Beilage . /11

Mahle Powertrain Ltd
Testing Facility

Costin House
St James Mill Road
Northampton
NN5 5TZ

ECE and FTP Emission Testing Report

Vehicle Code: NAYA 03

Renault Modus NU54 DYY

Customer: ████████████

Customer Contact: ████████████

Project Number:

Testing Date Started: 7th February 2011

Testing Date Completed: 18th March 2011

(Revised Document 30th November 2012
to include ASTME178 Data)

████████████

Signed by....TColcGan....................................

Signed by....Gixxxnurng....................................

MAHLE
Powertrain

CO Results

Baseline
FTP - Cold Starts
Outlier Check (for 3 Samples)

			p value*		
	Result	T Statistic	0.05	0.1	
1st Cold Start	0.36	0.9911	Ok	Ok	min diff
2nd Cold Start	0.51	1.0087	Ok	Ok	0.075333
3rd Cold Start	0.43	-0.0175	Ok	Ok	max diff
Mean =	0.4333	COV = ↓	% Change from Base		
Stdev =	0.0760	17.54049	0		

Cold CO Start Data — Baseline (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
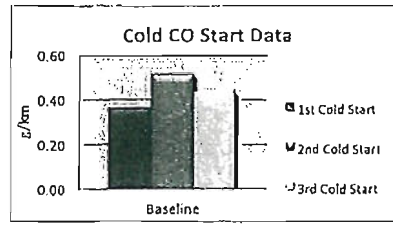
FTP - Cold Starts
Outlier Check (for 3 Samples)

			p value*		
	Result	T Statistic	0.05	0.1	
1st Cold Start	0.17	-0.7259	Ok	Ok	min diff
2nd Cold Start	0.18	-0.4148	Ok	Ok	0.009333
3rd Cold Start	0.20	1.1406	Ok	Ok	max diff
Mean =	0.1803	COV = ↓	% Change from Base		
Stdev =	0.0129	7.130241	-58.98461538		

Cold CO Start Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
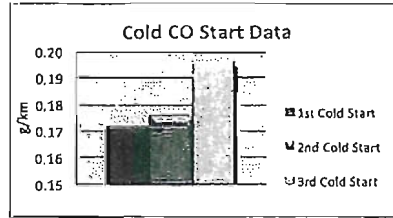
FTP - Cold Starts
Outlier Check (for 3 Samples)

			p value*		
	Result	T Statistic	0.05	0.1	
1st Cold Start	0.22	0.9309	Ok	Ok	min diff
2nd Cold Start	0.21	0.1262	Ok	Ok	0.022333
3rd Cold Start	0.18	-1.0571	Ok	Ok	max diff
Mean =	0.2033	COV = ↓	% Change from Base		
Stdev =	0.0211	10.39013	-53.07692308		

Cold CO Start Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
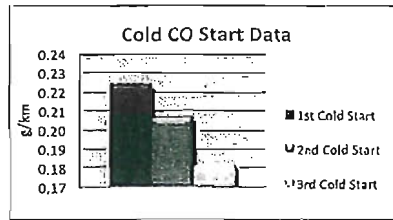
FTP - Cold Starts
Outlier Check (for 3 Samples)

			p value*		
	Result	T Statistic	0.05	0.1	
1st Cold Start	0.28	0.0267	Ok	Ok	min diff
2nd Cold Start	0.33	0.9864	Ok	Ok	0.050667
3rd Cold Start	0.23	-1.0131	Ok	Ok	max diff
Mean =	0.2797	COV = ↓	% Change from Base		
Stdev =	0.0500	17.88319	-35.46153846		

Cold CO Start Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
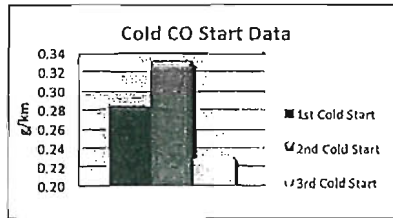
FTP - Cold Starts
Outlier Check (for 3 Samples)

			p value*		
	Result	T Statistic	0.05	0.1	
1st Cold Start	0.35	1.1464	Ok	Ok	min diff
2nd Cold Start	0.31	-0.4532	Ok	Ok	0.017333
3rd Cold Start	0.31	-0.6931	Ok	Ok	max diff
Mean =	0.3253	COV = ↓	% Change from Base		
Stdev =	0.0250	7.686475	-24.92307692		
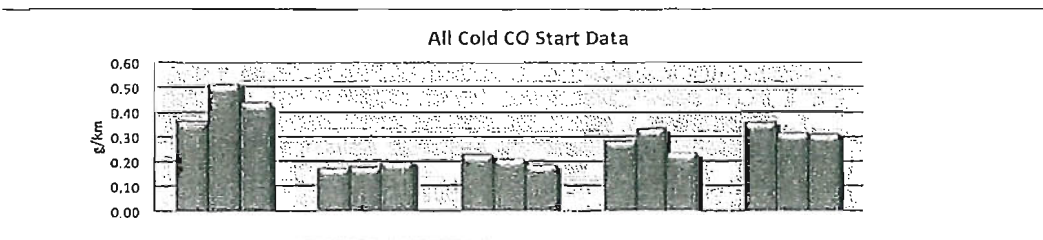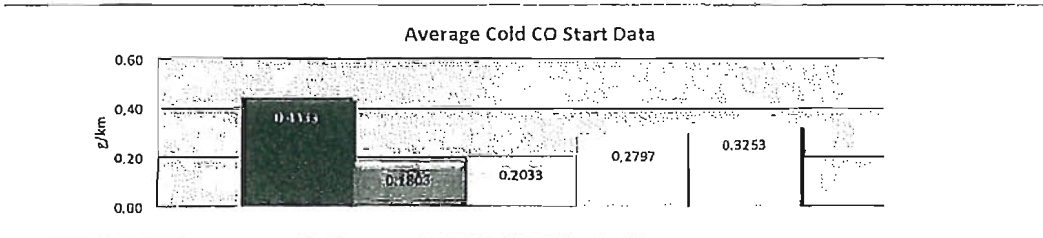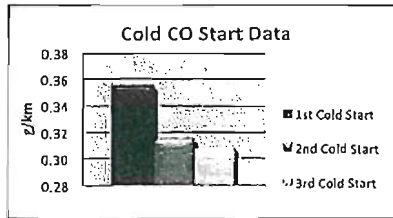
Cold CO Start Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)

Average Cold CO Start Data (0.4333, 0.1803, 0.2033, 0.2797, 0.3253)

All Cold CO Start Data

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CO_2 Results

Baseline
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p.value 0.05	0.1	
1st Cold Start	219.23	1.1323	OK	OK	min diff
2nd Cold Start	217.22	0.3702	OK	OK	1.019
3rd Cold Start	216.69	0.7621	OK	OK	max diff
Mean	217.7130	COV=↓	%Change from Base		
Stdev	1.3374	0.614149	0		
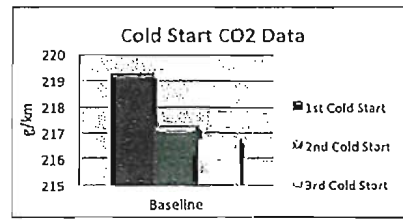
Cold Start CO_2 Data — Baseline

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p.value 0.05	0.1	
1st Cold Start	216.04	1.1985	OK	OK	min diff
2nd Cold Start	214.01	0.3023	OK	OK	0.970333
3rd Cold Start	213.57	0.7362	OK	OK	max diff
Mean	214.5403	COV=↓	%Change from Base		
Stdev	1.3181	0.614386	1.45727		
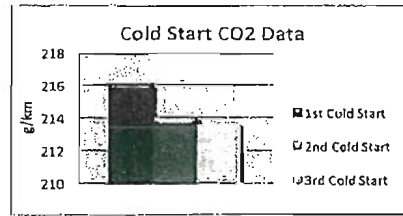
Cold Start CO_2 Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p.value 0.05	0.1	
1st Cold Start	213.28	0.9372	OK	OK	min diff
2nd Cold Start	214.64	0.3156	OK	OK	1.551333
3rd Cold Start	216.57	1.0528	OK	OK	max diff
Mean	214.8263	COV=↓	%Change from Base		
Stdev	1.6553	0.770596	1.3259		
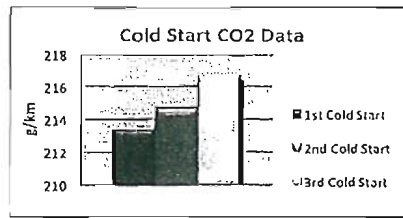
Cold Start CO_2 Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p.value 0.05	0.1	
1st Cold Start	212.92	1.0531	OK	OK	min diff
2nd Cold Start	212.00	0.1164	OK	OK	0.743333
3rd Cold Start	211.35	0.9367	OK	OK	max diff
Mean	212.0883	COV=↓	%Change from Base		
Stdev	0.7935	0.374155	2.58352		
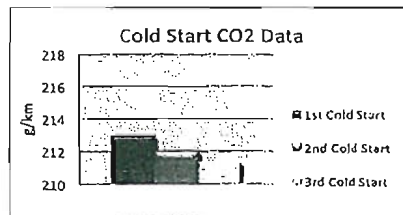
Cold Start CO_2 Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p.value 0.05	0.1	
1st Cold Start	211.48	0.1053	OK	OK	min diff
2nd Cold Start	212.71	1.0485	OK	OK	1.008667
3rd Cold Start	210.58	0.9432	OK	OK	max diff
Mean	211.5907	COV=↓	%Change from Base		
Stdev	1.0695	0.505438	2.81211		
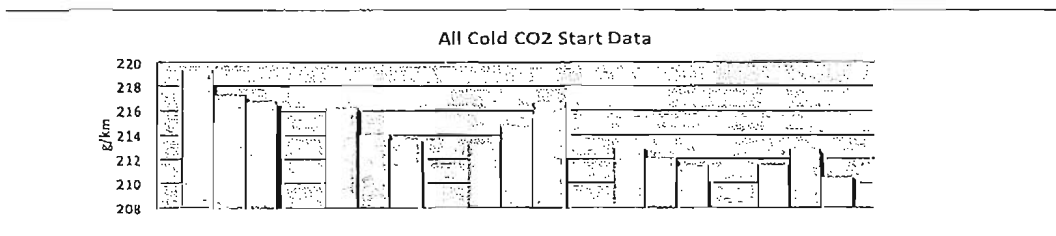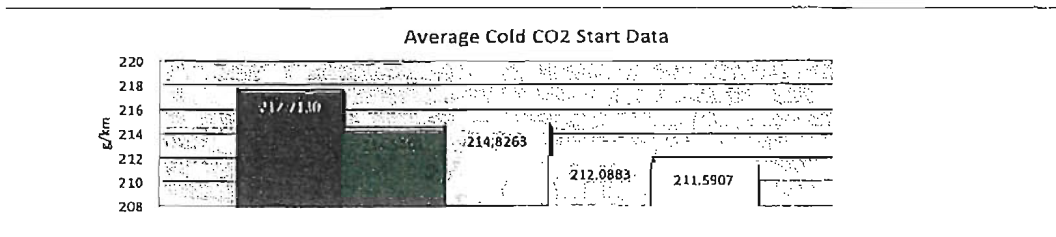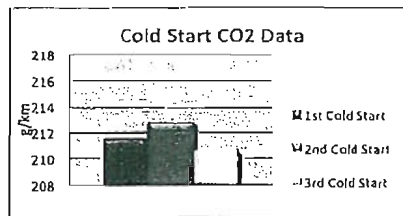
Cold Start CO_2 Data

