussion of Carbon Mass Balance Method

The carbon mass balance eliminates virtually all of the variables associated with field testing for fuel consumption changes. The method requires no modifications to fuel lines or engines, and can be conducted in a short period of time at minimal expense.

Instead of measuring fuel flow into the engine (ie., the weight or volume of the fuel), measurements are made of the exhaust gases leaving the engine. More precisely, the carbon containing gases in the exhaust are measured. The method is based upon the Law of Conservation of Matter, which states that atoms can neither be created nor destroyed. Since the engines only source of carbon is the fuel it consumes, the carbon measured in the exhaust must come from the fuel. By measuring the carbon going out of the engine in the form of products of combustion, the amount of carbon entering the engine can be determined.

Carbon Balance Calculation

The carbon leaving the engine is mainly in the form of carbon dioxide (CO_2), carbon monoxide (CO), unburned hydrocarbons (HC), and particulate (smoke). By collecting these data while the engine is operating at a given load and speed, the fuel flow rate into the engine can be accurately determined. When engine load and speed, along with other factors influencing fuel consumption are reproduced and/or monitored to make appropriate corrections, the carbon balance can be used to confidently determine changes in fuel consumption that might result from the use of a fuel catalyst, such as FPC-1.

With the carbon balance, engine efficiency is expressed in terms of engine performance factors. To calculate any change in engine performance, separate measurements are made with the engine running on base fuel (untreated) and FPC-1 treated fuel. Any changes are stated as percentage changes from baseline.

A copy of the carbon balance equations is found on Figure 1 (Appendix 1). A sample calculation for illustration purposes is also attached (see Figure 2, Appendix 1). Additionally, the carbon balance can be used to determine the effect of FPC-1 upon harmful emissions, such as carbon monoxide and smoke.

III. Instrumentation

Precision, state-of-the-art instrumentation is used to measure the concentrations of carbon containing gases in the exhaust stream and other factors related to fuel consumption and engine performance. The instruments and their purposes are listed below:

1) A Sun Electric SGA-9000 non-dispersive infrared (NDIR) four gas analyzer - measures the volume percent of CO2, CO, and oxygen (O2) in the exhaust, and the parts per million (ppm) of HC.

2) EPA I/M Calibration Gases - known gases used to internally calibrate the NDIR analyzer.

3) A twenty (20) foot sampling train and stainless steel exhaust gas probe - inserted into the engine exhaust pipe draws a sample of exhaust gases to the analyzer.

4) A Fluke Model 52 hand held digital thermometer and wet/dry thermocouple probe - measures exhaust, ambient, and fuel temperature.

5) A Dwyer Magnehelic 2000 Series Pressure Gauge and pitot tube - measures exhaust air velocity and/or pressure.

6) A Monarch Contact/Noncontact digital tachometer and magnetic tape - measures engine rpm when dash mounted tachometers are unavailable.

7) A hydrometer and flask - determines fuel specific gravity (density).

8) Barometric pressure is acquired from local airport or weather station.

9) A Bacharach TrueSpot Smokemeter - for smoke density determination.

With the exception of engine speed, fuel density, and ambient readings, all data are collected by simply inserting probes into the exhaust stream while the engine is running at a fixed rpm and load, and the vehicle is stationary. No modifications or device installation are made to the fuel system, nor are normal work cycles disrupted.

After baseline testing, the test fleet will operate with FPC-1 fuel treatment approximately 500 hours to ensure complete engine conditioning.

IV. Technical Approach

The following technical approach was observed during the baseline test, and will be reproduced during the treated fuel test segment:

1) All instruments are calibrated according to accepted protocol.

2) A sample of fuel is drawn from the fuel tank on each lorry. Using a hydrometer and wet/dry temperature probe, fuel specific gravity is recorded.

3) Each lorry to be tested is parked, brakes locked, and run out-of-gear at a specific engine speed (RPM) until engine water, oil, and exhaust temperature, and exhaust pressure have stabilized. Engine speed is controlled using either a hand held phototach or the tachometer in the cab.

4) Engine hours (or mileage) are taken from hour meters installed on the equipment.

