Test Report

Customer	WAS UK Limited
Vehicle	Fiat Ducato Ambulance – LC17GMU
Test	Ambulance Weight Reduction Fuel Economy Testing
Millbrook Report No.	18/0341
Millbrook Project No.	PT0327-001-01

Author:		Benedikt Koning Engineer – Propulsion Vehicle Test
Approved for Issue:		Dwight Lewis Senior Engineer – Propulsion Vehicle Test
Date:	19 March 2018	

Executive Summary

This report details the methods and results obtained from a test program conducted on a converted Fiat Ducato ambulance in January 2018. A converted box-body ambulance was used to determine the potential difference in tailpipe emissions and fuel consumption when testing the vehicle in standard operating conditions at two differing vehicle inertias (4000kg and 4200kg, test conditions B and A respectively). In both conditions, the vehicle was tested over three hot start repeats of a custom created drive cycle, designed using data gathered from in-service ambulances during both normal driving and 'emergency blue light' driving conditions. All tests were driven over this cycle by the same test driver, using a single axle chassis dynamometer in Millbrook's Variable Temperature Emissions Chamber (VTEC) at 18°C.

A (B-A) test method was used with test condition order configured to remove any 'false positives' caused due to vehicle running. The order of testing is shown in Figure 1 below, the full test procedure and methodology used is detailed in the Test Procedure section later in this report.

Test Day	Test Number	Test Condition	Vehicle Inertia
1	ML02017720	B	4000kg
	ML02017721	B	4000kg
	ML02017722	B	4000kg
	ML02017723	A	4200kg
	ML02017724	A	4200kg
	ML02017725	A	4200kg

Figure 1 - Test matrix showing test number, condition and order

Figure 2 below shows the change in the fuel consumption result with the tested in both conditions, when compared for statistical significance using ASTM method for statistical change and 95% confidence level. For the remainder of this report, the two test conditions (vehicle inertia) will be referred to as Condition A and Condition B respectively.

	Fuel Consumption
	(L/100km)
Condition A (4200kg) - Average of Combined Tests	**15.34**
Condition A (4200kg) - Standard Deviation/Mean x100	0.97
Condition B (4000kg) - Average of Combined Tests	**14.45**
Condition B (4000kg) - Standard Deviation/Mean x100	0.22
Change over **Condition A (4200kg)** (L/100km)	-0.895
Change over **Condition A (4200kg)** (%)	**-5.8%**
Statistically Significant?	**Y**

Figure 2 - Statistical significance analysis for change in fuel consumption

Distribution

Organisation	Recipient	Format	Qty
WAS UK Limited Augusta House Hawkins Lane Burton Upon Trent, Staffordshire DA14 1PT	Mr. Darren Sullivan	PDF	1
Millbrook Proving Ground Ltd Millbrook Bedford MK45 2JQ	Contract file	PDF	1
	Mr. Benedikt Koning	Paper	1

Report Revision History

Rev.	Revision Description	Date	Author	Approver	Pages
0	Initial release	19 March 2018	B. Koning	D. Lewis	All

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Objectives

1. Create a custom test cycle (WAS Ambulance Cycle) using data logged ‘in service’ in order to replicate real world driving conditions as closely as possible in a controlled laboratory environment on a chassis dynamometer.
2. Conduct a series of hot start WAS Ambulance test cycles at 18°C in Millbrook’s VTEC on one test vehicle at two differing vehicle inertias, 4200kg and 4000kg, to determine the potential reduction in fuel consumption when driving in Condition B as opposed to Condition A.

Conclusions

1. Data was provided from 3 in-service ambulances during ‘normal’ driving and ‘emergency’ driving. This data was used to create a custom test cycle (WAS Ambulance Cycle).
2. When comparing fuel consumption results of the test vehicle, driven over hot start WAS Ambulance test cycles at 18°C in Millbrook’s VTEC, a statistically significant decrease of 5.8% at 95% confidence was found when testing in Condition B condition compared to Condition A.

Test Facility and Date

All tests were performed on 30th January 2018 in the Variable Temperature Emissions Chamber at Millbrook Proving Ground Ltd.

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Test Vehicle Specification

Registration Number	:	LC17 GMU
Make/Model	:	Fiat Ducato Box Body Ambulance
Engine and Emissions Standard	:	2.3L Diesel, Euro 6
Transmission	:	6-speed Manual
Odometer at Beginning of Program	:	5168 miles
Odometer at Completion of Program	:	5350 miles

Test Procedure

Test cycle design

To produce test results that were representative of real world operation of the test vehicle, a custom test cycle was created for WAS Ambulance UK Limited as follows:

1. Data files recorded in service from 3 separate vehicles telematics systems were provided by the customer.
2. The data was processed, analysed and appended at appropriate points to create a two-phase drive cycle. Two distinct phases were created to allow analysis of specific driving conditions.
3. The drive cycle was assessed for driveability and to check the validity of the emissions output.

