

December 2007

**Test Report:
VRS,
Coventry
Emissions Sampling (November 2007)**

**Monitored by:
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Jane Howe,
Garage and Engineering Supplies Ltd,
Unit A Sparkhill Industrial Estate,
Birmingham,
B11 3JJ

Date: 10/12/2007

Ref: L.1721

Dear Jane,

Emissions Testing at VRS, Coventry:

Herewith my report on the testing undertaken at Coventry, on the 13th November 2007.

I have included two copies of the report, one bound, one loose, so that you can pass one as required.

If you have any queries on any part of the report, please do contact me.

Regards

Yours Sincerely,
For Aspen Environmental Ltd,

Dr Geoff Buck,
Director



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**Garage and Engineering Supplies Ltd,
Unit A Sparkhill Industrial Estate,
Birmingham,
B11 3JJ**

**Emissions Testing of Spray Booths
At VRS, Coventry 13th November 2007**

**Report Prepared for Aspen Environmental Ltd by
Dr G.W. Buck (Director)
J806
December 2007**

G.W. Buck 11/12/07

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Introduction

VRS operate a repair centre for vehicles in Coventry. The site has three Junair spraybooths located in one building.

Dr G Buck and Mr James Buck of Aspen Environmental Ltd visited the site on the 13th November 2007 to undertake the sampling of site emissions.

All three exhaust ducts were sampled.

Methodology

The test procedure followed the ISO 9096:2003 for sampling of particulates in the exhausts to our UKAS protocol.

Sampling was undertaken only while spraying was in process in the booths below, and the exhausts were functioning. After the spraying was complete, the booths moved into a bake function, circulating warm air to dry the paint with the exhausts blocked off.

For booth 1 (right hand side), and booth 2 (left hand side) two particulate samples were collected on each exhaust. For booth 3 (primer booth) only one sample was collected due to the very short spraying time. All samples were collected while spraying was underway on different vehicles/panels. The spraying time was representative of a typical painting session in a booth. For booths 1 & 2 monitoring was undertaken while a base coat was applied to a panel for the first sample, and while clear coat was applied to the same panel for the second sample. For booth 3, only one coat of primer was used, generating only one sample. A field blank has also been included within the results.

Dr Buck is personally MCerted to Level 2 (Team Leader), with technical endorsements TE1 (particulates) TE3 (gas analysis by manual methods) & TE4 (gas analysis by instrumental methods). Mr James Buck is personally MCerted to Level 1. Aspen Environmental Ltd is UKAS and MCerts accredited (UKAS Lab No. 2395) for particulates to BS 9096, weighings and for a range of other parameters.

Deviations from the standard method, are highlighted in the report appendix in red. There is a slight oversampling of Booth 1. Geometrically all sampling sites are OK, only one exhaust could be sampled on two traverses.

Results

The results are presented in a summary table below, which shows the emissions of particulates from the three booths. Each parameter was sampled twice in each exhaust, except for booth 3, and the individual results are shown, plus a mean. In each case an estimated uncertainty on the results is included, and the emission limits set by PG Note 6/34 2003 is included for comparison with the result.

VRS Coventry: Spray Booth Emissions 13th November 2007			
Total Particulates	mg/m³ Normalised to 273K, 1013 mb, dry gas	Uncertainty in Measurements	Emission Limit In mg/Nm³ PG 6/34 (July 2003)
Booth No.1	4.7 10.5		
Mean	7.6	± 0.8	10
Booth No.2	< 6 2.8		
Mean	2.8	± 0.3	10
Booth No.3	3.5		
Mean	3.5	± 0.4	10

The remaining results tables are included in the appendix as follows:

Appendix page 1 shows all the measurements associated with the particulate sampling, including filter references, gas meter readings, temperature readings, sampling times and filter weights. It also includes the derived results of sample volume (ambient and normal), and particulate weight and concentration. The page also includes two separate tables showing the calculation of isokinetic sampling efficiency based on the stack flow rate and test sampling rate.

Appendix pages 2 - 4 are tables of pitot tube measurements showing all the readings across the exhaust traverses. The tables show the calculation of velocity and volume flow in each stack.

Appendix pages 5 - 7 are copies of the on-site data sheets, which show all the data recorded in its original form. The flow rates are calculated for site work, which determines the isokinetic rate at each sampling point.