5) After engine stabilization, the exhaust gas sampling probe is inserted into the exhaust stream. The Autocal button is depressed and after the LED readouts clear, test personnel take multiple readings of carbon dioxide, carbon monoxide, unburned hydrocarbons, and oxygen, along with engine speed, exhaust temperature and pressure.

6) Periodically, ambient air temperature, atmospheric pressure, and relative humidity are recorded. Temperature readings are taken at the test site. Other ambient readings are acquired from local weather information services.

7) All data are recorded until technicians are confident the information is consistent and reproducible.

8) After completing the baseline, all test fleet fuel will be *treated with FPC-1. All equipment will operate as normal for approximately 400 to 500 hours, at which time the above procedure will be reproduced without alteration, except for FPC-1 fuel treatment in the test fleet.

The data relative to the rate of fuel consumption will be used by UHI and Interlink managers/engineers to calculate the percent change in fuel consumption before and after FPC-1 fuel treatment.

V. Data and Calculations

The data collected during the baseline fuel carbon balance test are summarized on the attached computer printouts (Appendix 2). From these data the volume fraction (VF) of each gas is determined and the average molecular weight (Mwt) of the exhaust gases computed. Next, the engine performance factor (pf) based upon the carbon mass in the exhaust is computed. The pf is finally corrected for intake air temperature and pressure (barometric), and total exhaust mass yielding a corrected engine performance factor (PF). The PFs are tabulated on Table 1 of Appendix 3. The smoke spot (smoke density) numbers are found on Table 2 of Appendix 3.

The cmb procedure is conducted while the engine is operated under steady-state conditions (fixed rpm, high idle). Because of the steady-state nature of the test, the cmb results obtained with FPC-1 treated fuel will likely represent the minimum improvement. FPC-1 created fuel savings should be greater under more transient conditions (changing loads and engine speed) typical to waste disposal operations. Further, <u>the test fleet accumulated less than half of the required engine preconditioning kilometers in order for maximum benefit to be realized.</u> Based upon prior laboratory and field trials over the last ten years, the reductions in fuel consumption observed in this shortened test should approximately double over the next several months.

VI. Discussion of Results

Fuel Consumption

Eight of the ten lorries experience significant reductions in fuel consumption after FPC-1 fuel treatment. Unit numbers 1128 and 1110 appear to be anomalies in the fleet.

Unit 1128 saw an increase in carbon dioxide (CO_2) and pressure. Both these are indicators of an increase in fuel consumption. Since FPC-1 cannot increase fuel consumption, and since this is the only case in the fleet of an increase in CO_2, UHI feels the increase in fuel consumption is likely a result of a mechanical malfunction or alteration to the engine or fuel system.

Unit 1110 saw a reduction in CO_2, which doe not agree with the increase in pressure also observed. This indicates a possible pressure reading error.

These lorries have been treated as anomalies, and have been removed from the test sample.

Units 1104 and 3080 also appear to be anomalies. However, in this case the two lorries experienced over an 11% reduction in fuel consumption. Although FPC-1 is capable of creating such an improvement under certain conditions, given the average improvement in the remaining six lorries, and the lack of engine preconditioning time, UHI feels the improvement observed in these two lorries has likely been aided by some mechanical change made to the engines.

Although the data from the four lorries mentioned above are shown in the tables, they are not included in the conclusions for fuel consumption change.

The remaining six lorries saw fuel consumption reductions ranging from 2.5 to 6.1%. The average reduction is 3.83%.

Smoke Density

Smoke density was reduced in all eight of the ten lorries. Smoke density change ranged from 0 to 47%. Not a single lorry saw an increase in smoke, in spite of colder intake air temperature and higher fuel density. Both conditions generally contribute to increased engine smoking. The average reduction in smoke for the fleet is 23%.

VII. Determining Changes in Fuel Consumption Using Operating Records.

Although it is comparatively easy to track and record the volumetric flow rate of fuel consumed by a lorry engine over a given distance or time period, it is far more difficult to determine the impact of uncontrolled operating variables upon that flow rate. Load changes, seasonal and day-to-day weather changes, driver changes, changes in tire pressure, wind conditions, road conditions, fuel density and temperature, are some of the variables that add to the inaccuracy associated with determining fuel consumption under field conditions. For this very reason, laboratory test procedures were developed that provide adequate controls to overcome these problems.