	Total time (s)	Time at idle (s)	Distance (km)	Average Speed (km/h)	Max Speed (km/h)	Maximum Acceleration (m/s^2)	Maximum Deceleration (m/s^2)
Phase 1 (Non-Emergency)	1177	314	6.295	26.3	48.3	3.1	-3.1
Phase 2 (Emergency)	1263	23	15.865	46.1	107.8	4.5	-5.4
Overall	2440	337	22.160	38.0	107.8	4.5	-5.4

Figure 3 - Characteristics of the WAS Ambulance Cycle

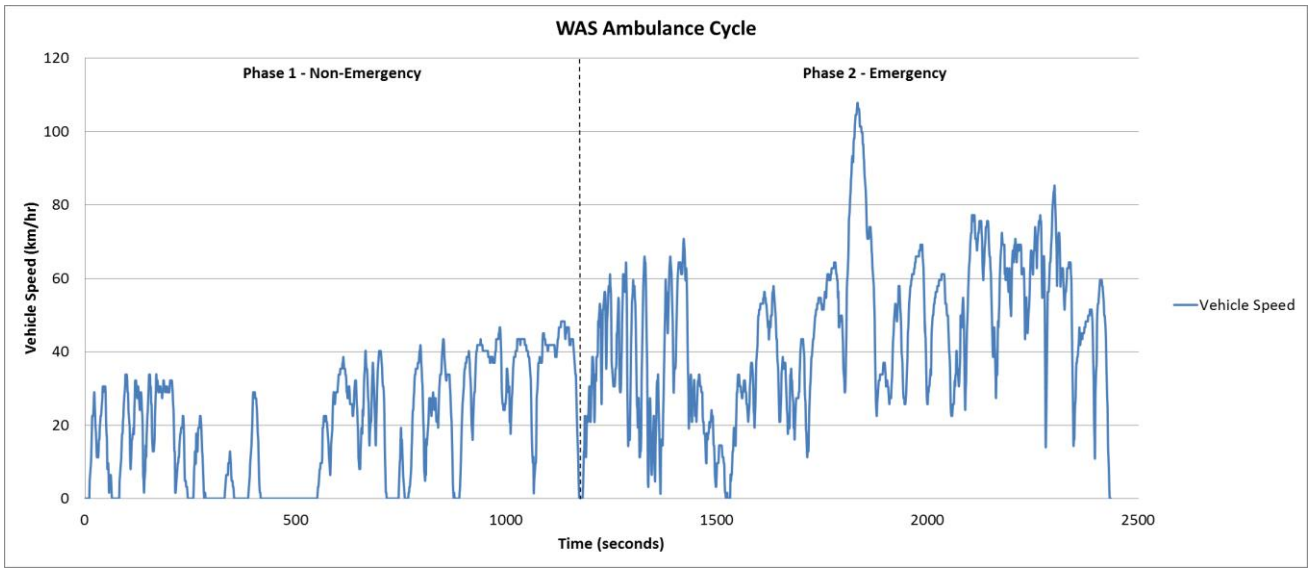

Figure 4 - WAS Ambulance Cycle speed time trace

Test Method

The test method used was a B-A method. This method was completed using one test driver over 1 test day, performing three hot-start tests on the test vehicle in each of the two test conditions. This method was used in order to ensure that any benefit due to possible change in frictional characteristics of the vehicle over the course of the testing would not cause a 'false benefit'.

The following procedure was used to each test condition.

1. Set simulated inertia to condition B (4000kg)
2. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
3. Perform hot start WAS Ambulance Cycle Test 1, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
4. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
5. Perform hot start WAS Ambulance Cycle Test 2, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
6. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
7. Perform hot start WAS Ambulance Cycle Test 3, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
8. Ensure CO_2 Coefficient of Variance for tests 1-3 is less than 2%.
9. Change simulated inertia to condition A (4200kg)
10. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
11. Perform hot start WAS Ambulance Cycle Test 4, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
12. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
13. Perform hot start WAS Ambulance Cycle Test 5, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
14. Perform 15 minute Millbrook Warm up (5 minutes @ 60km/h, 5 minutes @ 40km/h, 5 minutes @ 30km/h).
15. Perform hot start WAS Ambulance Cycle Test 6, logging dynamometer data and exhaust temperature → Coastdown check immediately after test.
16. Ensure CO_2 Coefficient of Variance for tests 4-6 is less than 2%.

Instrumentation

Item	Ser. No.	Calibration due date
Rebel XT CAN-BUS Logger	RBL619	N/A

Supplementary Information

Simulated road load

The test was tested under two conditions using the following test inertias, 4200kg and 4000kg, these inertias were specified by the customer. The road load (rolling, mechanical and aerodynamic friction losses) for each condition was derived from the ECE Reg. 101 'Cookbook' load for a 2-wheel drive van weighing over 2610kg as a basis and F_0 re-calculated for the required simulated vehicle inertia. The calculations for the mass and rolling resistance road load coefficient, F_0 are detailed below.

Condition A

F_0 calculation: Adjusted F_0 = Initial F_0 + (ΔInertia x g x C_{rr})

Where initial F_0 = 12.87 and g = 9.81m/s^2 and C_{rr} = 0.008 (Coefficient of rolling resistance)

Thus Adjusted F_0 = 12.87 + ((4200-2610) x 9.81 x 0.008))

F_0 = 164.34N

Test Inertia	4,200	kg
F_0	164.34	N
F_1	0.000	N/km/h
F_2	0.08762	N/km/h^2
F_3	0.0000000	N/km/h^3

Condition B

F_0 Calculation: Adjusted F_0 = Initial F_0 + (ΔInertia x g x C_{rr})

Where initial F_0 = 12.87 and g = 9.81m/s^2 and C_{rr} = 0.008 (Coefficient of rolling resistance)

Thus Adjusted F_0 = 12.87 + ((4000-2610) x 9.81 x 0.008))

F_0 = 148.64N

Test Inertia	4,000	kg
F_0	148.64	N
F_1	0.000	N/km/h
F_2	0.08762	N/km/h^2
F_3	0.0000000	N/km/h^3

Emissions testing

Exhaust emissions levels were recorded during each phase for HC, CO, NO_x and CO_2. A combined total was also determined for each pollutant. In addition to the bag emissions, second by second data was also sampled and recorded. Fuel consumption was calculated using the carbon balance method. All testing was completed at 18°C, as agreed with the customer.