Appendix

VRS Coventry

Aspen Environmental Ltd



Particulate Emissions from Spray Booths (13/11/2007)

Filter	Dry Gas Meter:			Temperature °C		Normal Sample Volume Litres	Time			Particulate		
	Ref	DGM Correction Factor =	1.03	Stack	Gas Meter		Initial	Final	Elapsed minutes	mg	Acetone mg	Concentration mg/m3

Booth No.1 (Junair)

Barometric Pressure =	1002	mb										
H418	368231.4	368257.8	26.4	21.5	10.4	24.4	11:58	12:02	4	0.058	0.056	4.67
H413	368272.8	368300.0	27.2	21.5	10.4	25.2	12:11	12:15	4	0.165	0.099	10.49
					Total	49.6					Mean	7.58

Booth No.2 (Junair)

Barometric Pressure =	1002	mb										
HD416	368122.5	368170.8	48.3	21.5	10	44.7	11:04	11:12	8	<0.15	0.26	<6
HD417	368182.7	368218.9	36.2	21.5	10	33.5	11:27	11:32	5	0.024	0.069	2.77
					Total	78.3					Mean	2.77

Booth No.3 (Primer)

Barometric Pressure =	1002	mb										
H411	368321.3	368352.6	31.3	21.5	10	29.0	13:24	13:28	4	0.020	0.082	3.52
					Total	29.0					Mean	3.52

H414 Field Blank

<0.15 0.01

Isokinetic Sampling Efficiency (Percentage)

No.1 Spray Booth			Sample Volume in Litres	
Normal Duct Velocity	7.07	Nm / s	Theoretical	42.6
Sampling Tip Diameter	4	mm	Actual	49.6
Sampling Time	8	minutes	% Isokinetic	

No.2 Spray Booth			Sample Volume in Litres	
Normal Duct Velocity	7.94	Nm / s	Theoretical	77.8
Sampling Tip Diameter	4	mm	Actual	78.3
Sampling Time	13	minutes	% Isokinetic	100.6

No.3 Spray Booth			Sample Volume in Litres	
Normal Duct Velocity	9.32	Nm / s	Theoretical	28.1
Sampling Tip Diameter	4	mm	Actual	29.0
Sampling Time	4	minutes	% Isokinetic	103.2

Pitot Flow Measurements

Aspen Environmental Ltd



Client: VRS	Time & Date: 11:50 (13/11/2007)
Address: Coventry	Operator: GB & JB
	Job Number: 806
	Location: Booth No.1 (Junair)

Details of Duct	Absolute Atmospheric Pressure (millibars)
Duct Shape: Vertical Circular	Instrument Correction Corrected
Dimension / Diameter: (cm) 65	Initial: 1004 -2 1002
Area: sq metres 0.33	Final: 1004 -2 1002
	Mean: 1002

Pitot Tube Position:	Distance into Duct		Axis 1:			Axis 2:		
	% Diameter	cm	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius
1	1.9	1.2	40	17	21	44	15	22
2	7.7	5.0	40	18	22	42	16	22
3	15.3	9.9	37	16	21	42	18	21
4	21.7	14.1	35	17	21	40	18	22
5	36.1	23.5	35	18	22	36	15	21
6	63.9	41.5	38	20	21	35	18	21
7	78.3	50.9	42	21	22	37	22	22
8	84.7	55.1	44	23	22	35	26	21
9	92.3	60.0	40	25	21	33	22	21
10	98.1	63.8	35	30	22	30	22	22

RMS & Means:	38.71	20.5	21.5	37.64	19.2	21.5
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Mean Pv (Pascals)	38.18	Mean T in K (°C + 273)	294.5
Static Pressure (Pa)	19.85	Pitot Tube 200 K Factor	0.96

Duct Velocity (V) @ Temperature (T) in metres per second	7.71
Duct Velocity (V) @ 273K, 1013mb, in metres per second	7.07
Duct Volume Flow @ T in cubic metres per second	2.56
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	2.34
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	4968
Duct Volume Flow @ Temperature (T) in cubic feet per minute	5418

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Pitot Flow Measurements

Aspen Environmental Ltd



Client: VRS	Time & Date: 10:55 (13/11/2007)
Address: Coventry	Operator: GB & JB
	Job Number: 806
	Location: Booth No.2 (Junair)

Details of Duct	Absolute Atmospheric Pressure (millibars)
	Instrument Correction Corrected
Duct Shape: Vertical Circular	Initial: 1004 -2 1002
Dimension / Diameter: (cm) 65	Final: 1004 -2 1002
Area: sq metres 0.33	Mean: 1002