FPC-1 has been tested repeatedly in qualified independent laboratories, using many recognized test methods. Fuel consumption reductions average approximately 6% in engines tested under transient conditions (changing engine speeds, loads, temperatures, fuel flow) that reproduce actually driving conditions.

The carbon mass balance, which is also used by the Environmental Protection Agency (EPA), is used by UHI and FPC because of it's accuracy ($\pm$ 1%). Further, because it is a steady-state test, the results tend to be minimum improvements, and therefore, the customer can expect even greater improvements under actual or transient conditions.

VIII. Conclusions

(1) The engine preconditioning period was approximately half of what is required for maximum fuel consumption reduction.

(2) The test fleet averaged a 3.83% reduction in fuel consumption after FPC-1 fuel treatment.

(3) Smoke density was reduced 23 after FPC-1 fuel treatment.

APPENDIX 1

Figure 1
CARBON MASS BALANCE FORMULAE

ASSUMPTIONS: $C_{12}H_{26}$ and SG = 0.82
Time is constant
Load is constant

DATA:

Mwt = Molecular Weight
pf1 = Calculated Performance Factor (Baseline)
pf2 = Calculated Performance Factor (Treated)
PF1 = Performance Factor (adjusted for Baseline exhaust mass)
PF2 = Performance Factor (adjusted for Treated exhaust mass)
CFM = Volumetric Flow Rate of the Exhaust
SG = Specific Gravity of the Fuel
VF = Volume Fraction
d = Exhaust stack diameter in inches
Pv = Velocity pressure in inches of H_20
P_B = Barometric pressure in inches of mercury
Te = Exhaust temperature ^oF
VFHC = "reading" ÷ 1,000,000
VFCO = "reading" ÷ 100
$VFCO_2$ = "reading" ÷ 100
VFO_2 = "reading" ÷ 100

EQUATIONS:

Mwt =

$$(VFHC)(86)+(VFCO)(28)+(VFCO_2)(44)+(VFO_2)(32)+[(1-VFHC-VFCO-VFCO_2-VFO_2)(28)]$$

pf1 or pf2 =

$$\frac{3099.6 \times Mwt}{86(VFHC)+13.89(VFCO)+13.89(VFCO_2)}$$

CFM =

$$\frac{(d/2)^2\pi}{144}\left(1096.2\sqrt{\frac{Pv}{1.325(PB/ET+460)}}\right)$$

PF1 or PF2 =

$$\frac{pf \times (Te+460)}{CFM}$$

FUEL ECONOMY:
PERCENT INCREASE (OR DECREASE)

$$\frac{PF2 - PF1}{PF1} \times 100$$

Figure 2.

SAMPLE CALCULATION FOR THE CARBON MASS BALANCE

BASELINE:

Equation 1 (Volume Fractions)

VFHC = 13.20/1,000,000
= 0.0000132

VFCO = 0.017/100
= 0.00017

$VFCO_2$ = 1.937/100
= 0.01937

VFO_2 = 17.10/100
= 0.171

Equation 2 (Molecular Weight)

$$Mwt1 = (0.0000132)(86) + (0.00017)(28) + (0.01937)(44) + (0.171)(32) + [(1-0.0000132-0.00017-0.01937-0.171)(28)]$$

$$Mwt1 = 28.995$$

Equation 3 (Calculated Performance Factor)

$$pf1 = \frac{3099.6 \times 28.995}{86(0.0000132) + 13.89(0.00017) + 13.89(0.01937)}$$

$$pf1 = 329{,}809$$

Equation 4 (CFM Calculations)

$$CFM = \frac{(d/2)^2\pi}{144}\left(1096.2\sqrt{\frac{Pv}{1.325(PB/ET+460)}}\right)$$

d = Exhaust stack diameter in inches
Pv = Velocity pressure in inches of H_20
P_B = Barometric pressure in inches of mercury
Te = Exhaust temperature ^{O}F

$$CFM = \frac{(10/2)^2\pi}{144}\left(1096.2\sqrt{\frac{.80}{1.325(30.00/313.100+460)}}\right)$$