Pollutant		Measurement Technique	Frequency	Analysis Technique
Regulated	Total hydrocarbons (HC)	Continuously integrated	Per phase	Flame ionisation
	Carbon monoxide (CO)	Bag	Per phase	Non-dispersive Infra-Red
	Nitrogen Oxides (NO_x)	Bag	Per phase	Chemiluminescence
	Particulate Mass (PM)	Continuous modal tailpipe	Per Test	Gravimetric Paper Filter
	Particulate Number (PN/km)	Continuous modal tailpipe	Per Test	Advanced Particle Counter
Unregulated	Carbon dioxide (CO_2)	Bag	Per phase	Non-dispersive Infra-Red
	Total hydrocarbons (HC)	Continuous modal tailpipe	1Hz	Flame ionisation
	Carbon monoxide (CO)	Continuous modal tailpipe	1Hz	Non-dispersive Infra-Red
	Nitrogen Oxides (NO_x)	Continuous modal tailpipe	1Hz	Chemiluminescence
	Nitric oxide (NO)	Continuous modal tailpipe	1Hz	Chemiluminescence
	Carbon dioxide (CO_2)	Continuous modal tailpipe	1Hz	Non-dispersive Infra-Red

Figure 5 - Table of measured regulated and unregulated exhaust emissions

Shake down testing

Prior to the commencement of testing, a series of 'shakedown tests' were conducted in order to ensure the following:

1. The validity of the emissions measurement and data output of the test cycle could be assessed.
2. The test driver had the opportunity to familiarise himself with the newly created cycle.
3. The engineer had the opportunity to assess the cycle's driveability based on technician feedback and data analysis.

Test Results and Discussion

Criteria and Results

The aim of this test program was to determine any change in fuel consumption and exhaust emissions of a Fiat Ducato Ambulance when tested using two inertia conditions. Figure 6 below shows the regulated bag emissions results along with fuel consumption and Carbon Dioxide (CO_2). Emissions results for the two vehicle test conditions will be analysed in three ways:

- Statistical analysis of emissions and fuel consumption for 'Normal' driving (phase 1)
- Statistical analysis of emissions and fuel consumption for 'Emergency' driving (phase 2)
- Statistical analysis of emissions and fuel consumption overall (complete test)

The purpose of statistical analysis is to determine the following; Firstly, it will determine what the difference between the two test conditions is and secondly, if there is a difference, it will determine whether this difference is statistically significant as per the ASTM method for statistical significance.

Test Number	Test Condition	Vehicle Inertia	HC (g/km)	CO (g/km)	NO_x (g/km)	CO_2 (g/km)	PM (g/km)	PN (PN/km)	Fuel Cons (L/100km)
ML02017720	B	4000kg	0.013	0.008	1.920	382.5	0.0030	1.63E+10	14.45
ML02017721	B	4000kg	0.007	0.010	2.035	381.5	0.0028	1.58E+10	14.41
ML02017722	B	4000kg	0.018	0.010	2.090	383.6	0.0028	1.65E+10	14.19
ML02017723	A	4200kg	0.019	0.007	2.273	402.1	0.0030	1.81E+10	15.19
ML02017724	A	4200kg	0.011	0.008	2.512	411.6	0.0032	1.59E+10	15.54
ML02017725	A	4200kg	0.017	0.010	2.387	405.0	0.0028	1.57E+10	15.30

Figure 6 - Summary of regulated bag emissions with CO_2 and fuel consumption

Discussion

Emissions and fuel consumption reduction between test conditions

Emissions and fuel consumption results between Condition A and Condition B were compared for each of the three different test results; normal driving, emergency driving and overall. These group-sets were compared for statistical significance using the ASTM method for statistical significance with a 95% confidence level.

Figure 7 below shows the results of statistical analysis between Condition A and Condition B for Normal driving. Using ASTM method for statistical significance with a 95% confidence level, there is a statistically significant decrease in NO_x emissions of 14.5%.

Normal Driving (Phase 1)	HC	CO	NO_x	CO_2	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	MODAL	(Carb Bal)
Condition A - Average of Combined Tests (g/km)	0.025	0.015	1.236	365.9	1.99E+10	13.82
Condition A - Standard Deviation/Mean x100	8.99	27.51	1.28	0.61	11.01	0.60
Condition B - Average of Combined Tests (g/km)	0.019	0.017	1.056	354.0	1.86E+10	13.37
Condition B - Standard Deviation/Mean x100	42.56	30.36	10.18	2.16	10.08	2.17
					(PN/km)	(L/100km)
Change over **Condition A** (g/km)	-0.006	0.002	-0.179	-11.9	-1.31E+09	-0.450
Change over **Condition A** (%)	-24.9%	11.4%	-14.5%	-3.3%	-6.6%	-3.3%
Statistically Significant?	**N**	**N**	**Y**	**N**	**N**	**N**

Figure 7 - Statistical analysis of bag emissions results for 'Normal Driving'

Figure 8 below shows the results of statistical analysis between Condition A and Condition B for Emergency driving. Using ASTM method for statistical significance with a 95% confidence level, there is a statistically significant decrease in NO_x emissions of 16.0% and a statistically significant decrease in CO_2 emissions and fuel consumption of 6.7%.