Average Cold CO_2 Start Data — 217.7130, 214.8263, 212.0883, 211.5907

All Cold CO_2 Start Data

T.HC Results

Baseline
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.01	
1st Cold Start	0.040	0.7259	Ok	Ok	min diff
2nd Cold Start	0.041	0.4148	Ok	Ok	0.002333
3rd Cold Start	0.046	1.1406	Ok	Ok	max diff
Mean =	0.0423	COV =	% Change from Base		
Stdev =	0.0032	7.593426	0		

Cold Start T.HC Data
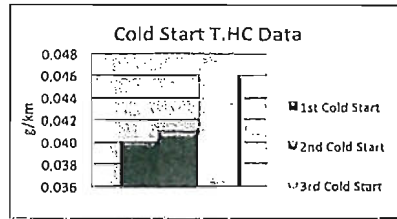
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.01	
1st Cold Start	0.027	0.0000	Ok	Ok	min diff
2nd Cold Start	0.026	1.0000	Ok	Ok	0.001
3rd Cold Start	0.028	1.0000	Ok	Ok	max diff
Mean =	0.0270	COV =	% Change from Base		
Stdev =	0.0010	3.703704	36.22055		

Cold Start T.HC Data
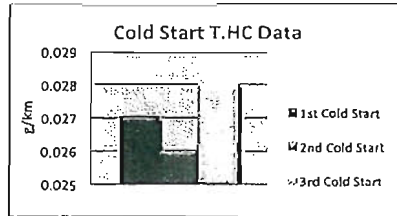
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.01	
1st Cold Start	0.031	0.5774	Ok	Ok	min diff
2nd Cold Start	0.031	0.5774	Ok	Ok	0.001333
3rd Cold Start	0.029	1.1547	Ok	Ok	max diff
Mean =	0.0303	COV =	% Change from Base		
Stdev =	0.0012	3.806705	28.3465		

Cold Start T.HC Data
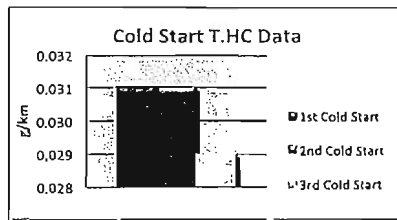
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.01	
1st Cold Start	0.029	1.1547	Ok	Ok	min diff
2nd Cold Start	0.028	0.5774	Ok	Ok	0.000333
3rd Cold Start	0.028	0.5774	Ok	Ok	max diff
Mean =	0.0283	COV =	% Change from Base		
Stdev =	0.0006	2.037707	33.07093		

Cold Start T.HC Data
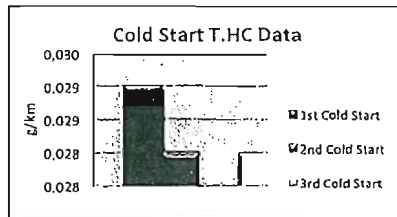
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.01	
1st Cold Start	0.034	1.0911	Ok	Ok	min diff
2nd Cold Start	0.032	0.2182	Ok	Ok	0.001333
3rd Cold Start	0.031	0.8729	Ok	Ok	max diff
Mean =	0.0323	COV =	% Change from Base		
Stdev =	0.0015	4.724305	23.622		
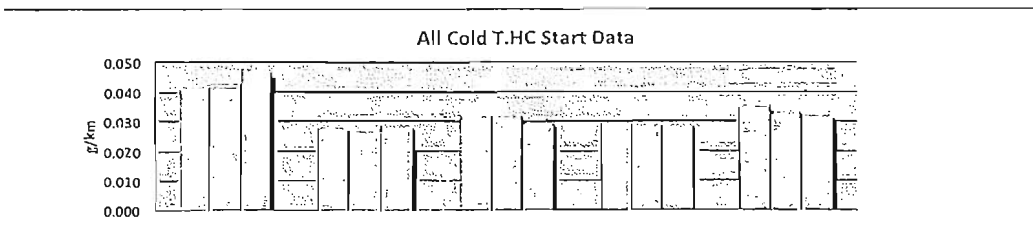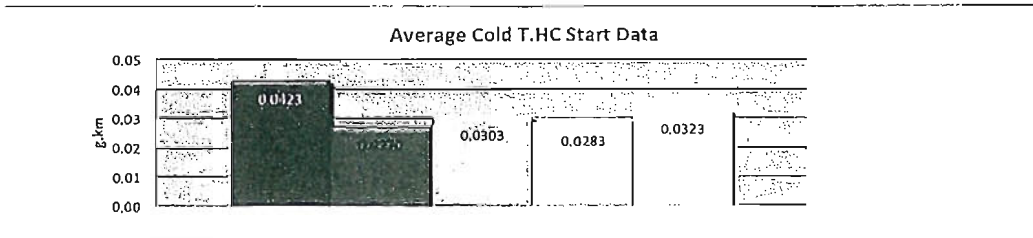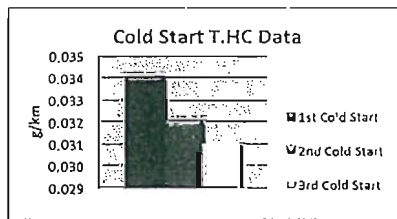
Cold Start T.HC Data

Average Cold T.HC Start Data

All Cold T.HC Start Data

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NOx Results

Baseline
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value* 0.05	0.1	
1st Cold Start	0.730	0.5505	Ok	Ok	min diff
2nd Cold Start	0.698	-1.1543	Ok	Ok	0.021667
3rd Cold Start	0.731	0.6038	Ok	Ok	max diff
Mean	0.7197	COV ↓	% Change from Base		
Stdev	0.0188	2.608228	0		
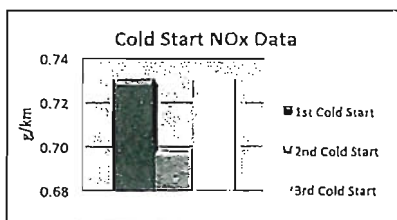
Cold Start NOx Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value* 0.05	0.1	
1st Cold Start	0.560	0.5774	Ok	Ok	min diff
2nd Cold Start	0.560	0.5774	Ok	Ok	0.005333
3rd Cold Start	0.552	-1.1547	Ok	Ok	max diff
Mean	0.5573	COV ↓	% Change from Base		
Stdev	0.0046	0.828732	-22.5567		
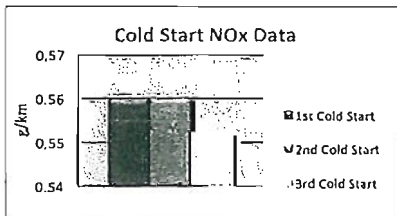
Cold Start NOx Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value* 0.05	0.1	
1st Cold Start	0.536	-0.0230	Ok	Ok	min diff
2nd Cold Start	0.551	1.0113	Ok	Ok	0.014333
3rd Cold Start	0.522	-0.9883	Ok	Ok	max diff
Mean	0.5363	COV ↓	% Change from Base		
Stdev	0.0145	2.704078	-25.4748		
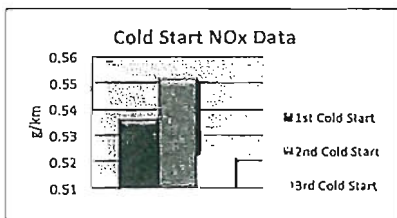
Cold Start NOx Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value* 0.05	0.1	
1st Cold Start	0.542	0.8836	Ok	Ok	min diff
2nd Cold Start	0.516	-1.0856	Ok	Ok	0.014333
3rd Cold Start	0.533	0.2020	Ok	Ok	max diff
Mean	0.5303	COV ↓	% Change from Base		
Stdev	0.0132	2.489667	-26.3085		
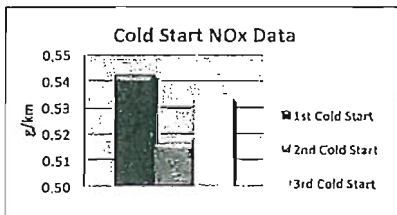
Cold Start NOx Data

FTP - Cold Starts
Outlier Check (for 3 Samples)

	0	T Statistic	p value* 0.05	0.1	
1st Cold Start	0.545	1.1209	Ok	Ok	min diff
2nd Cold Start	0.537	-0.8006	Ok	Ok	0.003333
3rd Cold Start	0.539	-0.3203	Ok	Ok	max diff
Mean	0.5403	COV ↓	% Change from Base		
Stdev	0.0042	0.770512	-24.9189		