CFM =2358.37

Equation 5 (Corrected Performance Factor)

$$PF1 = \frac{329.809(313.1 \text{ deg F} + 460)}{2358.37 \text{ CFM}}$$

PF1 = 108,115

TREATED:

Equation 1 (Volume Fractions)

VFHC = 14.6/1,000,000
= 0.0000146

VFCO = .013/100
= 0.00013

$VFCO_2$ = 1.826/100
= 0.01826

VFO_2 = 17.17/100
= 0.1717

Equation 2 (Molecular Weight)

Mwt2 $= (0.0000146)(86) + (0.00013)(28) + (0.01826)(44) + (0.1717)(32) + [(1-0.0000146-0.00013-0.01826-0.1717)(28)]$

Mwt2 $= 28.980$

Equation 3 (Calculated Performance Factor)

$$pf2 = \frac{3099.6 \times 28.980}{86(0.0000146)+13.89(0.00013)+13.89(0.01826)}$$

pf2 $= 349{,}927$

Equation 4 (CFM Calculations)

$$CFM = \frac{(d/2)^2 \pi}{144}\left(1096.2\sqrt{\frac{Pv}{1.325(PB/ET+460)}}\right)$$

d =Exhaust stack diameter in inches

Pv =Velocity pressure in inches of H_20

P_B =Barometric pressure in inches of mercury

Te =Exhaust temperature ^{O}F

$$CFM = \frac{(10/2)^2 \pi}{144}\left(1096.2\sqrt{\frac{.775}{1.325(29.86/309.02+460)}}\right)$$

CFM $= 2320.51$

Equation 5 (Corrected Performance Factor)

$$PF2 = \frac{349.927(309.02 \text{ deg F} + 460)}{2320.51 \text{ CFM}}$$

$= 115{,}966$

Fuel Specific Gravity Correction Factor

Baseline Fuel Specific Gravity - Treated Fuel Specific Gravity/Baseline Fuel Specific Gravity +1

.840-.837/.840+1=1.0036

PF2 = 115,966 x Specific Gravity Correction

PF2 = 115,966 x 1.0036

PF2 = 116,384

Equation 6 (Percent Change in Engine Performance Factor:)

$$\% \text{ Change PF} = \frac{PF2 - PF1}{PF1} \times 100$$

% Change PF = [(116,384 - 108,115)/108,115](100)

= +7.65

Note: A positive change in PF equates to a reduction in fuel consumption.

APPENDIX 2

Company Name:	Interlink	*Location*	England	*Date:*	7/19/95
Test Portion:	Baseline	*Stack Diam.*	6 Inches		
Engine Type:	1834	*Mile/Hrs*	181997		
Equipment Type:	Mer	*ID #:*	1112	*Baro*	30.10
Fuel Sp. Gravity(SG	.825	*Temp:*	80		
				Time:	11:22

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	375.8	3.8	0.02	8	2.42	17.4	
2000	378.6		0.01	8	2.43	17.4	
2000	381.7	3.8	0.01	6	2.43	17.4	
2000	383		0.02	7	2.45	17.3	
2000	383.4		0.02	9	2.43	17.4	
2000	383.8	3.6	0.02	9	2.38	17.4	
2000	384.2		0.02	8	2.43	17.4	
2000	384.4		0.02	8	2.44	17.4	
2000	**381.863**	**3.733**	**.018**	**7.875**	**2.426**	**17.388**	Mean
0	**3.088**	**.115**	**.005**	**.991**	**.021**	**.035**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw1	pf1	PF1
7.88E-06	0.000175	.024	.174	29.084	265,037	116,835

Company Name:	Interlink	*Location:*	England	*Test Date:*	11/30/95
Test Portion:	Treated	*Stack Diam:*	6 Inches		
Engine Type:	1834	*Mile/Hrs:*	7472		
Equipment Type	Mer	*ID #:*	1112	*Baro:*	30.10
Fuel Sp. Gravity:	.846	*Temp:*			
SG Corr Factor:	.975			*Time:*	10:10am