Emergency Driving (Phase 2)	HC	CO	NO_x	CO_2	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	MODAL	(Carb Bal)
Condition A - Average of Combined Tests (g/km)	0.012	0.006	2.853	422.4	1.51E+10	15.95
Condition A - Standard Deviation/Mean x100	31.86	7.18	4.56	1.12	10.24	1.11
Condition B - Average of Combined Tests (g/km)	0.010	0.006	2.397	393.9	1.52E+10	14.88
Condition B - Standard Deviation/Mean x100	35.00	26.78	2.45	0.56	5.59	0.56
					(PN/km)	(L/100km)
Change over **Condition A** (g/km)	-0.002	0.001	-0.456	-28.4	2.50E+07	-1.074
Change over **Condition A** (%)	-17.3%	12.2%	-16.0%	-6.7%	0.2%	-6.7%
Statistically Significant?	**N**	**N**	**Y**	**Y**	**N**	**Y**

Figure 8 - Statistical analysis of bag emissions results for 'Emergency Driving'

Figure 9 below shows the results of statistical analysis between Condition A and Condition B for the test cycle overall. Using ASTM method for statistical significance with a 95% confidence level, there is a statistically significant decrease in NO_x emissions of 15.7% and a statistically significant decrease in CO_2 emissions and fuel consumption of 5.8%.

Overall (Phase 1 and 2 combined)	HC	CO	NO_x	CO_2	PM	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	FILTER	MODAL	(Carb Bal)
Condition A - Average of Combined Tests (g/km)	0.016	0.008	2.391	406.2	0.0030	1.65E+10	15.34
Condition A - Standard Deviation/Mean x100	20.80	14.08	4.08	0.98	5.09	6.68	0.97
Condition B - Average of Combined Tests (g/km)	0.013	0.009	2.015	382.5	0.0029	1.62E+10	14.45
Condition B - Standard Deviation/Mean x100	36.40	9.36	3.51	0.22	3.27	1.91	0.22
						(PN/km)	(L/100km)
Change over **Condition A** (g/km)	-0.003	0.001	-0.376	-23.7	-0.0001	-3.60E+08	-0.895
Change over **Condition A** (%)	-20.8%	11.7%	-15.7%	-5.8%	-2.5%	-2.2%	-5.8%
Statistically Significant?	**N**	**N**	**Y**	**Y**	**N**	**N**	**Y**

Figure 9 - Statistical analysis of bag emissions results Overall (test total)

Photographic

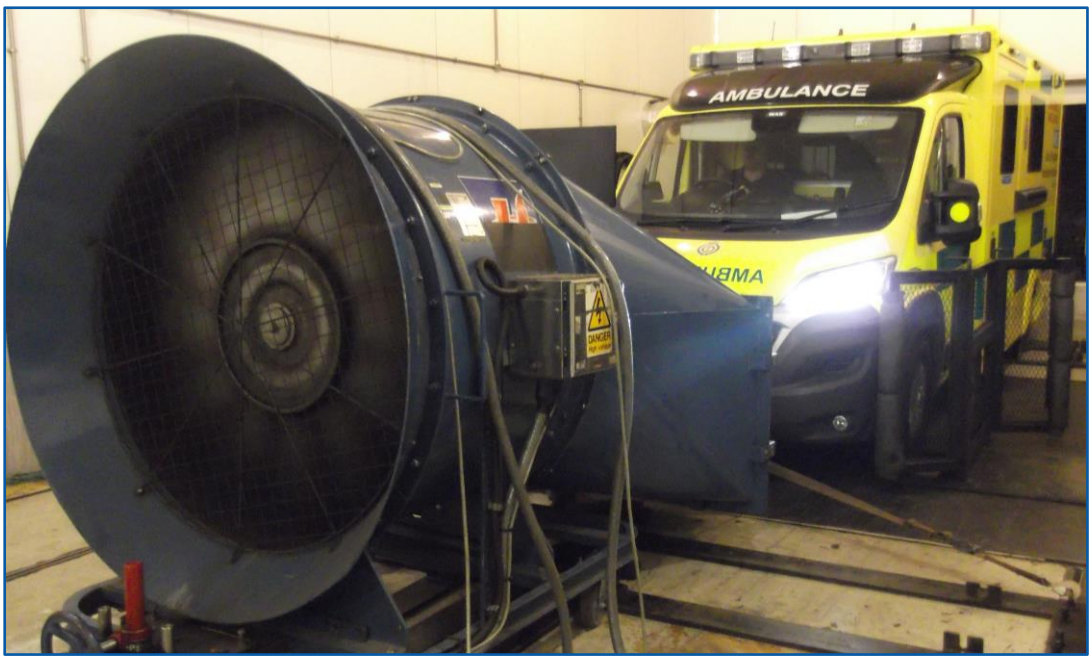

Figure 10 - Test vehicle on chassis dynamometer during testing in the VTEC

Figure 11 - Test vehicle on chassis dynamometer during testing in the VTEC

Figure 8 - Emissions sampling equipment connection to vehicle

Figure 13 - Emissions sampling equipment

Further Work

At this stage, no further work is currently under discussion.

