082

March 2005

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Emissions Testing of Spray Booths
at WMK 08/03/2005

Report Prepared for Aspen Environmental Ltd by
Dr G.W.Buck (Director)
J 612
March 2005

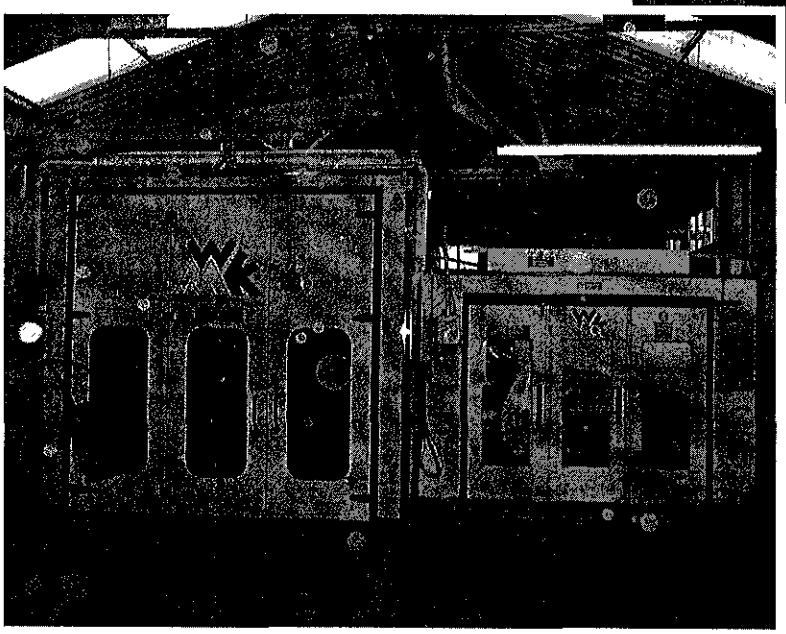
Contents

Introduction

WMK Accident Repair Ltd operate a bodyshop in Keresley in Coventry. The bodyshop has two spraybooths located side by side at the end of the property.

Dr Buck of Aspen Environmental Ltd, visited the site on the 8th March 2005 to undertake the sampling of the site emissions.

The two spraybooths have circular profile exhausts extending approximately 3m above the metal roof. Both have reductions in the stack diameter (Venturis) at the top to increase the final exhaust velocity.



For identification purposes, the booths are defined throughout the report by their manufacturers. Spraybooth No.1 (seen here, in both photos, on the RHS) is a Burntwood Booth, and the larger Spraybooth (LHS) is a Spraybake Booth with Junair select control.

Methodology

The test procedure followed the main procedural points of ISO 9096:2003 for sampling of particulates in the exhausts. Each filter sample was collected at two points on each traverse, four per sample, collected in duplicate, in each exhaust.

Sampling was undertaken when spraying was in progress in the booth below, and the exhaust was functioning. In both cases after the spraying was complete, the booth moved into a bake function, circulating warm air to dry the paint, and with the exhaust blocked off.

The flow in the Burntwood booth exhaust was very turbulent, with some negative flows recorded. However the positioning of the sampling points was optimal, and for this booth sampling was undertaken at a single centre point location.

For each booth two samples were collected while spraying was underway on the same vehicle part. The item sprayed in the Spraybake Booth No. 2 was a vehicle roof section. For the first sample the spray was base coat silver (water based), and the second was clearcoat (solvent based). Similarly in the Burntwood Booth No.1 silver basecoat and clearcoat were applied to the front wings of a Renault MPV.

Dr Buck is personally MCerted to Team Leader grade, with technical extensions for particulates and gas analysis, Aspen Environmental Ltd is endorsed by the STA for particulate testing and gas analysis, and the company has nearly completed its passage to UKAS & MCerts accreditation for gas and organic analysis. The draft schedule document issued by UKAS includes EN 13649 above.

Results

The results are presented in a summary table below, which shows the emissions of particulates from the two booths. Each parameter was sampled twice in each exhaust, and the individual results are shown, plus a mean result. 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.

WMK Accident Repair: Spray Booth Emissions 08/03/2005			
Total Particulates	**mg/m^3 Normalised to 273 K, 1013 mb, dry gas**	**Uncertainty in Measurements**	**Emission Limit in mg/Nm^3 PG 6/34 (July 2003)**
No. 1 Burntwood Booth	5.5 28.7		
Mean	**17.1**	± 2.6	10
No. 2 Spraybake Booth	3.9 12.3		
Mean	**8.1**	± 0.8	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 & 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 & 3 are two tables of pitot tube flow measurements, showing all the readings across the two traverses. The turbulence in No. 1 can clearly be seen, and the better performance of No. 2. The table shows the calculation of velocity and volume flow in each stack.

Appendix pages 4 & 5 are copies of the on-site data sheets, and show all the data recorded in its original form. In each case the flow rates are calculated for site work, which determines the isokinetic rate at each sampling point.

Discussion

In both cases the base coat spray releases much less material to atmosphere than the clear coat. This is probably because the clear coat is solvent based, rather than water based, and forms smaller droplets which can more easily pass the spray booth filters.