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	371	3.5	0.02	9	2.38	17.3	
2000	368	3.5	0.01	9	2.38	17.2	
2000	368	3.5	0.02	7	2.38	17.2	
2000	372	3.4	0.02	6	2.39	17.2	
2000	368		0.03	10	2.37	17.2	
2000	372.8	3.4	0.03	9	2.34	17.2	
2000.000	**369.967**	**3.460**	**.022**	**8.333**	**2.373**	**17.217**	Mean
0	**2.229**	**.055**	**.008**	**1.506**	**.018**	**.041**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw2	pf2	PF2
8.33E-06	0.000216667	.024	.172	29.069	270,246	122,869

Performance factor adjusted for fuel density: 119,742

****% Change PF= 2.49 %**

***** A positive change in PF equates to a reduction in fuel consumption.***

Company Name:	Interlink	*Location:*	England	*Date:*	7/19/95
Test Portion:	Baseline	*Stack Diam.*	6 Inches		
Engine Type:	1834 Mer	*Mile/Hrs*	244594		
Equipment Type:	Long haul	*ID #:*	1110	*Baro*	30.10
Fuel Sp. Gravity(SG	.830	*Temp:*	80		
				Time:	10:25

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	355	2.8		6	2.42	17.4	
2000	363	2.8	0.01	9	2.41	17.4	
2000	361.4		0.01	9	2.37	17.4	
2000	363.6	2.8	0.02	10	2.33	17.4	
2000	367.6		0.02	9	2.34	17.4	
2000	371.6	2.8	0.02	10	2.32	17.4	
2000	368.8		0.02	10	2.3	17.5	
2000			0.02	10	2.31	17.4	
2000.000	**364.429**	**2.800**	**.017**	**9.125**	**2.350**	**17.413**	Mean
0	**5.498**	**.000**	**.005**	**1.356**	**.045**	**.035**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw1	pf1	PF1
9.13E-06	0.000171429	.024	.174	29.073	273,400	137,717

Company Name:	Interlink	*Location:*	England	*Test Date:*	11/30/95
Test Portion:	Treated	*Stack Diam:*	6 Inches		
Engine Type:	1834 Mer	*Mile/Hrs:*	276540		
Equipment Type	Long haul	*ID #:*	1110	*Baro:*	30.10
Fuel Sp. Gravity:	.852	*Temp:*			
SG Corr Factor:	.973			*Time:*	11:55am

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	352	3.4	0.02	9	2.24	17.4	
2000	352.6		0.02	9	2.23	17.4	
2000	352.6	3.4	0.02	10	2.24	17.4	
2000	353		0.03	10	2.23	17.4	
2000	354.4	3.4	0.03	10	2.22	17.4	
2000	352.8		0.03	10	2.2	17.4	
2000	353.2		0.02	10	2.22	17.5	
2000	352.8		0.02	10	2.19	17.5	
2000.000	**352.925**	**3.400**	**.024**	**9.750**	**2.221**	**17.425**	Mean
0	**.692**	**.000**	**.005**	**.463**	**.018**	**.046**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw2	pf2	PF2
9.75E-06	0.0002375	.022	.174	29.053	287,986	130,722

Performance factor adjusted for fuel density: 127,257

****% Change PF= -7.60 %**

*** A positive change in PF equates to a reduction in fuel consumption.*

Company Name:	Interlink	*Location:*	England	*Date:*	7/19/95
Test Portion:	Baseline	*Stack Diam.*	6 Inches		
Engine Type:	1820	*Mile/Hrs*	172905		
Equipment Type:	Mer	*ID #:*	3080	*Baro*	30.10
Fuel Sp. Gravity(SG	.830	*Temp:*	80	*Time:*	10:45

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	305.2	1.2	0.03	17	1.82	18.2	
2000	306.4		0.03	17	1.79	18.2	
2000	308.8	1.2	0.03	18	1.75	18.2	
2000	310		0.04	19	1.75	18.2	
2000	311.2	1.2	0.03	18	1.76	18.2	
2000	312.4		0.03	19	1.77	18	
2000	312.8	1.2	0.03	18	1.75	18.2	
2000	313.2		0.03	17	1.77	18.1	
2000	313.6	1.2	0.03	18	1.77	18.2	
2000	314.6		0.02	18	1.76	18.2	
2000.000	**310.820**	**1.200**	**.030**	**17.900**	**1.769**	**18.170**	Mean
0	**3.164**	**.000**	**.005**	**.738**	**.022**	**.067**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw1	pf1	PF1
1.79E-05	0.0003	.018	.182	29.011	357,580	266,042