Cold Start NOx Data

Average Cold NOx Start Data

All Cold NOx Start Data
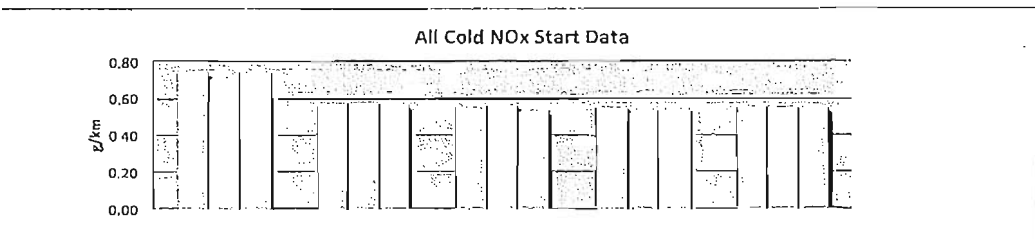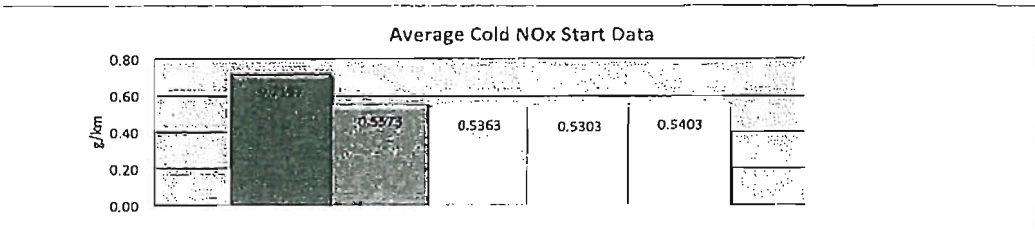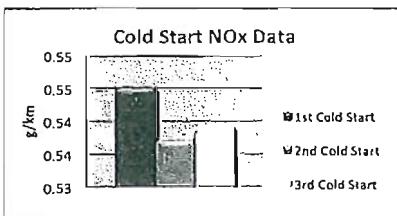
From: Simader Günter <Guenter.Simader@energyagency.at>
Sent: Monday, 1 February 2016 17:22
To: Fenzl, Elisa
Subject: AW: Energy saving measure

Dear Elisa,

Yes, I can confirm that the Energy Efficiecy Act and § 27 regulation (including appendices) does not specify any particular testing method for the 'Reinigungs- und Reinhalteadditive für Dieselkraftstoffe'-method!

Best greetings from Vienna

Günter Simader

DI Dr. Günter R. Simader

Leitung: Nationale Energieeffizienz Monitoringstelle

Leitung: Center Gebäude

ÖSTERREICHISCHE ENERGIEAGENTUR

AUSTRIAN ENERGY AGENCY

Mariahilfer Straße 136 | 1150 Vienna | Austria

T. +43-1-586 15 24-124 | Fax +43-1-586 15 24-340

guenter.simader@energyagency.at | www.energyagency.at

Dear Gunter

I hope you are well.

The deadline for the implementation of the energy saving measure is approaching and I am sure you are busy!

We are working with our customers to comply on time and I would need your help on the following question, as we have been asked for it by some of our customers:

Can you confirm that the legislation does not specify any particular testing method, therefore a "real world" method is also acceptable as long as we provide the necessary documents ?

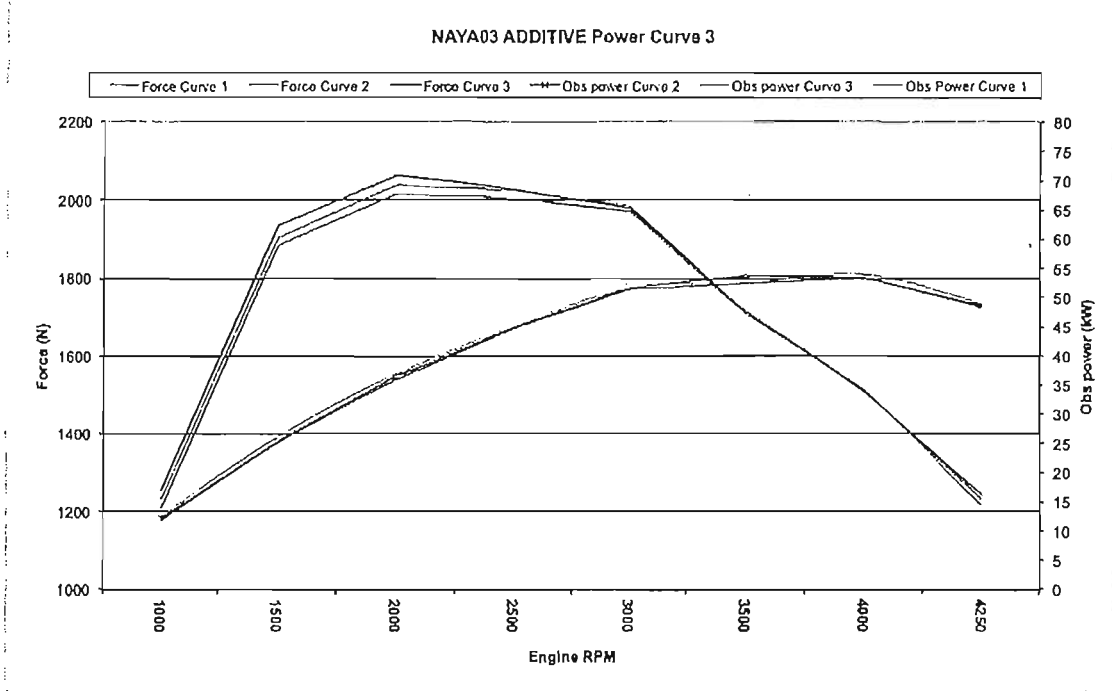Many thanks for your understanding

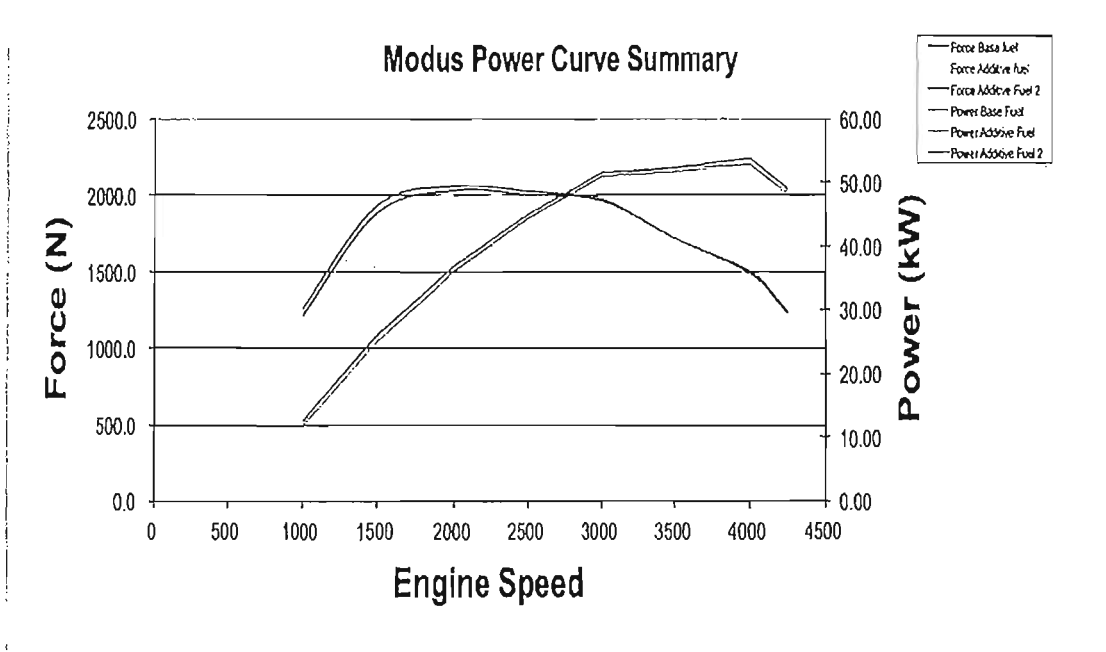Regards

Elisa fenzi

Afton Chemical

Tel: 00447595075743

Power Curve 3 Additive Fuel (End of Project)

NAYA03 ADDITIVE Power Curve 3

Power Curve before and after project comparison

Modus Power Curve Summary

Appendix 2: Base Fuel Certificate Analysis

PETROCHEM CARLESS

Certificate of Analysis

Lot : 10005788
Batch : 10/282

Petrochem Carless UVBA
Onehukkaai 2–8Bus 26
2000 Antwerp
Belgium

Telephone +323 2069379
Fax 323 2203120

Customer Name	Mahle
Customer No	057000
Ship To Name	
Delivery Address	St James Mill Road
	Northampton
	NN5 1JH
PCL Order Reference	
Customer Reference	MANUCATION AGR
Customer Item Code	
Customer Description	

Product Name	
Product Number	47054
Quantity	
Certificate No	2000R663
Certificate Date	04/02/2011
Approval Date	
Approved By:	
Checked by	Silva I Calvar
Approval Status	
Spec No	47084

Method	Description	MIN	Max	Result	Unit
ASTM D4052	Density at 15°C	0.830	0.837	0.8357	g/mL
ASTM D86	I B Pt			191.0	°C
ASTM D86	10 % Recovered at			215.0	°C
ASTM D86	50 % Recovered at	245		275.0	°C
ASTM D86	90 % Recovered at			320.0	°C
ASTM D86	95 % Recovered at	345	300	345.0	°C
ASTM D86	F B Pt		370	362.0	°C
ASTM D613	Cetane Number	52	54	53.4	Unit
ASTM D1319	Aromatics			30.7	% vol
ASTM D1319	Olefins			13.6	% vol
ASTM D93	Flash Point, Pensky Closed	55		82	°C
IP 391	Polycyclic Aromatic Hydrocarbons (PCA)	3.0	5.0	3.7	% mass
ASTM D2500	Cloud Point			-22	°C
ASTM D974	Strong Acid Number		0.02	0	mg KOH/g
ASTM D2274	Oxidation Stability		2.5	0.7	mg/100ml
IP 12	Gross Heat of Combustion			45.76	MJ/kg
ASTM D130	Copper Corrosion, 3hrs at 100°C			1A	
ASTM D445	Viscosity at 40°C	2.3	3.3	2.65	mm²/s
ASTM D5453	Sulphur		10	<10	mg/kg
ISO 12156	Lubricity WSD 1.4 at 60°C		400	304	μm
ASTM D4530	Carbon Residue (on 10% Dist. Res)		0.2	0.01	% m/m
ASTM D482	Ash		0.01	<0.001	% mass
EN 116	Cold Filter Plug Pt		5	22	°C
IP 391	Aromatics Total			28.4	% m/m
ASTM D2709	Water & Sediment			0	% vol
IP 438	Water Content		200	70	mg/kg
EN 14078	Fatty Acid Methyl Ester (FAME) Content			NONE	% v/v
IP 12	Net Caloric Value			42.92	MJ/kg
IP 12 / CALCULATION	Net Caloric Value			18452	Btu/lb
ELEMENTAL ANALYSIS	Oxygen Content			<0.04	%
ASTM D5291	Carbon Content			86.60	% mass
ASTM D5291	Hydrogen Content			13.40	% mass
CALCULATION	Atomic H/C Ratio			1.84	Ratio
CALCULATION	Atomic O/C Ratio			<0.0003	Ratio

Printed 04/02/2011

Page 1

This certificate is generated electronically and is therefore valid without a signature

14

The information below shows the ▓▓▓▓▓▓▓ data for this vehicle.