Appendices

Appendix A – Bag emissions summary Condition A

WAS AMBULANCE CYCLE DIESEL

EMISSIONS TEST SUMMARY SHEET

Customer:	**WAS UK Limited**
Customer Address:	**August House, Hawkins Lane, Burton Upon Trent,Staffordshire, DE14 1PT**
Test Purpose:	**Weight Reduction Fuel Economy Testing - Baseline Test (4200kg vehicle weight)**
Vehicle No:	***LC17GMU***
Vehicle Type:	***Fiat Ducato Ambulance***
Engine:	***2.3L Diesel***
Transmission:	***6-speed Manual***
Fuel Type:	***Forecourt Diesel***
Fuel Batch No:	***N/A***
Millbrook Project No:	***PT0327-001-01***

Site No. 2

DYNAMOMETER SETTINGS	
INERTIA	4200 kg
F°	164.34 N
F¹	0.0000 N/kmh
F²	0.08762 N/kmh ²
F³	0.0000000 N/kmh ³

Test No. ***ML02017723***	***30-Jan-18***							Fuel Cons
Odo **5271**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.028	0.010	1.223	364.5	N/A	13.77
Phase 2	*Emergency*	g/km	0.015	0.006	2.695	417.1	N/A	15.75
Combined result		**g/km**	**0.019**	**0.007**	**2.273**	**402.1**	**0.0030**	litres/100km
						Pn/km	***1.81E+10***	**15.19**

Test No. ***ML02017724***	***30-Jan-18***							Fuel Cons
Odo **5294**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.023	0.016	1.258	369.0	N/A	13.94
Phase 2	*Emergency*	g/km	0.007	0.005	3.013	428.6	N/A	16.18
Combined result		**g/km**	**0.011**	**0.008**	**2.512**	**411.6**	**0.0032**	litres/100km
						Pn/km	***1.59E+10***	**15.54**

Test No. ***ML02017725***	***30-Jan-18***							Fuel Cons
Odo **5318**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.024	0.020	1.227	364.1	N/A	13.76
Phase 2	*Emergency*	g/km	0.015	0.006	2.851	421.4	N/A	15.91
Combined result		**g/km**	**0.017**	**0.010**	**2.387**	**405.0**	**0.0028**	litres/100km
						Pn/km	***1.57E+10***	**15.30**

Average of Combined Tests (g/km)	0.016	0.008	2.391	406.2	0.0030	15.34
Standard Deviation/Mean x100	20.80	14.08	4.08	0.98	5.09	0.97

Comments:

Compiling Engineer: Date: 31.01.2018

Approving Engineer: Date: 02.02.2018

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Appendix B – Bag emissions summary Condition B

WAS AMBULANCE CYCLE DIESEL
EMISSIONS TEST SUMMARY SHEET

Customer:	**WAS UK Limited**
Customer Address:	**August House, Hawkins Lane, Burton Upon Trent,Staffordshire, DE14 1PT**
Test Purpose:	**Weight Reduction Fuel Economy Testing - Candidate Test (4000kg vehicle weight)**
Vehicle No:	***LC17GMU***
Vehicle Type:	***Fiat Ducato Ambulance***
Engine:	***2.3L Diesel***
Transmission:	***6-speed Manual***
Fuel Type:	***Forecourt Diesel***
Fuel Batch No:	***N/A***
Millbrook Project No:	***PT0327-001-01***

Site No. 2

DYNAMOMETER SETTINGS	
INERTIA	4000 kg
F°	148.64 N
F¹	0.0000 N/kmh
F²	0.08762 N/kmh ²
F³	0.0000000 N/kmh ³

Test No. ***ML02017720***	***30-Jan-18***							Fuel Cons
Odo **5201**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.016	0.013	0.931	347.6	N/A	13.13
Phase 2	*Emergency*	g/km	0.012	0.006	2.314	396.4	N/A	14.97
Combined result		**g/km**	**0.013**	**0.008**	**1.920**	**382.5**	**0.0030**	litres/100km
						Pn/km	***1.63E+10***	**14.45**

Test No. ***ML02017721***	***30-Jan-18***							Fuel Cons
Odo **5225**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.011	0.024	1.044	349.6	N/A	13.21
Phase 2	*Emergency*	g/km	0.005	0.004	2.430	394.2	N/A	14.89
Combined result		**g/km**	**0.007**	**0.010**	**2.035**	**381.5**	**0.0028**	litres/100km
						Pn/km	***1.58E+10***	**14.41**

Test No. ***ML02017722***	***30-Jan-18***							Fuel Cons
Odo **5248**		UNITS	**HC**	**CO**	**NO_x**	**CO_2**	**PM**	(Carb Bal)
Phase 1	*Normal Driving*	g/km	0.030	0.014	1.194	364.7	N/A	13.78
Phase 2	*Emergency*	g/km	0.013	0.008	2.447	391.1	N/A	14.77
Combined result		**g/km**	**0.018**	**0.010**	**2.090**	**383.6**	**0.0028**	litres/100km
						Pn/km	***1.65E+10***	**14.49**

Average of Combined Tests (g/km)	0.013	0.009	2.015	382.5	0.0029	14.45
Standard Deviation/Mean x100	36.40	9.36	3.51	0.22	3.27	0.22