The No.1 Burntwood Booth has a basecoat emission of 5.5 mg/Nm^3 and a clearcoat emission of 28.7 mg/Nm^3 generating a final mean emission of 17.1 mg/Nm^3, which is not in compliance with the 10 mg/Nm^3 emission limit in the new (draft) version of PG 6/34.

The No. 2 Spraybake Booth has a basecoat emission of 3.9 mg/Nm^3 and a clearcoat emission of 12.3 mg/Nm^3 generating a final mean emission of 8.1 mg/Nm^3, which is in compliance with the 10 mg/Nm^3 emission limit in the new (draft) version of PG 6/34.

This emission limit is unchanged from the previous version PG6/34(92).

Conclusion

The No.1 spraybooth at WMK is out of compliance with PG 6/34, and the filtration media should be replaced to improve the efficiency of the booth

The No. 2 spraybooth is in compliance overall.

Appendix

WMK Accident Repair Centre

Aspen Environmental Ltd

Particulate Emission from Spray Booths (08/03/2005)

Filter	Dry Gas Meter:			Temperature ° C			Time			Filter Weight		Particulate		
Ref	Initial	Final	Elapsed	Stack	DGM	Normal Sample Volume Litres	Initial	Final	Elapsed minutes	Initial mg	Final mg	mg	Acetone mg	Concentration mg/m3
No. 1 Burntwood Booth														
Barometric Pressure =			**1019**	**mb**										
29379	261798.2	261833.9	35.7	25	14	34.2	14.15	14.23	8	120.424	120.511	0.087	0.1	**5.47**
29380	261833.9	261853.6	19.7	25	14	18.9	14.40	14.44	4	118.627	119.068	0.441	0.1	**28.70**
					Total	**53.0**								
No. 2 Spraybake Booth														
Barometric Pressure =			**1019**	**mb**										
29358	261672.8	261736.0	63.2	20	14	60.5	12.45	12.55	10	119.148	119.286	0.138	0.1	**3.94**
29359	261736.0	261798.2	62.2	20	14	59.5	13.15	13.24	9	119.196	119.527	0.331	0.4	**12.28**
					Total	**120.0**								
29360	Control									119.593	119.616	0.023	-0.4	

Isokinetic Sampling Efficiency

No.1 Burntwood Booth			**Sample Volume in Litres**	
Centre N Duct Velocity	5.7	Nm / s	Theoretical	50.1
Sampling Tip Diameter	4	mm	Actual	53.0
Sampling Time	11.7	minutes	**% Isokinetic**	**105.7**

No.2 Spraybake Booth			**Sample Volume in Litres**	
Normal Duct Velocity	9.66	Nm / s	Theoretical	137.2
Sampling Tip Diameter	4	mm	Actual	120.0
Sampling Time	18.8	minutes	**% Isokinetic**	**87.5**

Pitot Flow Measurements

Aspen Environmental Ltd

Client:	WMK Accident Repair	**Time & Date:**	08/03/2005
Address:	Coventry	**Operator:**	GB
		Job Number:	612
		Location:	Burntwood Booth No. 1

Details of Duct		
Duct Shape:	Vertical	Circular
Dimension / Diameter: (cm)		70
Area: sq metres		0.38

Atmospheric Pressure (Pa) millibars	
Initial:	1019
Final:	1019
Mean:	1019

Pitot Tube Position:	Distance into Duct % Diameter	cm	Axis 1: Velocity Pressure Pv Pascals	Duct Temp ° Celsius	Axis 2: Velocity Pressure Pv Pascals	Duct Temp ° Celsius
1	1.9	1.0	0	25	0	
2	7.7	4.1	0		0	
3	15.3	8.1	0		0	
4	21.7	11.5	0		18	
5	36.1	19.1	0		27	
6	63.9	33.9	14		18	
7	78.3	41.5	23		11	
8	84.7	44.9	25		9	
9	92.3	48.9	2		0	
10	98.1	52.0	7		0	
		RMS:	11.84		12.57	
Mean Pv (Pascals)			12.21	**Mean T in K (°C + 273)**		298
Static Pressure (Pa)			-50	**Pitot Tube** 200	**K Factor**	1

Duct Velocity (V) @ Temperature (T) in metres per second	**4.53**
Duct Velocity (V) @ 273K, 1013mb, in metres per second	**4.17**
Duct Volume Flow @ T in cubic metres per second	**1.74**
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	**1.61**
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	**3403**
Duct Volume Flow @ Temperature (T) in cubic feet per minute	**3693**

Pitot Flow Measurements

Aspen Environmental Ltd

Client:	WMK Accident Repair	**Time & Date:**	08/03/2005
Address:	Coventry	**Operator:**	GB
		Job Number:	612
		Location:	Spraybake Booth No. 2

Details of Duct			**Atmospheric Pressure (Pa) millibars**	
Duct Shape:	Vertical	Circular	**Initial:**	1019
Dimension / Diameter: (cm)		76	**Final:**	1019
Area: sq metres		0.45	**Mean:**	1019