Fuel Economy Results

Baseline
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	min diff
1st Cold Start	55.8069	-0.4586	Ok	Ok	0.12640
2nd Cold Start	55.7647	-0.6884	Ok	Ok	max diff
3rd Cold Start	56.1017	1.1470	Ok	Ok	0.21060
Mean =	55.8911	COV = ↓	% Change from Base		
Stdev =	0.1836	0.328498	0		

Cold Start FE Data — Baseline (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
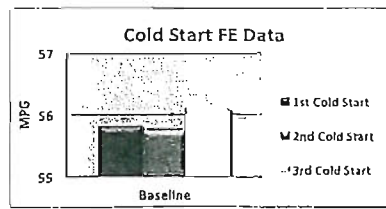
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	min diff
1st Cold Start	56.0700	-1.1224	Ok	Ok	0.28667
2nd Cold Start	56.4400	0.3263	Ok	Ok	max diff
3rd Cold Start	56.5600	0.7961	Ok	Ok	0.20333
Mean =	56.3567	COV = ↓	% Change from Base		
Stdev =	0.2554	0.4532	0.832989		

Cold Start FE Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
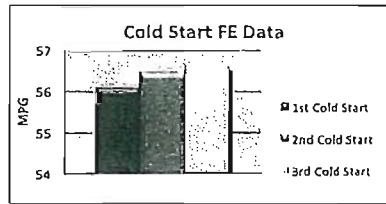
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	min diff
1st Cold Start	56.7121	-1.1081	Ok	Ok	0.02560
2nd Cold Start	56.7570	0.8354	Ok	Ok	max diff
3rd Cold Start	56.7440	0.2727	Ok	Ok	0.01930
Mean =	56.7377	COV = ↓	% Change from Base		
Stdev =	0.0231	0.04072	1.514731		

Cold Start FE Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
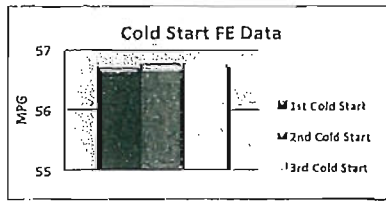
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	min diff
1st Cold Start	56.7250	-0.7443	Ok	Ok	0.09125
2nd Cold Start	56.9210	1.1944	Ok	Ok	max diff
3rd Cold Start	56.7090	-0.9026	Ok	Ok	0.12075
4th Cold Start	56.8460	0.4525	Ok	Ok	
Mean =	56.8003	COV = ↓	% Change from Base		
Stdev =	0.1011	0.17799	1.626645		

Cold Start FE Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start, 4th Cold Start)
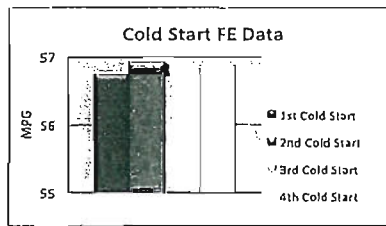
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	min diff
1st Cold Start	57.5079	0.5383	Ok	Ok	0.31230
2nd Cold Start	57.5288	0.6155	Ok	Ok	max diff
3rd Cold Start	57.0499	-1.1538	Ok	Ok	0.16660
Mean =	57.3622	COV = ↓	% Change from Base		
Stdev =	0.2707	0.471847	2.632083		
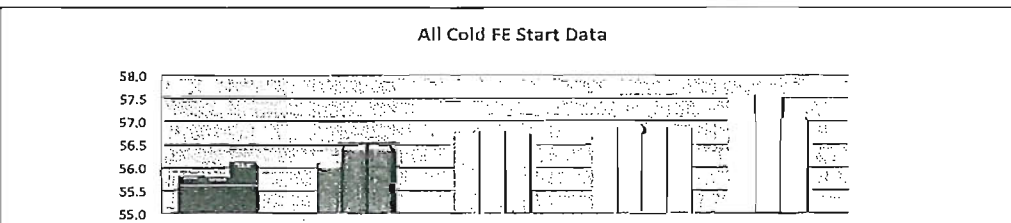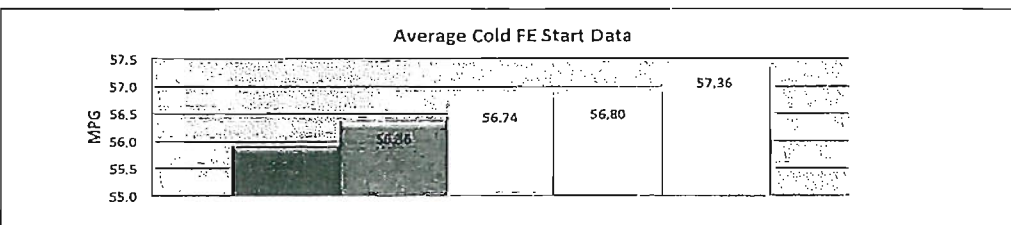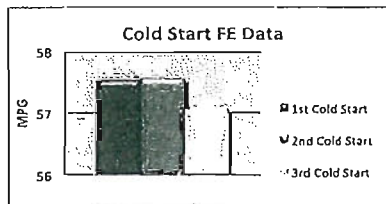
Cold Start FE Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)

Average Cold FE Start Data — 56.74, 56.80, 57.36

All Cold FE Start Data

CO Results

Baseline
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	0.498	-1.1401	Ok	Ok	min diff 0.03600
2nd Cold Start	0.547	0.4117	Ok	Ok	max diff
3rd Cold Start	0.557	0.7284	Ok	Ok	0.02300
Mean =	0.5340	COV = ↓	% Change from Base		
Stdev =	0.0316	5.912979	0		
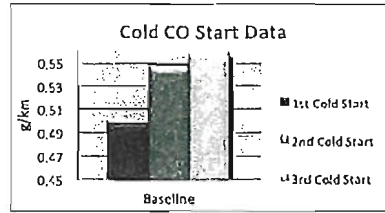
Cold CO Start Data (Baseline) — 1st Cold Start, 2nd Cold Start, 3rd Cold Start

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NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	0.424	-1.1022	Ok	Ok	min diff 0.02033
2nd Cold Start	0.449	0.2530	Ok	Ok	max diff
3rd Cold Start	0.460	0.8492	Ok	Ok	0.01567
Mean =	0.4443	COV = ↓	% Change from Base		
Stdev =	0.0184	4.151866	-16.79151061		
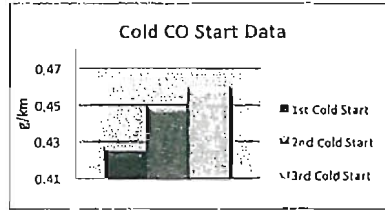
Cold CO Start Data — 1st Cold Start, 2nd Cold Start, 3rd Cold Start

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NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	0.465	0.0949	Ok	Ok	min diff
2nd Cold Start	0.461	-1.0441	Ok	Ok	0.00367
3rd Cold Start	0.468	0.9492	Ok	Ok	max diff
Mean =	0.4647	COV = ↓	% Change from Base		0.00333
Stdev =	0.0035	0.755786	-12.98377029		
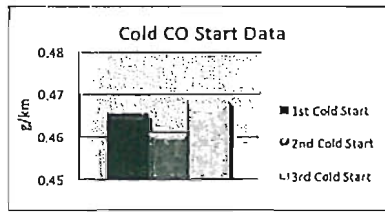
Cold CO Start Data — 1st Cold Start, 2nd Cold Start, 3rd Cold Start

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NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	0.456	0.9690	Ok	Ok	min diff
2nd Cold Start	0.505	1.2654	Ok	Ok	0.02125
3rd Cold Start	0.484	0.3078	Ok	Ok	max diff
4th Cold Start	0.464	-0.6042	Ok	Ok	0.04100
Mean =	0.4773	COV = ↓	% Change from Base		
Stdev =	0.0219	4.595037	-10.62734082		
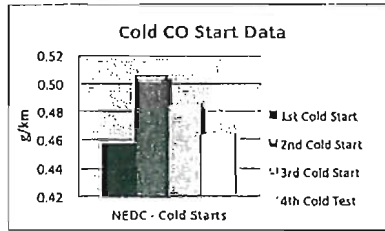
Cold CO Start Data (NEDC - Cold Starts) — 1st Cold Start, 2nd Cold Start, 3rd Cold Start, 4th Cold Test