Comments:

Compiling Engineer: Date: 30.01.2018

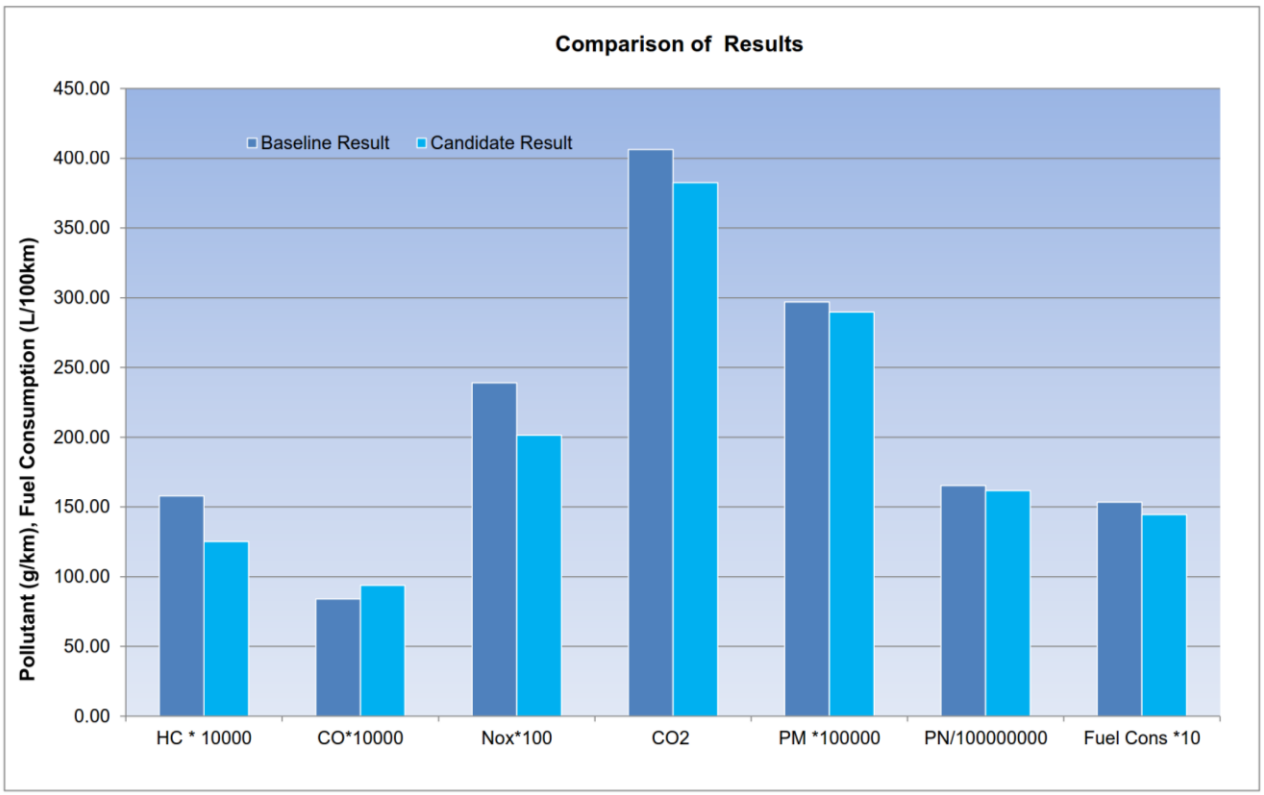
Approving Engineer: Date: 02.02.2018

Appendix C – Statistical analysis of emissions - Overall

STATISTICAL ANALYSIS SUMMARY SHEET

Customer:	**WAS UK Limited**
Customer Address:	**August House, Hawkins Lane, Burton Upon Trent,Staffordshire, DE14 1PT**
Test Purpose:	**Weight Reduction Fuel Economy Testing**
Test Vehicle	**Fiat Ducato Ambulance (WAS UK Box Body Conversion)**

Emissions Summary Data	HC	CO	NO_x	CO_2	PM	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	FILTER	MODAL	(Carb Bal) L/100km
Baseline (4200kg) - Average of Combined Tests (g/km)	0.016	0.008	2.391	406.2	0.0030	1.65E+10	15.34
Baseline (4200kg) - Standard Deviation/Mean x100	20.80	14.08	4.08	0.98	5.09	6.68	0.97
Candidate (4000kg) - Average of Combined Tests (g/km)	0.013	0.009	2.015	382.5	0.0029	1.62E+10	14.45
Candidate (4000kg) - Standard Deviation/Mean x100	36.40	9.36	3.51	0.22	3.27	1.91	0.22
						(N/km)	(L/100km)
Change over **Baseline** (g/km)	-0.003	0.001	-0.376	-23.7	-0.0001	-3.60E+08	-0.895
Change over **Baseline** (%)	-20.8%	11.7%	-15.7%	-5.8%	-2.5%	-2.2%	-5.8%
Significant?	N	N	Y	Y	N	N	Y



Comments: Baseline Tests: ML02017723, ML02017724, ML02017725 (4200kg)
Candidate Tests: ML02017720, ML02017721, ML02017722 (4000kg)