Pitot Tube Position:	Distance into Duct % Diameter	cm	Axis 1: Velocity Pressure Pv Pascals	Duct Temp ° Celsius	Axis 2: Velocity Pressure Pv Pascals	Duct Temp ° Celsius
1	**1.9**	1.0	76	20	106	
2	**7.7**	4.1	105		99	
3	**15.3**	8.1	107		73	
4	**21.7**	11.5	87		27	
5	**36.1**	19.1	99		4	
6	**63.9**	33.9	54		10	
7	**78.3**	41.5	4		32	
8	**84.7**	44.9	0		44	
9	**92.3**	48.9	0		54	
10	**98.1**	52.0	0		37	
		RMS:	69.68		58.70	
Mean Pv (Pascals)			64.19	**Mean T in K (°C + 273)**		293
Static Pressure (Pa)			-30	**Pitot Tube** 200	**K Factor**	1

Duct Velocity (V) @ Temperature (T) in metres per second	**10.30**
Duct Velocity (V) @ 273K, 1013mb, in metres per second	**9.65**
Duct Volume Flow @ T in cubic metres per second	**4.67**
Duct Volume Flow @ 273K, 1013mb, in cubic metres per second	**4.38**
Duct Volume Flow @ 273K, 1013mb, in cubic feet per minute	**9276**
Duct Volume Flow @ Temperature (T) in cubic feet per minute	**9897**

Aspen Environmental Ltd

General Sampling Data Form

Location & Drawing

Wyndon Motors
Keresley

Burntwood Booth
No1.

Location	
Date 8/3/05 Time	11.10
Barometric Pressure mb	1019
Temperature ° C Exhaust	25
Ambient	12
Gas Meter	14

Pitot Tube Traverses (Measurements in Pascals)

Stack Dimensions (cm) & Aspect 70cm circ vert ↑

Position	Time	1	2	3	4	5	6	7	8	9	10	Mean	Static
Pv A		-53	-73	-85	-61	-7	14	23	25	2	9		
Ps													
T													
Pv B		-73	-74	-19	18	27	18	11	9	-8	-20		-50
Ps													
T													

Vacuum Check ✓ **Flow @ Ambient** Centre 5.7 m/s **Sampling Flow** 4.3 (4.8) L/min **Tip Diameter** 4 (6) mm **Pitot Tube** 200

Sampling Points Centre Point 35 cm

Comments 4.3 @ 4 in centre.

Sample Reference	Position	Time Initial	Time Final	Gas Meter / Counter Initial	Gas Meter / Counter Final	Comments
29379	Centre	14.15.	7.30.	261798.2	261833.9	Silver MPV Renault both front wings 6 spray
29380	Centre	14.40	4.10.	↙	261853.6.	Basecoat (79) Topcoat (80)

Equipment

129	Pump
80	Flowmeter
87	Gasmeter
83	Gas Temp
77	Silica Gel
X	Condenser
194	Thermocouple
179	S Gp stat

Operator GB

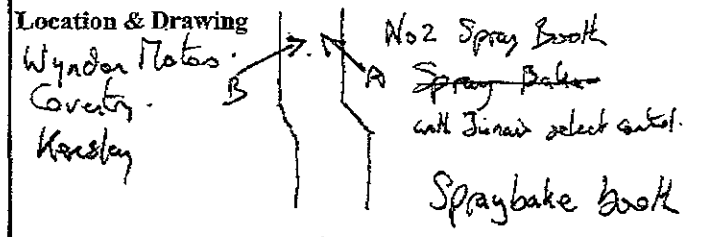
Normal Flow ~~7.63~~ PB 4.17

Form 1 © Aspen Environmental Ltd Version 4 (May 2004)

Aspen Environmental Ltd — General Sampling Data Form

Location & Drawing

Wynden Motors
Coventry
Keresley



Location						
Date 8/3/05	Time	11.05				
Barometric Pressure	mb	1019				
Temperature °C	Exhaust	20.				
	Ambient	22				
	Gas Meter	14.2	K			

Pitot Tube Traverses (Measurements in Pascals)

Stack Dimensions (cm) & Aspect 76 cm circ vert ↑

Position		Time	1	2	3	4	5	6	7	8	9	10	Mean	Static
Pv	A	10.50	76	105	107	87	99	54	4	-6	0	-15		
Ps														
T														
Pv	B	10.55	106	99	73	27	4	10	32	44	54	37	(50)	-30
Ps														
T														

Vacuum Check ✓ **Flow @ Ambient** 9.0 m/s **Sampling Flow** 7 (10.3) L/min **Tip Diameter** 6 mm **Pitot Tube** 200

Sample Reference	Position	Time Initial	Time Final	Gas Meter / Counter Initial	Gas Meter / Counter Final	Comments
29358	4pts	12.45	9.47 Sat	261672.8	261736.0	Base coat silver roof.
29359	4pts	13.15	9.03		261982	2.5 mins per point.
29360	Cntrl	.				Clearcoat silver roof.

Sampling Points 11 + 65 cm

Equipment	
129	Pump
80	Flowmeter
87	Gasmeter
83	Gas Temp
77	Silica Gel
X	Condenser
194	Thermocouple
179	Stopwatch

Operator SB

Normal Flow 9.65 SB