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NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	0.499	0.0949	Ok	Ok	min diff
2nd Cold Start	0.511	0.9492	Ok	Ok	0.014667
3rd Cold Start	0.483	-1.0441	Ok	Ok	max diff
Mean =	0.4977	COV = ↓	% Change from Base		0.01333
Stdev =	0.0140	2.82268	-6.803995006		
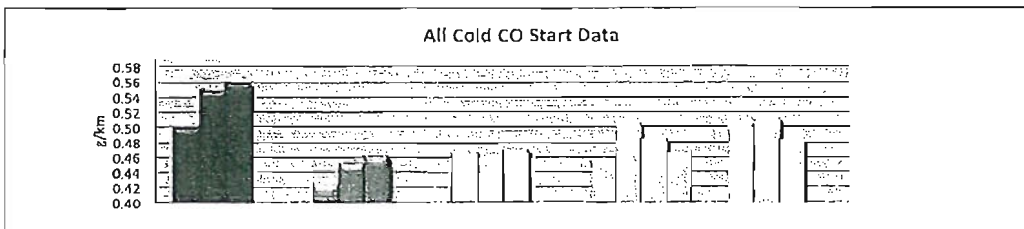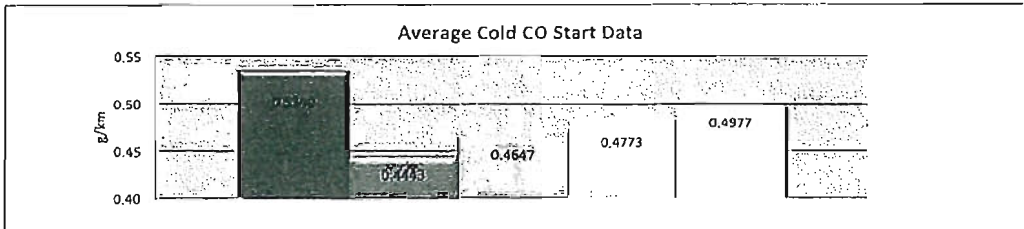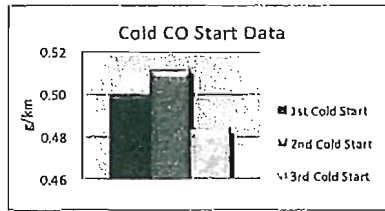
Cold CO Start Data — 1st Cold Start, 2nd Cold Start, 3rd Cold Start

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Average Cold CO Start Data

0.4647, 0.4773, 0.4977

All Cold CO Start Data

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CO2 Results

Baseline
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	133.29	0.5667	Ok	Ok	min diff
2nd Cold Start	133.30	0.5879	Ok	Ok	0.54333
3rd Cold Start	132.48	-1.1546	Ok	Ok	max diff
Mean	133.0233	COV	%change from base		0.276667
Stdev	0.4706	0.353748	0		

Cold Start CO2 Data — Baseline (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
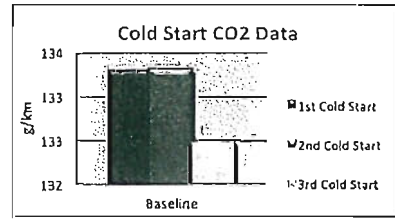
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	132.77	1.1190	Ok	Ok	min diff
2nd Cold Start	131.87	-0.3229	Ok	Ok	0.506667
3rd Cold Start	131.56	-0.8061	Ok	Ok	max diff
Mean	132.0667	COV	%change from base		0.703333
Stdev	0.6285	0.475909	-0.71917		
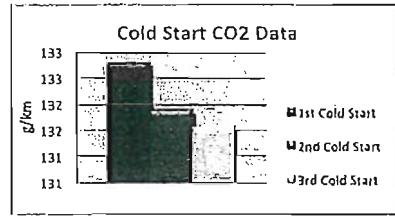
Cold Start CO2 Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)

NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	131.20	1.1488	Ok	Ok	min diff
2nd Cold Start	131.11	-0.6757	Ok	Ok	0.033333
3rd Cold Start	131.12	-0.4730	Ok	Ok	max diff
Mean	131.1433	COV	%change from base		0.056667
Stdev	0.0493	0.037614	-1.418297		

Cold Start CO2 Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)
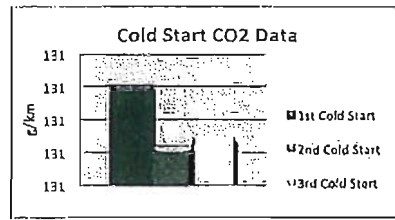
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	131.20	0.8267	Ok	Ok	min diff
2nd Cold Start	130.66	-1.2497	Ok	Ok	0.32500
3rd Cold Start	131.19	0.7883	Ok	Ok	max diff
4th Cold Start	130.89	-0.3653	Ok	Ok	0.21500
Mean	130.9850	COV	%change from base		
Stdev	0.2601	0.198545	-1.53231		
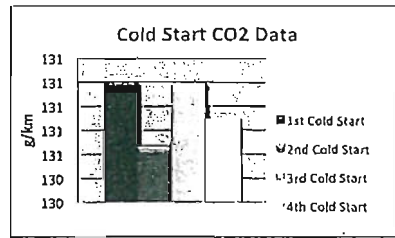
Cold Start CO2 Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start, 4th Cold Start)

NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	129.33	0.5439	Ok	Ok	min diff
2nd Cold Start	129.25	-0.6385	Ok	Ok	0.41000
3rd Cold Start	130.40	1.1575	Ok	Ok	max diff
Mean	129.6600	COV	%change from base		0.74000
Stdev	0.6421	0.495223	-2.5289		

Cold Start CO2 Data (1st Cold Start, 2nd Cold Start, 3rd Cold Start)

Average Cold CO2 Start Data (131.1433, 130.9850, 129.6600)

All Cold CO2 Start Data

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T.HC Results

Baseline
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T-Statistic	p value 0.05	0.1	
1st Cold Start	0.026	1.1547	OK	OK	min diff
2nd Cold Start	0.031	0.5774	OK	OK	0.00333
3rd Cold Start	0.031	0.5774	OK	OK	max diff
Mean =	0.0293	COV = ↓	% Change from Base		0.001667
Stdev =	0.0029	9.841198	0		

Cold Start T.HC Data

NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T-Statistic	p value 0.05	0.1	
1st Cold Start	0.023	0.5774	OK	OK	min diff
2nd Cold Start	0.023	0.5774	OK	OK	0.000333
3rd Cold Start	0.024	1.1547	OK	OK	max diff
Mean =	0.0233	COV = ↓	% Change from Base		0.000667
Stdev =	0.0006	2.474358	20.4545		

Cold Start T.HC Data
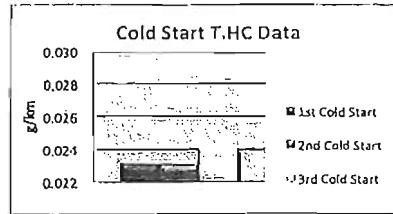
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T-Statistic	p value 0.05	0.1	
1st Cold Start	0.024	0.5774	OK	OK	min diff
2nd Cold Start	0.024	0.5774	OK	OK	0.000667
3rd Cold Start	0.026	1.1547	OK	OK	max diff
Mean =	0.0247	COV = ↓	% Change from Base		0.001333
Stdev =	0.0012	4.681218	15.9091		
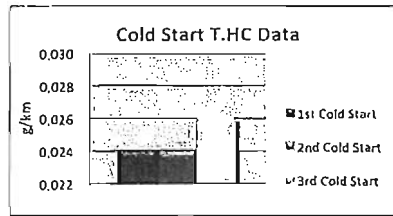
Cold Start T.HC Data

NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T-Statistic	p value 0.05	0.1	
1st Cold Start	0.020	1.3339	OK	OK	min diff
2nd Cold Start	0.023	0.1213	OK	OK	0.00275
3rd Cold Start	0.023	0.1213	OK	OK	max diff
4th Cold Start	0.025	1.0914	OK	OK	0.00225
Mean =	0.0228	COV = ↓	% Change from Base		
Stdev =	0.0021	9.061721	22.4432		
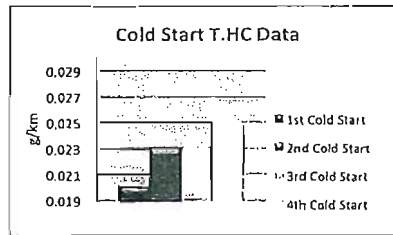
Cold Start T.HC Data

NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T-Statistic	p value 0.05	0.1	
1st Cold Start	0.023	0.5774	OK	OK	min diff
2nd Cold Start	0.025	1.1547	OK	OK	0.000667
3rd Cold Start	0.023	0.5774	OK	OK	max diff
Mean =	0.0237	COV = ↓	% Change from Base		0.001333
Stdev =	0.0012	4.879016	19.3182		
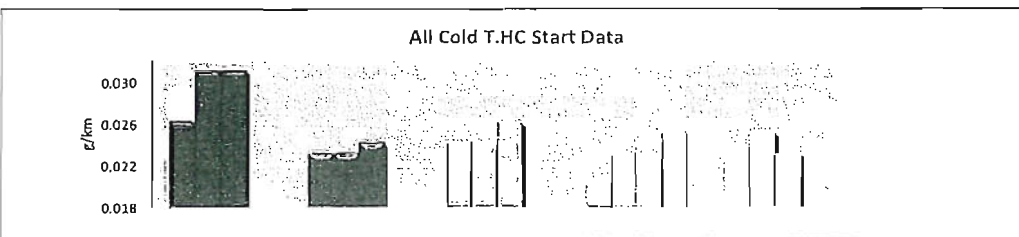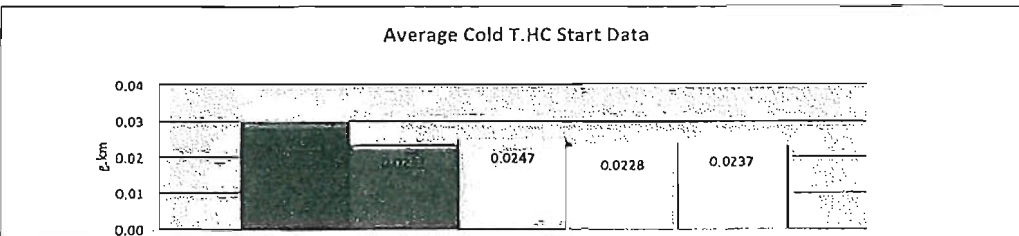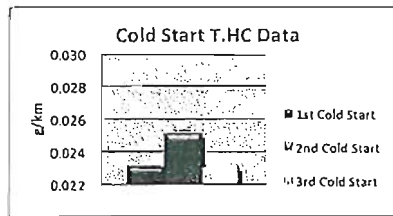
Cold Start T.HC Data