Pitot Tube Position:	Distance into Duct		Axis 1:			Axis 2:		
	% Diameter	cm	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius
1	1.9	1.2	35	28	21	45	29	22
2	7.7	5.0	40	33	22	55	29	22
3	15.3	9.9	40	34	21	52	31	21
4	21.7	14.1	41	34	21	50	30	22
5	36.1	23.5	41	33	22	53	30	21
6	63.9	41.5	42	29	21	53	32	21
7	78.3	50.9	41	34	22	58	35	22
8	84.7	55.1	45	35	22	62	34	21
9	92.3	60.0	44	35	21	66	36	21
10	98.1	63.8	42	35	22	56	35	22

RMS & Means:	41.18	33	21.5	55.29	32.1	21.5
Mean Pv (Pascals)	48.24	Mean T in K (°C + 273)				294.5
Static Pressure (Pa)	32.55	Pitot Tube	200	K Factor	0.96	

Duct Velocity (V) @ Temperature (T) in metres per second	8.66
Duct Velocity (V) @ 273K, 1013mb, in metres per second	7.94
Duct Volume Flow @ T in cubic metres per second	2.87
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	2.64
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	5583
Duct Volume Flow @ Temperature (T) in cubic feet per minute	6089

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Pitot Flow Measurements

Aspen Environmental Ltd



Client: VRS Address: Coventry	Time & Date: 13:15 (13/11/2007) Operator: GB & JB Job Number: 806 Location: Booth No.3 (Primer)
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Details of Duct			Absolute Atmospheric Pressure (millibars)		
Duct Shape: Vertical	Circular	Initial: 1004	Instrument Correction: -2	Corrected: 1002	
Dimension / Diameter: (cm)	65	Final: 1004	-2	1002	
Area: sq metres	0.33	Mean: 1002			

Pitot Tube Position:	Distance into Duct		Axis 1:			Axis 2:		
	% Diameter	cm	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius
1	1.9	1.2	58	43	22			
2	7.7	5.0	59	46	22			
3	15.3	9.9	65	61	23			
4	21.7	14.1	72	71	22			
5	36.1	23.5	76	76	23			
6	63.9	41.5	70	70	23			
7	78.3	50.9	72	70	22			
8	84.7	55.1	72	72	23			
9	92.3	60.0	64	78	23			
10	98.1	63.8	55	76	22			

RMS & Means:	66.65	66.3	22.5	66.65	66.3	22.5
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Mean Pv (Pascals)	66.65	Mean T in K (°C + 273)	295.5
Static Pressure (Pa)	66.3	Pitot Tube	200
		K Factor	0.96

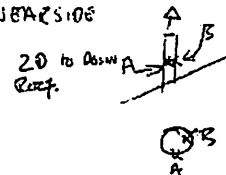
Duct Velocity (V) @ Temperature (T) in metres per second	10.20
Duct Velocity (V) @ 273K, 1013mb, in metres per second	9.32
Duct Volume Flow @ T in cubic metres per second	3.38
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	3.09
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	6551
Duct Volume Flow @ Temperature (T) in cubic feet per minute	7169

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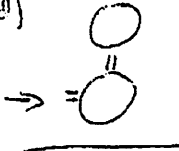
Data should be entered in all fields

Aspen Environmental Ltd					Sheet 2 of 3			General Sampling Data Form								
Location & Drawing Spray Booth No.1 Junai					Location											
					Date	15/11/17	Time	17:05								
					Barometric Pressure		mb		1004							
					Temperature °C		Exhaust									
							Ambient									
		Gas Meter		10.4												
Pitot Tube Traverses (Measurements in Pa)			Stack Dimensions (cm) & Aspect 65 circ vent A					Aspen Job Number 806								
Position	Time	1	2	3	4	5	6	7	8	9	10	Mean	Notes			
Pv	A	10	10	27	35	35	38	42	44	40	35					
Ps		17	18	16	17	18	20	21	23	25	20					
T		21/22														
Angle	15															
Pv	B	46	42	42	40	36	35	37	35	33	30					
Ps		13	16	18	15	15	18	22	26	22	22					
T		21/22														
Angle	15															
Flow @ Ambient		m/s		Sampling Flow		L/min		Tip Diameter		mm		Pitot Tube 20		Equipment & Blank		
Sample Reference	Position	Vac Check	Time		Gas Meter / Counter		Sampling Points		cm							
			Initial	Final	Initial	Final	Comments									
H68	B	✓✓	11.58	4	368231.4	3682578	60pa @ 20						AS1 Pump			
H613	B	✓✓	12.11	4	3682728	368300.0	7.7 m/s						Flowmeter			
							53 @ 6						Gasmeter			
													Gas Temp			
													Silica Gel			
													Thermocouple			
													Field Blank			
												Operator JB				
												Normal Flow				
					Form 1					© Aspen Environmental Ltd		Version 7 (June 2007)				

