

November 2006

# Vehicle Remarketing Solutions, Coventry

## Spray Booth Emissions 2006

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

Date: 27/11/2006

Ref: L.1618

Dear Jane,

**Emissions Testing at VRS, Coventry:**

Herewith my report on the testing undertaken at Coventry, on the 18th October 2006.

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,  
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**Emissions Testing of Spray Booths  
At VRS, Coventry 18th October 2006**

**Report Prepared for Aspen Environmental Ltd by  
Dr G.W. Buck (Director)  
J742  
November 2006**

*G.W. Buck*  
27/11/06

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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 Buck and Miss K Lunnon of Aspen Environmental Ltd visited the site on the 18th October 2006 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.

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 loaded control 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). Miss K Lunnon is personally MCerted to Level 1. Aspen Environmental Ltd is UKAS and MCerts accredited (UKAS Lab No. 2395) for particulates to BS 9096 and for a range of other parameters.

Two of the duct flows were only measured using one traverse. The weighing of filters was done using Aspen's Cahn balance, which is due to be UKAS assessed in mid December.

## 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.

<b>VRS Coventry: Spray Booth Emissions 18th October 2006</b>			
<b>Total Particulates</b>	<b>mg/m<sup>3</sup> Normalised to 273K, 1013 mb, dry gas</b>	<b>Uncertainty in Measurements</b>	<b>Emission Limit In mg/Nm<sup>3</sup> PG 6/34 (July 2003)</b>
<b>Booth No.1</b>	2.31 1.53		
<b>Mean</b>	<b>1.92</b>	$\pm 0.2$	10
<b>Booth No.2</b>	2.10 2.81		
<b>Mean</b>	<b>2.45</b>	$\pm 0.25$	10
<b>Booth No.3</b>	2.13		
<b>Mean</b>	<b>2.13</b>	$\pm 0.2$	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



# Garage Engineering, VRS Coventry

Aspen Environmental Ltd



## Particulate Emissions

Filter Ref	Dry Gas Meter:			Temperature ° C		Normal Sample Volume Litres	Time			Particulate	
	DGM Correction Factor =	1.01		Stack	Gas Meter		Initial	Final	Elapsed minutes	mg	Concentration mg/m3

### Booth 1 (Junair Booth) (18/10/2006)

Barometric Pressure =			996	mb								
0035	323883.8	324026.1	142.3	25	18.5	129.7	14:45	14:55	10	< 0.3	2.31	
0036	324026.1	324169.4	143.3	25	18.5	130.6	14:56	15:06	10	0.2	1.53	
						<b>Total</b>	<b>260.4</b>				<b>Mean:</b>	<b>1.92</b>
0034	Control										< 0.3	

### Booth 2 (Junair Booth) (18/10/2006)

Barometric Pressure =			994	mb								
0037	324169.4	324327.4	158.0	24	20.3	142.9	15:30	15:40	10	< 0.3	2.10	
0038	324327.4	324485.0	157.6	24	20.4	142.5	15:43	15:53	10	0.4	2.81	
						<b>Total</b>	<b>285.3</b>				<b>Mean:</b>	<b>2.45</b>

### Booth 3 (Primer Booth) (18/10/2006)

Barometric Pressure =			993	mb								
0039	324485.0	324640.8	155.8	24	20.3	140.7	16:42	16:52	10	< 0.3	2.13	
						<b>Total</b>	<b>140.7</b>					
0040	Loaded Control										0.0	

## Percentage Isokinetic Sampling

Booth 1 (Junair)				Sample Volume in Litres	
Normal Duct Velocity	8.35	Nm / s		Theoretical	283.3
Sampling Tip Diameter	6	mm		Actual	260.4
Sampling Time	20	minutes		<b>% Isokinetic</b>	<b>91.9</b>

Booth 2 (Junair)				Sample Volume in Litres	
Normal Duct Velocity	10.07	Nm / s		Theoretical	341.7
Sampling Tip Diameter	6	mm		Actual	285.3
Sampling Time	20	minutes		<b>% Isokinetic</b>	<b>83.5</b>

Booth 3 (Primer)				Sample Volume in Litres	
Normal Duct Velocity	9.84	Nm / s		Theoretical	166.9
Sampling Tip Diameter	6	mm		Actual	140.7
Sampling Time	10	minutes		<b>% Isokinetic</b>	<b>84.3</b>