Average Cold T.HC Start Data

All Cold T.HC Start Data

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NOx Results

Baseline
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value* 0.05	0.1	min diff
1st Cold Start	0.535	-1.0739	Ok	Ok	0.01900
2nd Cold Start	0.570	0.9044	Ok	Ok	max diff
3rd Cold Start	0.557	0.1696	Ok	Ok	0.01600
Mean =	0.5540	COV=↓	% Change from Base	0	
Stdev =	0.0177	3.193467	0		

Cold Start NOx Data
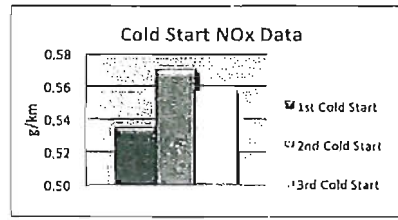
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value* 0.05	0.1	min diff
1st Cold Start	0.475	0.7474	Ok	Ok	0.008333
2nd Cold Start	0.479	0.3886	Ok	Ok	max diff
3rd Cold Start	0.496	1.1360	Ok	Ok	0.012667
Mean =	0.4833	COV=↓	% Change from Base		
Stdev =	0.0112	2.306997	-12.7557		

Cold Start NOx Data
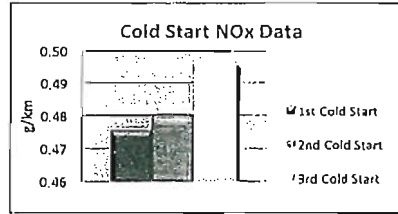
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value* 0.05	0.1	min diff
1st Cold Start	0.453	0.6402	Ok	Ok	
2nd Cold Start	0.452	0.5121	Ok	Ok	0.00900 max diff
3rd Cold Start	0.439	1.1523	Ok	Ok	0.00500
Mean =	0.4480	COV=↓	% Change from Base		
Stdev =	0.0078	1.743359	-19.1336		

Cold Start NOx Data
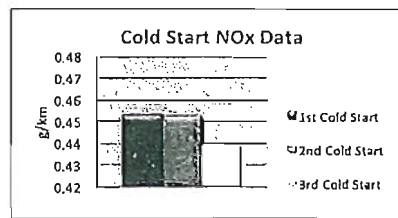
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	Result	T Statistic	p value* 0.05	0.1	min diff
1st Cold Start	0.444	0.0808	Ok	Ok	
2nd Cold Start	0.448	0.5115	Ok	Ok	0.01325 max diff
3rd Cold Start	0.451	0.8345	Ok	Ok	0.00775
4th Cold Start	0.430	1.4267	Ok	Ok	
Mean =	0.4433	COV=↓	% Change from Base		
Stdev =	0.0093	2.095226	-19.991		

Cold Start NOx Data
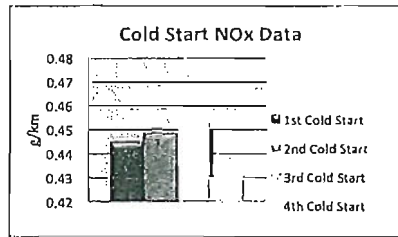
NEDC - Cold Starts
Outlier Check (for 4 Samples)

	0	T Statistic	p value* 0.05	0.1	min diff
1st Cold Start	0.433	-1.1488	Ok	Ok	
2nd Cold Start	0.441	0.4730	Ok	Ok	0.005667 max diff
3rd Cold Start	0.442	0.6757	Ok	Ok	0.00333
Mean =	0.4387	COV=↓	% Change from Base		
Stdev =	0.0049	1.124517	-20.8183		
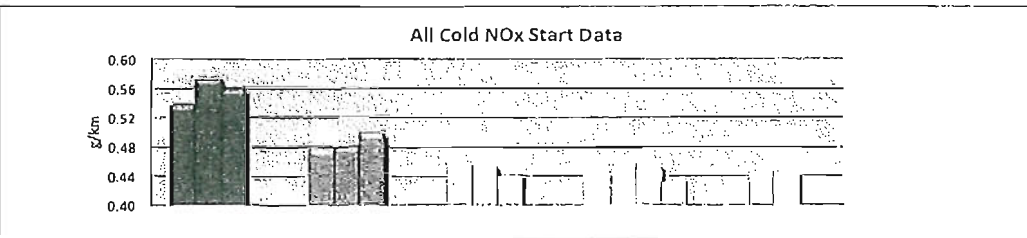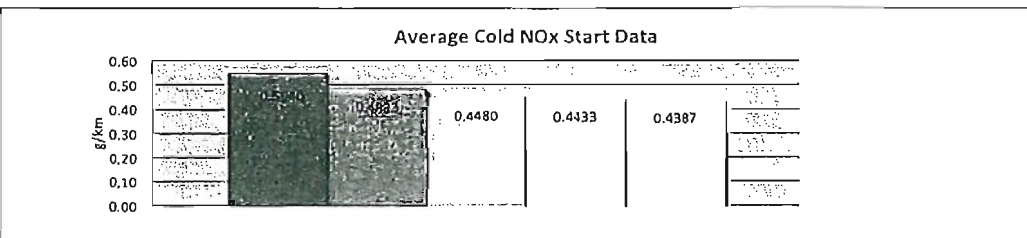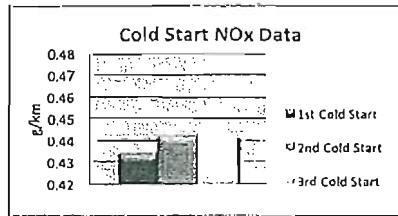
Cold Start NOx Data

Average Cold NOx Start Data

All Cold NOx Start Data

19

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The information below shows the ▓▓▓▓▓▓ data for this vehicle.

Fuel Economy Results

Baseline
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	55.5692	-1.1162	Ok	Ok	min diff
2nd Cold Start	56.0195	0.3022	Ok	Ok	0.354367
3rd Cold Start	56.1820	0.8141	Ok	Ok	max diff
Mean =	55.9236	COV = ↓	% Change from Base		
Stdev =	0.3175	0.567675	0		

Cold Start FE Data — Baseline (1st Cold Start, 2nd Cold Start, 3rd Cold Start)

FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	56.4740	-1.1409	Ok	Ok	min diff
2nd Cold Start	57.0090	0.4162	Ok	Ok	0.392
3rd Cold Start	57.1150	0.7247	Ok	Ok	max diff
Mean =	56.8660	COV = ↓	% Change from Base		
Stdev =	0.3436	0.604217	1.685217		

Cold Start FE Data
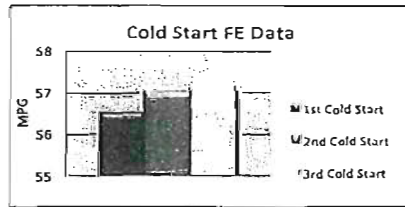
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	57.1794	0.9407	Ok	Ok	min diff
2nd Cold Start	56.8250	0.1096	Ok	Ok	0.447867
3rd Cold Start	56.3304	-1.0503	Ok	Ok	max diff
Mean =	56.7783	COV = ↓	% Change from Base		
Stdev =	0.4264	0.751036	1.528336		

Cold Start FE Data
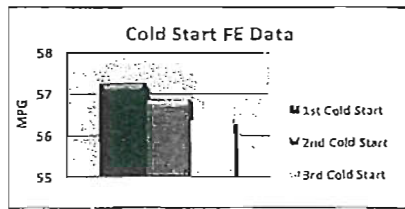
FTP - Cold Starts
Outlier Check (for 3 Samples)

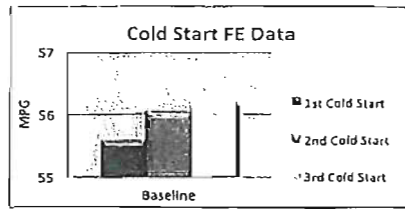|	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	57.2513	-1.0074	Ok	Ok	min diff
2nd Cold Start	57.4811	0.0150	Ok	Ok	0.226433
3rd Cold Start	57.7008	0.9924	Ok	Ok	max diff
Mean =	57.4777	COV = ↓	% Change from Base		
Stdev =	0.2248	0.391054	2.779091		

Cold Start FE Data
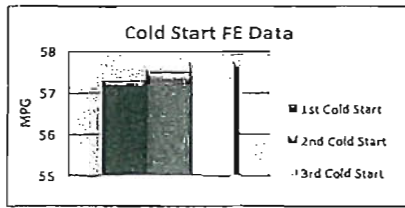
FTP - Cold Starts
Outlier Check (for 3 Samples)

	Result	T Statistic	p value 0.05	0.1	
1st Cold Start	57.6064	0.0561	Ok	Ok	min diff
2nd Cold Start	57.2912	-1.0269	Ok	Ok	0.298867
3rd Cold Start	57.8726	0.9708	Ok	Ok	max diff
Mean =	57.5901	COV = ↓	% Change from Base		
Stdev =	0.2910	0.505372	2.97996		

Cold Start FE Data

Average Cold FE Start Data (55.92, 56.87, 56.78, 57.48, 57.59)

All Cold FE Start Data
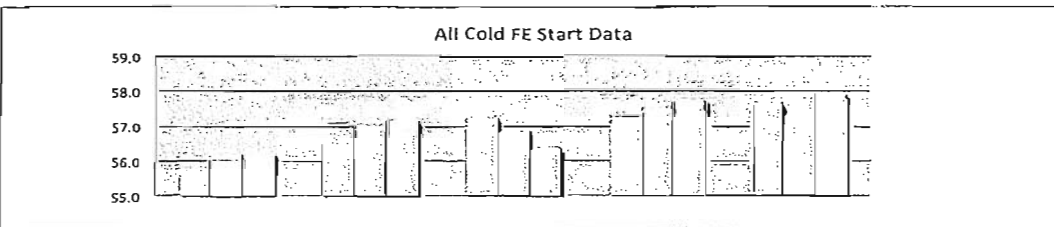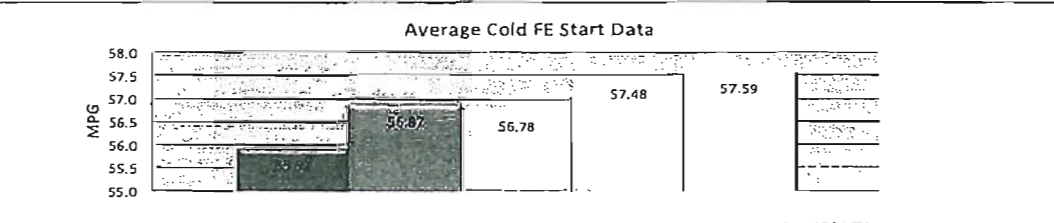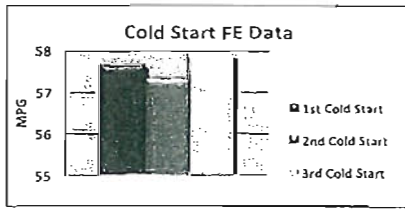
Summary

Vehicle emission testing was carried out at the Mahle emission testing facility based at Costin House St James Mill Road Northampton NN5 5TZ.