Data should be entered in all fields

Aspen Environmental Ltd							Sheet 1 of 3			General Sampling Data Form									
Location & Drawing SMT 800TH NEAR S106 VES Coventry No2 June 							Location												
							Date 15/11/07		Time 1126		Barometric Pressure mb 1004			Temperature °C			Exhaust		
							Ambient			Gas Meter 10.0			Aspen Job Number 808			Notes			
							Pitot Tube Traverses (Measurements in Pa)				Stack Dimensions (cm) & Aspect 65 circ vert A				Aspen Job Number 808				
							Position	Time	1	2	3	4	5	6	7	8	9	10	Mean
Pv	A	35	40	40	41	41	42	41	45	44	42								
Ps		+28	+33	+36	+34	+33	+29	+34	+35	+35	+35								
T		21/22																	
Angle	15>																		
Pv	B	45	55	52	50	53	53	58	62	66	56								
Ps		+29	+31	+31	+30	+30	+32	+35	+36	+36	+35								
T		21/22																	
Angle	15>																		
Flow @ Ambient m/s		Sampling Flow L/min		Tip Diameter mm		Pitot Tube 210		Equipment & Blank											
Sample Reference	Position	Vac Check	Time		Gas Meter / Counter		Sampling Points		cm										
			Initial	Final	Initial	Final	Comments												
MD 416	A1	✓✓	11.04	+8	368122.5	368120.8	60 mm @ 20	50 mm @ 20	60 mm @ 20			129	Pump						
MD 417		✓✓	11.27	+5	368182.7	368218.9	7.7	8.6	9.5			80	Flowmeter						
							5.8 @ 4	6.5 @ 4	7.2 @ 4			97	Gasmeter						
												83	Gas Temp						
												77	Silica Gel						
												330	Thermocouple						
													Field Blank						
												Operator							
												GD JB							
												Normal Flow							
						Form 1		© Aspen Environmental Ltd			Version 7 (June 2007)								

Data should be entered in all fields

Aspen Environmental Ltd						Sheet <u>3 of 3</u>		General Sampling Data Form					
Location & Drawing <u>SINGLE booth (3rd)</u> <u>PRIMER</u> <u>only available reverse</u> → 						Location <u>13:20</u>							
Date <u>15/11/77</u>						Time							
Barometric Pressure <u>mb</u>													
Temperature °C						Exhaust							
						Ambient							
Gas Meter <u>10.0</u>													
Pitot Tube Traverses (Measurements in Pa)				Stack Dimensions (cm) & Aspect					Aspen Job Number <u>806</u>				
Position	Time	1	2	3	4	5	6	7	8	9	10	Mean	Notes
Pv		<u>58</u>	<u>59</u>	<u>65</u>	<u>70</u>	<u>76</u>	<u>80</u>	<u>77</u>	<u>72</u>	<u>66</u>	<u>55</u>		
Ps		<u>+63</u>	<u>+66</u>	<u>+61</u>	<u>+71</u>	<u>+76</u>	<u>+70</u>	<u>+70</u>	<u>+72</u>	<u>+78</u>	<u>+76</u>		
T		<u>22.23</u>											
Angle		<u>152</u> →											
Pv													
Ps													
T													
Angle													
Flow @ Ambient		m/s		Sampling Flow		L/min		Tip Diameter		mm		Pitot Tube <u>25</u>	
Equipment & Blank													
Sample Reference	Position	Vac Check	Time		Gas Meter / Counter		Sampling Points					cm	
<u>H411</u>	<u>95.55.5</u>	<u>✓✓</u>	<u>13:24</u>	<u>4</u>	<u>368321.3</u>	<u>368352.6</u>	<u>20pa @ 20</u>					<u>AB</u>	<u>Pump</u>
<u>H398</u>							<u>10.7 m/s</u>					<u>Sheet</u>	<u>Flowmeter</u>
							<u>7.6 um @ 4</u>					<u>①</u>	<u>Gasmeter</u>
													<u>Gas Temp</u>
													<u>Silica Gel</u>
													<u>Thermocouple</u>
												<u>H414</u>	<u>Field Blank</u>
											Operator <u>SP+JB</u>		
											Normal Flow		