# Pitot Flow Measurements

Aspen Environmental Ltd



Client: Garage Engineering VRS Address: Coventry	Time & Date: 13:35-13:45 (18/10/2006) Operator: GB + KL Job Number: 742 Location: Booth 1 (Junair)
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<b>Details of Duct</b> Duct Shape: Vertical      Circular Dimension / Diameter: (cm)      64 Area: sq metres      0.32	<b>Atmospheric Pressure (Pa) millibars</b> Initial: 996 Final: 996 Mean: 996
---	---

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	49	29	25			
2	7.7	4.9	56	33	25			
3	15.3	9.8	53	33	25			
4	21.7	13.9	48	34	25			
5	36.1	23.1	46	33	25			
6	63.9	40.9	45	34	25			
7	78.3	50.1	49	34	25			
8	84.7	54.2	51	32	25			
9	92.3	59.1	54	32	25			
10	98.1	62.8	48	35	25			

<b>RMS &amp; Means:</b>	50.01	32.9	25	50.01	32.9	25
Mean Pv (Pascals)	50.01	Mean T in K (°C + 273)	298			
Static Pressure (Pa)	32.9	Pitot Tube	200	K Factor	1	

Duct Velocity (V) @ Temperature (T) in metres per second	9.27
Duct Velocity (V) @ 273K, 1013mb, in metres per second	8.35
Duct Volume Flow @ T in cubic metres per second	2.98
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	2.69
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	5690
Duct Volume Flow @ Temperature (T) in cubic feet per minute	6318

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# Pitot Flow Measurements

Aspen Environmental Ltd



<b>Client:</b> Garage Engineering VRS <b>Address:</b> Coventry			<b>Time &amp; Date:</b> 15:15-15:25 (18/10/2006) <b>Operator:</b> GB + KL <b>Job Number:</b> 742 <b>Location:</b> Booth 2 (Junair)					
<b>Details of Duct</b> <b>Duct Shape:</b> Vertical      Circular <b>Dimension / Diameter: (cm)</b> 64 <b>Area: sq metres</b> 0.32			<b>Atmospheric Pressure (Pa) millibars</b> <b>Initial:</b> 994 <b>Final:</b> 994 <b>Mean:</b> 994					
Pitot Tube Position:	Distance into Duct		Axis 1:			Axis 2:		Duct Temp ° Celsius
	% Diameter	cm	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	
1	1.9	1.2	57	12	24	69	19	24
2	7.7	4.9	65	16	24	86	24	24
3	15.3	9.8	66	20	24	86	25	24
4	21.7	13.9	69	26	24	71	25	24
5	36.1	23.1	69	28	24	69	28	24
6	63.9	40.9	69	31	24	66	28	24
7	78.3	50.1	67	32	24	72	33	24
8	84.7	54.2	72	33	24	78	33	24
9	92.3	59.1	82	35	24	79	34	24
10	98.1	62.8	79	37	24	77	34	24
<b>RMS &amp; Means:</b>			69.82	27	24	75.60	28.3	24
<b>Mean Pv (Pascals)</b>			72.71	<b>Mean T in K (°C + 273)</b>			297	
<b>Static Pressure (Pa)</b>			27.65	<b>Pitot Tube</b>	200	<b>K Factor</b>	1	
<b>Duct Velocity (V) @ Temperature (T) in metres per second</b>								11.17
<b>Duct Velocity (V) @ 273K, 1013mb, in metres per second</b>								10.07
<b>Duct Volume Flow @ T in cubic metres per second</b>								3.59
<b>Duct Volume Flow @ 273K, 1013mb, in cubic metres per second</b>								3.24
<b>Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute</b>								6866
<b>Duct Volume Flow @ Temperature (T) in cubic feet per minute</b>								7613

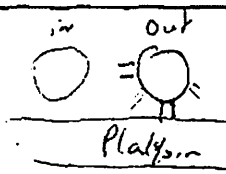
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# Pitot Flow Measurements