The purpose of this test program was to evaluate the performance of a ███████████ additive, with a main focus on fuel economy and CO_2 emissions reduction.

Renault Modus diesel engine vehicle was chosen for testing. The vehicle had completed over 88,000 miles prior to testing and was fitted with a 5 speed manual gearbox. It was tested using the ECE 1505 (M) 11s and FTP75 drive cycles. Power curves were completed by Mahle Powertrain Ltd and performed at the start and end of the test program.

The base fuel used was ███████████ supplied by ███████████. For the additive testing the base fuel used for car registration number NU54 DYY was dosed with ███████████ diesel.

During testing and road durability the vehicles were insured by ███████ Breakdown cover provided by the AA (Automobile Association).

██████ was found to give a 2.6% MPG fuel economy benefit. Fuel consumption was reduced from 5.054 L/100km to 4.924 L/100km over the ECE drive cycle.

██████ was found to give a 3.0% MPG fuel economy benefit. Fuel consumption was reduced from 5.051 L/100km to 4.905 L/100km over the FTP drive cycle.

The following information explains the definition of POWER and TORQUE. An engine produces POWER by providing a ROTATING SHAFT, which can exert a given amount of TORQUE on a load at a given RPM. The amount of TORQUE the engine can exert usually varies with RPM. A dynamometer determines the POWER an engine produces by applying a load to the engine output shaft by an eddy-current absorber. The dynamometer control system causes the absorber to exactly match the amount of torque the engine is producing at that instant, then measures that TORQUE as well as the RPM of the engine shaft, and from those two measurements, it calculates observed power. Then it applies various factors (air temperature, barometric pressure, relative humidity) in order to correct the observed power to the value it would have been if it had been measured at standard atmospheric conditions (corrected power).

Torque

Torque is a force that turns, twists or rotates. The spinning crankshaft of the engine thus creates torque. Torque is defined as force multiplied by distance. Standard methods of measurement use a Dynamometer (or Dyno). This works by placing an engine under load and measuring its output. This can be done either directly at the crank or by methods such as a rolling road. Measuring the amount of load that an engine can handle at given engine speeds gives a torque figure. Torque being a product of power (as below) and can be converted to give us the benchmark power figure. Torque and power are related by the following equation.

Power = Torque x RPM / 5252
The above formula varies if the measurement units are not BHP and lb/ft.
Brake Horsepower

Brake horsepower (bhp) is the measure of an engine's horsepower before the loss in power caused by the gearbox, alternator, differential, water pump, and other auxiliary components such as power steering pump, muffled exhaust system, etc. Brake refers to a device that is used to load an engine and hold it at a desired RPM. During testing, the output torque and rotational speed are measured to determine the brake horsepower. The output delivered to the driving wheels is less than that obtainable at the engine's crankshaft.

Table of Contents

1.0 Introduction

This report describes the test methodology used and summarises the results found. A detailed data set from the tests performed has been given to the customer separately.

1.1 Emission Test Laboratory

MAHLE Powertrain has comprehensive, fully certified on-site facilities for vehicle emissions testing and drivability optimisation. State-of-the-art Emissions and Drivability Centre (EDC) at Northampton incorporates two fully equipped chassis dynamometers, one for climatic testing and the other for ambient work. Engineers and technicians have a wealth of experience in testing a wide range of vehicles and have all the necessary equipment to conduct globally legislative test programs in this fully certified facility.

- Full size dilution tunnel
- Particulate mass and count measurement
- Gasoline DI and diesel testing capability
- Currently certified to Euro 5a standards
- Cold environment testing to -40°C
- Dynamometers rated to 210 kW/600 Nm
- Vehicles up to 3000 kg accommodated

Facilities include an ambient chamber operational up to +50°C, and a climatic chamber capable of -40°C to +50°C. Each chamber has a 48"single-roll chassis dynamometer rated at 210kW for vehicles up to 3000kg, running on gasoline, diesel and alternative fuels. All world legislative cycles and custom cycles are supported. Analysis of both raw and dilute emissions is available; along with gasoline GDI and diesel particulate mass and count capability in the ambient chamber. The facility also includes a cold soak area capable of -40°C with space for up to 4 vehicles and a warm soak area, controlled to 25°C +/- 2°C, which can accommodate 10 vehicles.

1.2 Mahle Powertrain Ltd Certification

MAHLE Powertrain is one of the world's leading providers of powertrain solutions to the global automotive sector. They achieve this outstanding position through the implementation of effective management systems.

Mahle has been awarded the following certifications.

- **ISO/TS 16949:2002**

- **ISO 14001: 2004**

- **EMAS**

- **Ford Q1 preferred quality award** Ford Q1 status is recognition of MAHLE Powertrain Ltd as an approved Tier 1 supplier to Ford

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1.3 ETF UK Ltd Credits

ETF UK Ltd is a member of the British Technical Council (BTC) testing advisory group and actively participates in a vehicle correlation exercise. This involves a vehicle being passed around participating laboratories and emissions tests conducted at each facility. Results from each facility are collated.

ETF UK Ltd has recently featured in Professional Motor Mechanic July/August 2010 edition. The article reported on research into aftermarket passenger car catalysts by▇▇▇▇▇▇▇▇▇▇▇who selected ETF UK Ltd to perform a series of vehicle emissions tests using different manufactures of catalyst.

This research found many non-type approved catalysts available on the market today are substandard. The results showed 20 times the level of Nitrogen Dioxide and 50% higher levels of hydrocarbons being emitted by non-type approved catalysts compared with Original Equipment Manufacture (OEM) approved catalysts. This study is leading to calls for Type-Approval to become mandatory in the UK as it already is in Europe.

This study looked at a single car with a large variety of type approved and non-type approved exhausts. A great number of tests were performed for▇▇▇▇▇in this study by ETF UK Ltd.

▇▇▇▇▇▇▇▇▇▇▇▇▇catalysts for both aftermarket and original equipment (OE) and is fully EU type approved. They can supply exhausts for 97% of the European car parts. Over 200,000 replacement exhausts are fitted every month in the UK.

ETF UK Ltd also assisted Horiba in the testing and development of a standalone CVS system.

Ashwoods Hybrid Technologies selected ETF UK Ltd to perform emissions tests for their hybrid vehicle development project. This project received funding from the United Kingdom (UK) Department for Transport.

2.0 Aims

The main aim of this study is to evaluate the performance of an Afton Chemical fuel additive on fuel economy and tailpipe emissions.

2.1 Vehicle Preparation and Selection

The test vehicle and engine chosen for this fuel economy test program is the Renault Modus 1.4 and has the registration NU54 DYY. The vehicle was sourced from a vehicle commercial company. Prior to the test program the vehicle had completed around 88,000 miles of normal consumer use. This made it very typical of the vehicles on public roads today. A set of dynamometer tyres was fitted prior to all emissions tests.

2.2 Test Schedule

The vehicle underwent the NEDC 1505 (M) 11s test cycle and FTP75 test cycle.

Base Fuel Test Cycle 1

- Drain and Refill RF06 Base Fuel
- Fit Dyno Tyres
- OBD Check
- ECE Emission Preconditioning
- NEDC Emission Test 1
- NEDC Emission Test 2
- NEDC Emission Test 3
- ASTME 178 test results analysis
- FTP74 Emission Preconditioning
- FTP75 Emission Test 1
- FTP75 Emission Test 2
- FTP75 Emission Test 3
- Standard Power Curve
- ASTME 178 test results analysis
- Fit Road Tyres
- Mileage Accumulation

Additive Fuel Test Cycle 2,3,4,5

- Drain and Refill ███████████
- Standard Power Curve
- ECE Emission Preconditioning
- NEDC Emission Test 1
- NEDC Emission Test 2
- NEDC Emission Test 3
- ASTME 178 test results analysis
- FTP74 Emission Preconditioning
- FTP75 Emission Test 1
- FTP75 Emission Test 2
- FTP75 Emission Test 3
- ASTME 178 test results analysis
- Fit Road Tyres
- Mileage Accumulation

After each test cycle was completed the emissions results were checked for anomalies before testing continued. If an outlining emitter was identified a further test was conducted.

The base fuel used was ████████████ and supplied by ████████████ as a reference fuel, batch number ████████ A full analysis of the fuel properties can be found in appendix 2.

The Renault Modus used this base fuel plus ████ mv of additive when additive fuel was required.

A final set of power curves were conducted at the end of the test program.

2.3 Test Procedure

The test vehicle was installed into the test laboratory chassis dynamometer with the driven wheels on the dynamometer rollers. The dynamometer control system was set to the appropriate road load model (RLM) and the exhaust tailpipe was connected to the Constant Volume Sampling (CVS) system.

The vehicle was weighed and inertia was set to ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮

The vehicle was driven to the ECE Emissions Cycle. The vehicle preconditioning uses this cycle, but no data is taken during this phase. The vehicle was driven to the FTP75 Emissions Cycle. The vehicle preconditioning uses the FTP74 cycle, but no data is taken during this phase. Before each test the vehicle is contained within a soak area kept at 25±2°C for at least 10 hours. The test cell is also kept at this temperature. A road speed-tracking fan is used to provide airflow over the car during testing.

All test equipment is calibrated by Horiba trained personnel and traceable records kept.