Compiling Engineer: Date: 31.01.2018 | Approving Engineer: DATE: 02.02.2018

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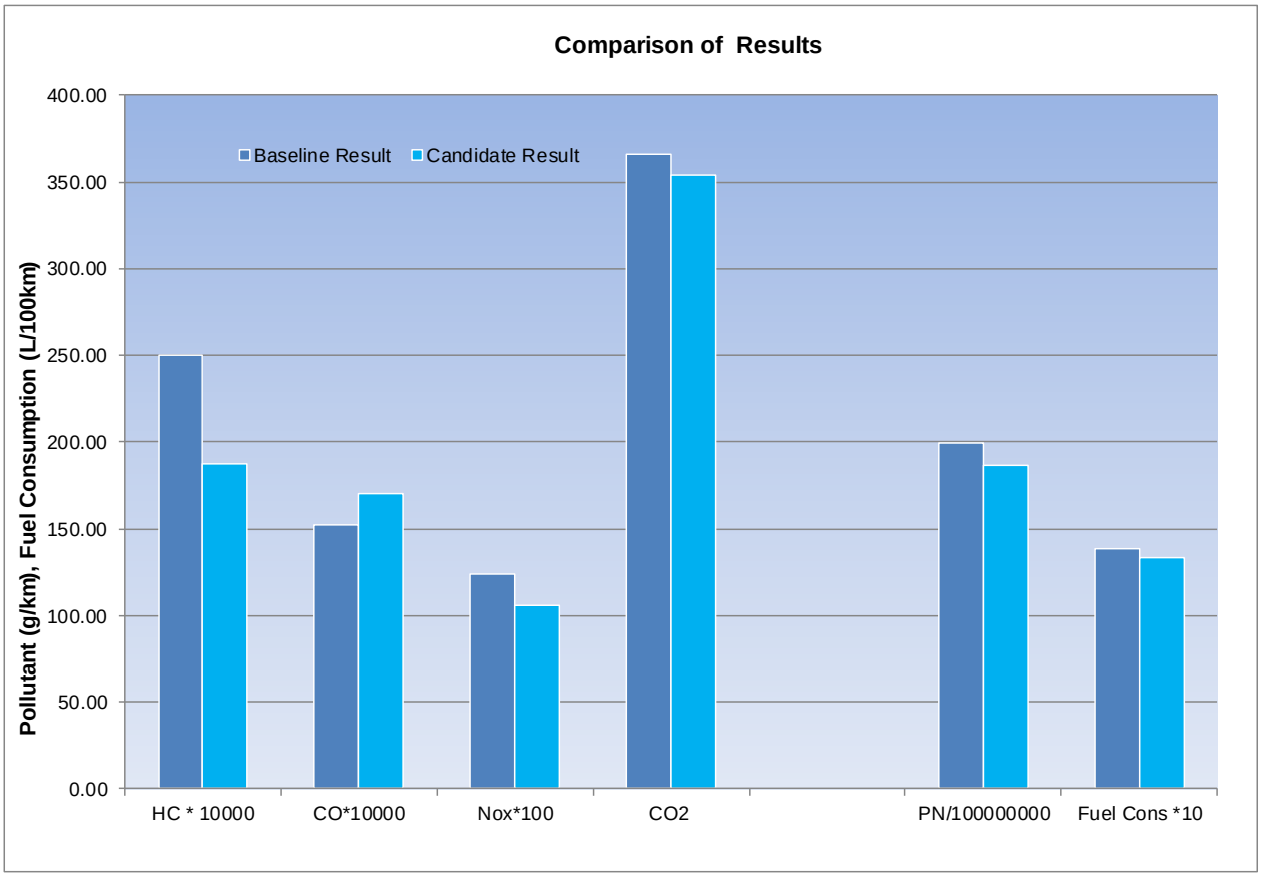
Appendix D – Statistical analysis of emissions – Normal Driving

STATISTICAL ANALYSIS SUMMARY SHEET

Customer:	**WAS UK Limited**
Customer Address:	**August House, Hawkins Lane, Burton Upon Trent,Staffordshire, DE14 1PT**
Test Purpose:	**Weight Reduction Fuel Economy Testing**
Test Vehicle	**Fiat Ducato Ambulance (WAS UK Box Body Conversion) - Normal Driving**

Emissions Summary Data	HC	CO	NO_x	CO_2	PM	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	FILTER	MODAL	(Carb Bal) L/100km
Baseline (4200kg) - Average of Combined Tests (g/km)	0.025	0.015	1.236	365.9	N/A	1.99E+10	13.82
Baseline (4200kg) - Standard Deviation/Mean x100	8.99	27.51	1.28	0.61	N/A	11.01	0.60
Candidate (4000kg) - Average of Combined Tests (g/km)	0.019	0.017	1.056	354.0	N/A	1.86E+10	13.37
Candidate (4000kg) - Standard Deviation/Mean x100	42.56	30.36	10.18	2.16	N/A	10.08	2.17
						(N/km)	(L/100km)
Change over **Baseline** (g/km)	-0.006	0.002	-0.179	-11.9	N/A	-1.31E+09	-0.450
Change over **Baseline** (%)	-24.9%	11.4%	-14.5%	-3.3%	N/A	-6.6%	-3.3%
Significant?	N	N	Y	N	N/A	N	N



Comments: Baseline Tests: ML02017723, ML02017724, ML02017725 (4200kg)
Candidate Tests: ML02017720, ML02017721, ML02017722 (4000kg)