Aspen Environmental Ltd



<b>Client:</b> Garage Engineering VRS <b>Address:</b> Coventry			<b>Time &amp; Date:</b> 16:30-16:40 (18/10/2006) <b>Operator:</b> GB + KL <b>Job Number:</b> 742 <b>Location:</b> Booth 3 (Primer)						
<b>Details of Duct</b> <b>Duct Shape:</b> Vertical      Circular <b>Dimension / Diameter: (cm)</b> 64 <b>Area: sq metres</b> 0.32			<b>Atmospheric Pressure (Pa) millibars</b> <b>Initial:</b> 993 <b>Final:</b> 993 <b>Mean:</b> 993						
Pitot Tube Position:	Distance into Duct		Axis 1:			Axis 2:		Duct Temp ° Celsius	
	% Diameter	cm	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals	Duct Temp ° Celsius	Velocity Pressure Pv Pascals	Static Pressure Ps Pascals		
1	1.9	1.2	76	36	24				
2	7.7	4.9	75	34	24				
3	15.3	9.8	70	38	24				
4	21.7	13.9	71	44	24				
5	36.1	23.1	74	44	24				
6	63.9	40.9	74	49	24				
7	78.3	50.1	65	49	24				
8	84.7	54.2	63	52	24				
9	92.3	59.1	63	52	24				
10	98.1	62.8	61	52	24				
<b>RMS &amp; Means:</b>			69.41	45	24	69.41	45	24	
<b>Mean Pv (Pascals)</b>			69.41	<b>Mean T in K (°C + 273)</b>			297		
<b>Static Pressure (Pa)</b>			45	<b>Pitot Tube</b>			200	<b>K Factor</b>	1
<b>Duct Velocity (V) @ Temperature (T) in metres per second</b>								10.92	
<b>Duct Velocity (V) @ 273K, 1013mb, in metres per second</b>								9.84	
<b>Duct Volume Flow @ T in cubic metres per second</b>								3.51	
<b>Duct Volume Flow @ 273K, 1013mb, in cubic metres per second</b>								3.16	
<b>Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute</b>								6705	
<b>Duct Volume Flow @ Temperature (T) in cubic feet per minute</b>								7441	
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Aspen Environmental Ltd										General Sampling Data Form						
Location & Drawing VRS - COUNTRY SOUTH JUNAK BATH 					Location											
					Date	18/10/06	Time	15:35	14:00							
					Barometric Pressure	mb	99.8									
					Temperature °C	Exhaust										
						Ambient										
	Gas Meter	#22	18.5													
Pitot Tube Traverses (Measurements in Pascals)					Stack Dimensions (cm) & Aspect 6cm circ vent ↑											
Position	Time	1	2	3	4	5	6	7	8	9	10	Mean	Notes			
Pv	13:35	49	56	53	48	46	45	49	51	54	48					
Ps		+29	+33	+33	34	32	34	32	32	32	35					
T		25														
Angle		<15														
Pv																
Ps																
T																
Angle																
Vacuum Check ✓		Flow @ Ambient 8.4 m/s		Sampling Flow 14.2 L/min		Tip Diameter 6 mm		Pitot Tube 200								
Sample Reference	Position	Time		Gas Meter / Counter		Sampling Points		Equipment & Blank								
		Initial	Final	Initial	Final	Comments	cm									
0034	Control						32cm centre	129	Pump							
							Centre point 10 mins each Gmeter	#2082	Flowmeter							
								97	Gasmeter							
0035		14:45	14:55	3238838	324026.1	base coat		83	Gas Temp							
0036		14:56	15:06		324169.4	14:58 spraying finished in both N° ①.		77	Silica Gel							
									Thermocouple							
									Field Blank							
									Operator GB + KL							
									Normal Flow							
Form 1 © Aspen Environmental Ltd										Version 5 (December 2005)						

Aspen Environmental Ltd										General Sampling Data Form					
Location & Drawing VRS - CONCRETE BOOTH ② JUNAIR BOOTH 					Location										
					Date	18/10/06	Time	15:20	15:44	15:53					
					Barometric Pressure	mb	996								
					Temperature °C	Exhaust									
						Ambient									
	Gas Meter		20.3	20.4											
Pitot Tube Traverses (Measurements in Pascals)					Stack Dimensions (cm) & Aspect <b>84</b> cm circ vent ↑										
Position	Time	1	2	3	4	5	6	7	8	9	10	Mean	Notes		
A	Pv	57	65	66	69	69	69	67	72	82	79				
	Ps	+12	16	20	26	28	31	32	33	35	37				
	T	24													
	Angle	<15													
B	Pv	67	86	86	71	69	66	72	78	79	77				
	Ps	19	24	25	25	28	28	33	33	34	34				
	T	24													
	Angle	<15													
Vacuum Check		Flow @ Ambient		10.6	m/s	Sampling Flow		18	L/min	Tip Diameter		6	mm	Pitot Tube	200
Sample Reference	Position	Time		Gas Meter / Counter		Sampling Points		10 mins on each beam @		cm		Equipment & Blank			
		Initial	Final	Initial	Final	Comments									
0037		15:30	15:40	324169.4	324327.4	open flow - just under 18 l/min						129	Pump		
												82	Flowmeter		
												97	Gas meter		
0038		15:43	15:53		324485.0								Gas Temp		
													Silica Gel		
													Thermocouple		
													Field Blank		
												Operator			
												GB+KL			
												Normal Flow			
										Form 1		© Aspen Environmental Ltd		Version 5 (December 2005)	