2.4 Mileage Accumulation Procedure

Between tests the vehicle was required to complete 500km mileage accumulation to allow the fuel additive to have an effect. This was performed by ETF UK Ltd employees and was conducted on public roads. A variety of motorway, main roads and intercity driving were used as would be typical of an average consumer. The Welsh route was used to maintain repeatability over the course of the program.

2.5 Fuel Blending Procedure

Mahle Powertrain Ltd blended the fuel. The additive used was ▮▮▮▮. The required amount of additive was added to a barrel of reference fuel. This was then mixed using an air stirrer for 20 minutes. During this time the fuel barrel was earthed to prevent static charge build up. No further action was needed.

3.0 Test Average Results

3.1.1 ECE Emissions Results No Additive (Phase 1)

Reference Fuel No Additive	Emission Results					Fuel Consumption ECE		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAYA03-002	0.498	133.29	0.026	0.535	0.561	55.807	5.062	88731
NAYA03-003	0.547	133.30	0.031	0.570	0.601	55.765	5.066	88738
NAYA03-004	0.557	132.48	0.031	0.557	0.588	56.102	5.035	88745
Average	0.534	133.02	0.029	0.554	0.583	55.891	5.054	

3.1.2 ECE Emissions Results with Additive (Phase 2)

Reference Fuel + Additive	Emission Results					Fuel Consumption ECE		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAYA03-013	0.424	132.77	0.023	0.475	0.498	56.0700	5.030	89183
NAYA03-014	0.449	131.87	0.023	0.479	0.502	56.4400	5.000	89189
NAYA03-015	0.460	131.56	0.024	0.496	0.520	56.5600	4.994	89196
Average	0.444	132.07	0.023	0.483	0.507	56.3567	5.008	

3.1.3 ECE Emissions Results with Additive (Phase 3)

Reference Fuel + Additive	Emission Results					Fuel Consumption ECE		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAYA03-021	0.465	131.20	0.024	0.453	0.477	56.712	4.981	89366
NAYA03-022	0.461	131.11	0.024	0.452	0.476	56.757	4.977	89373
NAYA03-023	0.468	131.12	0.026	0.439	0.465	56.744	4.978	89380
Average	0.465	131.14	0.025	0.448	0.473	56.738	4.979	

3.1.4 ECE Emissions Results with Additive (Phase 4)

Reference Fuel + Additive	Emission Results					Fuel Consumption ECE		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAYA03-029	0.456	131.20	0.020	0.444	0.464	56.725	4.980	89801
NAYA03-030	0.505	130.66	0.023	0.448	0.471	56.921	4.963	89808
NAYA03-031	0.484	131.19	0.023	0.451	0.474	56.709	4.981	89815
NAYA03-032	0.464	130.89	0.025	0.430	0.455	56.846	4.969	89822
Average	0.477	130.99	0.023	0.443	0.466	56.800	4.973	

3.1.5 ECE Emissions Results with Additive (Phase 5)

Reference Fuel + Additive	Emission Results					Fuel Consumption ECE		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAYA03-039	0.499	129.33	0.023	0.433	0.456	57.508	4.912	90191
NAYA03-040	0.511	129.25	0.025	0.441	0.466	57.529	4.910	90197
NAYA03-041	0.483	130.40	0.023	0.442	0.465	57.050	4.950	90204
Average	0.498	129.66	0.024	0.439	0.462	57.362	4.924	

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3.2.1 FTP75 Emissions Results No Additive (Phase 1)

Reference Fuel No Additive	Emission Results					Fuel Consumption EPA		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAY03-006	0.358	219.23	0.040	0.730	0.770	55.569	5.083	88759
NAY03-007	0.510	217.22	0.041	0.698	0.739	56.020	5.042	88770
NAY03-008	0.432	216.69	0.046	0.731	0.777	56.182	5.028	88781
Average	0.433	217.71	0.042	0.720	0.762	55.924	5.051	

3.2.2 FTP75 Emissions Results with Additive (Phase 2)

Reference Fuel + Additive	Emission Results					Fuel Consumption EPA		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAY03-017	0.171	216.04	0.027	0.560	0.587	56.474	5.002	89211
NAY03-018	0.175	214.01	0.026	0.560	0.586	57.009	4.955	89221
NAY03-019	0.195	213.57	0.028	0.552	0.580	57.115	4.946	89232
Average	0.180	214.54	0.027	0.557	0.584	56.866	4.968	

3.2.3 FTP75 Emissions Results with Additive (Phase 3)

Reference Fuel + Additive	Emission Results					Fuel Consumption EPA		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAY03-025	0.223	213.28	0.031	0.536	0.567	57.179	4.940	89393
NAY03-026	0.206	214.64	0.031	0.551	0.582	56.825	4.971	89405
NAY03-027	0.181	216.57	0.029	0.522	0.551	56.330	5.015	89416
Average	0.203	214.83	0.030	0.536	0.567	56.778	4.975	

3.2.4 FTP75 Emissions Results with Additive (Phase 4)

Reference Fuel + Additive	Emission Results					Fuel Consumption EPA		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAY03-034	0.156	231.80	0.023	0.616	0.639	52.648	5.365	89843
NAY03-035	0.281	212.92	0.029	0.542	0.571	57.251	4.934	89858
NAY03-036	0.329	212.00	0.028	0.516	0.544	57.481	4.914	89865
NAY03-037	0.229	211.35	0.028	0.533	0.561	57.701	4.896	89876
Average	0.249	217.02	0.027	0.552	0.579	56.270	5.027	

3.2.5 FTP75 Emissions Results with Additive (Phase 5)

Reference Fuel + Additive	Emission Results					Fuel Consumption EPA		Odometer
Test Number	CO	CO2	T.HC	NOx	T.HC + NOx	MPG	L/100km	Mileage
NAY03-043	0.354	211.48	0.034	0.545	0.579	57.606	4.904	90218
NAY03-044	0.314	212.71	0.032	0.537	0.569	57.291	4.931	90229
NAY03-045	0.308	210.58	0.031	0.539	0.570	57.873	4.881	90240
Average	0.325	211.59	0.032	0.540	0.573	57.590	4.905	

3.1 Evaluation of Additive Performance

The main focus of this test was to evaluate the effect of the fuel additive of CO_2 and emissions. The table below shows the percentage improvement from start to end of test.

ECE					
CO2		FE, MPG		FC, l/100km	
Start of Test	End of test	Start of Test	End of test	Start of Test	End of test
133.02	129.66	55.891	57.362	5.054	4.924
% Change		% Change		% Change	
-2.53		2.63		-2.57	

Using the data above, the CO2 has reduced from 133.02 to 129.66 indicating an improvement of 2.5%.

Using MPG, 55.891 goes to 57.362 an improvement of 2.6%.

ECE fuel consumption improvement in l/100km was 2.6%, going from 5.054 to 4.924 /100km.

FTP					
CO2		FE, MPG		FC, l/100km	
Start of Test	End of test	Start of Test	End of test	Start of Test	End of test
217.71	211.59	55.924	57.590	5.051	4.905
% Change		% Change		% Change	
-2.81		2.98		-2.89	

Using the data above, the CO2 has reduced from 217.71 to 211.59 indicating an improvement of 2.8%.

Using MPG, 55.924 goes to 57.590 an improvement of 3.0%.

EPA fuel consumption improvement in l/100km should be 2.9%, going from 5.051 to 4.905 /100km.

3.2 Power Test Results

At the start of the test program a power curve was conducted on the vehicle whilst using the base fuel and additive fuel. After the test program a repeat power curve was performed on the vehicle whilst using additive fuel.

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Appendix 1: Power Curve Results

Power Curve 1 Base Fuel (Start of Project)

NAYA03 MODUS Base fuel Power Curve 1
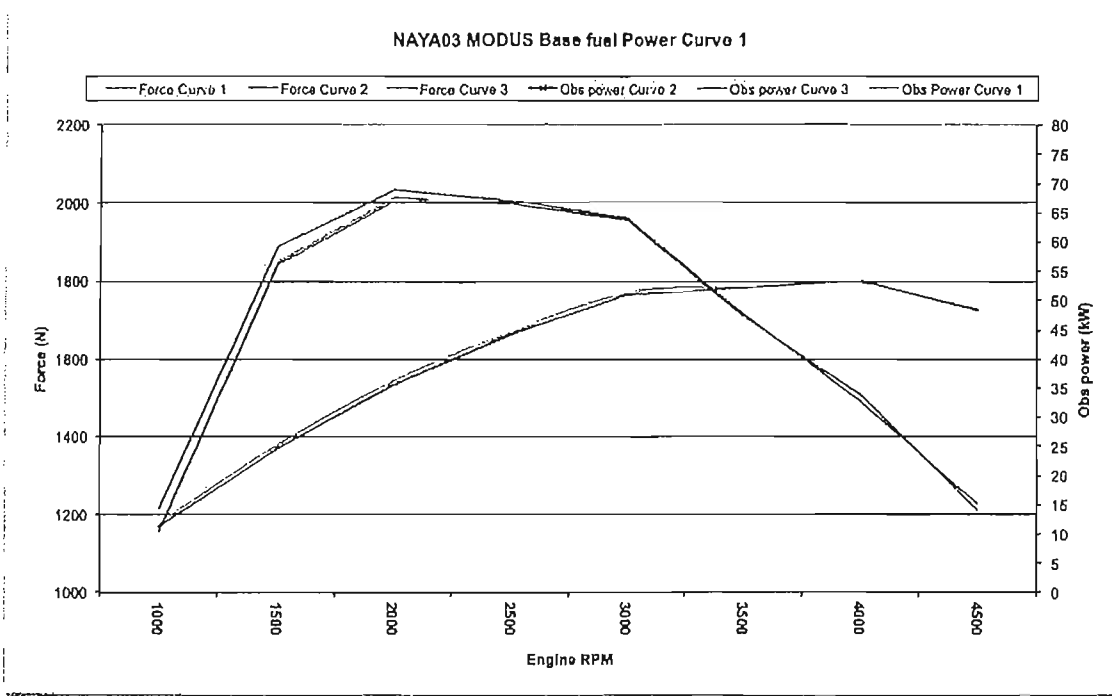
Power Curve 2 Additive Fuel (Start of Project)

NAYA03 MODUS Additive Power Curve 2

12