Company Name:	Interlink	*Location:*	England	*Test Date:*	11/30/95
Test Portion:	Treated	*Stack Diam:*	6 Inches		
Engine Type:	1820	*Mile/Hrs:*	267987		
Equipment Type	Mer	*ID #:*	3080	*Baro:*	30.10
Fuel Sp. Gravity:	.848	*Temp:*			
SG Corr Factor:	.978			*Time:*	12:50pm

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	296.6	1	0.05	12	1.68	18	
2000	297.6		0.04	13	1.67	18	
2000	299	1.1	0.04	12	1.66	18.1	
2000	300		0.04	13	1.67	18	
2000	302	1	0.04	13	1.66	18.2	
2000	299.8		0.04	12	1.65	18.2	
2000	302.4	1	0.04	12	1.66	18.1	
2000	302		0.04	12	1.66	18.1	
2000.000	**299.925**	**1.025**	**.041**	**12.375**	**1.664**	**18.088**	Mean
0	**2.141**	**.050**	**.004**	**.518**	**.009**	**.083**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw2	pf2	PF2
1.24E-05	0.0004125	.017	.181	28.990	377,675	301,879

Performance factor adjusted for fuel density: 295,333

****% Change PF= 11.01 %**

***** A positive change in PF equates to a reduction in fuel consumption.***

Company Name:	Interlink	*Location:*	England		*Date:*	7/19/95
Test Portion:	Baseline	*Stack Diam.*	6	Inches		
Engine Type:	1820	*Mile/Hrs*	73935			
Equipment Type:	Mer	*ID #:*	3084		*Baro*	30.10
Fuel Sp. Gravity(SG	.830	*Temp:*	80			
					Time:	10:30

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	329.4	1.2	0.03	17	1.86	18.2	
2000	330		0.03	17	1.85	18.1	
2000	331	1.2	0.03	18	1.85	18.1	
2000	331.1		0.03	18	1.85	18.1	
2000	331.6	1.2	0.03	17	1.86	18.1	
2000	332		0.04	18	1.86	18.1	
2000	332.2	1.2	0.03	17	1.86	18.1	
2000	332.4		0.03	17	1.86	18.1	
2000.000	**331.213**	**1.200**	**.031**	**17.375**	**1.856**	**18.113**	Mean
0	**1.067**	**.000**	**.004**	**.518**	**.005**	**.035**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw1	pf1	PF1
1.74E-05	0.0003125	.019	.181	29.023	341,112	257,125

Company Name:	Interlink	*Location:*	England		*Test Date:*	11/30/95
Test Portion:	Treated	*Stack Diam:*	6	Inches		
Engine Type:	1820	*Mile/Hrs:*	125599			
Equipment Type	Mer	*ID #:*	3084		*Baro:*	30.10
Fuel Sp. Gravity:	.850	*Temp:*				
SG Corr Factor:	.976				*Time:*	10:55am

RPM	Exh Temp	Pv Inch	CO	HC	CO2	O2	
2000	312	1	0.04	14	1.84	17.8	
2000	310		0.04	15	1.84	17.8	
2000	310.6	1.1	0.06	15	1.83	18	
2000	312		0.05	14	1.83	18	
2000	312	1.1	0.05	15	1.82	18	
2000	310		0.05	17	1.81	18	
2000	311.4	1.1	0.05	17	1.81	18	
2000.000	**311.143**	**1.075**	**.049**	**15.286**	**1.826**	**17.943**	Mean
0	**.929**	**.050**	**.007**	**1.254**	**.013**	**.098**	Std Dev

VFHC	VFCO	VFCO2	VFO2	Mtw2	pf2	PF2
1.53E-05	0.000485714	.018	.179	29.011	343,607	270,158

Performance factor adjusted for fuel density: 263,648

****% Change PF = 2.54** %

***** A positive change in PF equates to a reduction in fuel consumption.***