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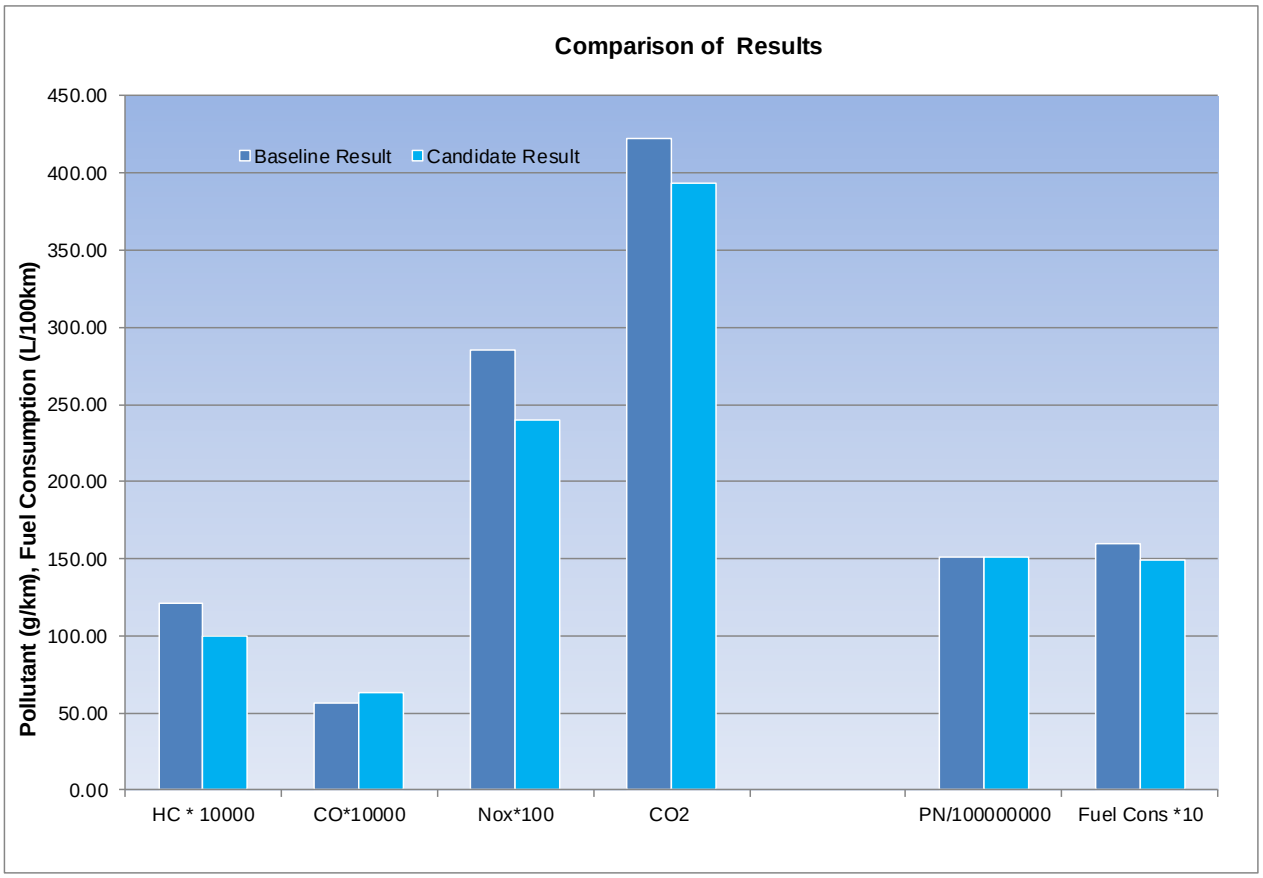
Appendix E – Statistical analysis of emissions – Emergency Driving

STATISTICAL ANALYSIS SUMMARY SHEET

Customer:	**WAS UK Limited**
Customer Address:	**August House, Hawkins Lane, Burton Upon Trent,Staffordshire, DE14 1PT**
Test Purpose:	**Weight Reduction Fuel Economy Testing**
Test Vehicle	**Fiat Ducato Ambulance (WAS UK Box Body Conversion) - Emergency Driving**

Emissions Summary Data	HC	CO	NO_x	CO_2	PM	PN/km	Fuel Cons
Analyser	BAG	BAG	BAG	BAG	FILTER	MODAL	(Carb Bal) L/100km
Baseline (4200kg) - Average of Combined Tests (g/km)	0.012	0.006	2.853	422.4	N/A	1.51E+10	15.95
Baseline (4200kg) - Standard Deviation/Mean x100	31.86	7.18	4.56	1.12	N/A	10.24	1.11
Candidate (4000kg) - Average of Combined Tests (g/km)	0.010	0.006	2.397	393.9	N/A	1.52E+10	14.88
Candidate (4000kg) - Standard Deviation/Mean x100	35.00	26.78	2.45	0.56	N/A	5.59	0.56
						(N/km)	(L/100km)
Change over **Baseline** (g/km)	-0.002	0.001	-0.456	-28.4	N/A	2.50E+07	-1.074
Change over **Baseline** (%)	-17.3%	12.2%	-16.0%	-6.7%	N/A	0.2%	-6.7%
Significant?	N	N	Y	Y	N/A	N	Y



Comments: Baseline Tests: ML02017723, ML02017724, ML02017725 (4200kg)
Candidate Tests: ML02017720, ML02017721, ML02017722 (4000kg)

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End of Report