

TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 1)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry Spray Booth 1

Monitoring dates: 10th January 2006

Contract number: Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address: Stonybridge Trading Estate

Rowley Drive Coventry

CV3 4FG

Monitoring Organisation: CPL Laboratories

Address: Mill Lane

Wingerworth Chesterfield

S42 6NG

Date of Report: 10th February 2006

Report Approved by: C. M. Greenaway

MCERTS Registration Number: 02 048

Function: Team Leader

Signed:

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1.1 Monitoring Objectives

Mr Mark Rose of Nationwide Craft Repair Centre, requested CPL Laboratories to monitor emissions to air from Spray Booth 1.

The monitoring was carried out on the 10th January 2006, to determine compliance with specified emission limits. The substances requested for monitoring at each emission point are listed below.

Substances To be	Emission Point Identification		
Monitored	Spray Booth 1		
Total part	iculate matter (TPM)		

1.2 Monitoring Results

Emission point reference	Spray Booth 1
Substance to be monitored	Total particulate matter (TPM)
Emission limit value mg/m ³	10
Periodic monitoring results	<0.46
mg/m ³	0.46
Uncertainty %	400
	400
Monitoring Method reference	ISO 9096: 2003
Accreditation for use of method	UKAS
	MCERTS
Date of sampling	10/01/06
Start & end times	12:02 – 12:34
	14:55 – 15:25
Reference conditions 273K, 101.3kPa	No correction for oxygen or moisture
Operating status	Normal

1.3 Operating Information

This process involves the paint spraying of automobiles within confined booths and extraction through a filter unit before outlet to air.

Emission point reference	Spray Booth 1		
Date	10/01/06		
Process type	Panel Spraying		
Process duration	Approximately 30 to 60 mins		
Fuel	Not Applicable		
Feedstock	Paints		
Abatement	Filters		
Load	Automobiles		

Comparison with Operator CEMs	A SI = MAI 25 SI = 25 N
Operator CEMs Particulate matter mg/m ³	Not Applicable
Particulate matter mg/m ³	< 0.46
Periodic monitoring results	0.46

1.4 Monitoring Deviations

Emission point reference		Spi	ray Booth	1	
Substance deviations	None				
Monitoring deviations	Note 1	Note 2	Note 3	Note 4	Note 5
Other relevant issues	Note 6	Note 7	Note 8		

Notes

- 1. Nozzle diameter less than 6mm
- 2. Negative duct gas flows
- 3. Differential pressure at pitot tube less than 5 Pa
- 4. Ratio of maximum to minimum duct gas velocities greater than 3:1
- 5. Duct gas flow with regard to duct access greater than 15°
- 6. Less than 2 duct diameters straight length after the sampling plane
- 7. Less than 5 duct diameters straight length before the emission point
- 8. Weighing uncertainties greater than 5% of the LV



TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 2)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry Spray Booth 1

Monitoring dates: 10th January 2006

Contract number: Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address: Stonybridge Trading Estate

Rowley Drive

Coventry CV3 4FG

Monitoring Organisation: CPL Laboratories

Address: Mill Lane

Wingerworth Chesterfield S42 6NG

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2 Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Monitoring organisation staff details

Sampling Team Members

Name	MCert Status	MCert Registration No.	Responsibility
C M Greenaway	Level 2 With TE 1, 2, 3, 4	MM 02 048	Team Leader
D Martschenko	-	General Information	Technician

2.1.2 Monitoring organisation method details

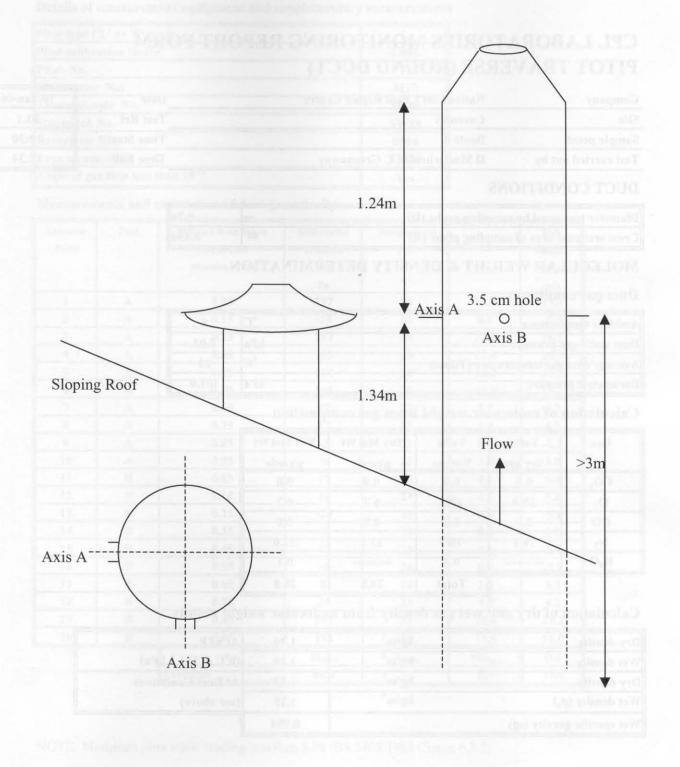
Pollutant		Measurement Method	No. tests / blanks
Total Particulate Matter (TPM)	ST 6	ISO 9096: 2003	2/1

2.1.3 Monitoring organisation equipment checklist

06/007	CL-081	

2.2 Appendix 2

2.2.1 Diagram of Sampling Location and Position



2.2.2 Flow criteria and gas measurements

CPL LABORATORIES MONITORING REPORT FORM PITOT TRAVERSE (ROUND DUCT)

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 1	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

10-Jan-06	
FL1	
10:30	
10:34	

DUCT CONDITIONS

Diameter traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

MOLECULAR WEIGHT & DENSITY DETERMINATION

Duct gas conditions

Ambient temperature	°C	8
Duct static gas pressure	kPa	0.03
Average duct gas temperature (Tduct)	°C	23
Barometric pressure	kPa	101.6

Calculation of molecular weight from gas composition

Gas	Vol% Dry gas	Vol% Wet gas	Dry Mol Wt g/gmole	Wet Mol Wt g/gmole
CO ₂	0.0	0.0	0.0	0.0
O_2	20.9	20.8	6.7	6.7
CO	0.0	0.0	0.0	0.0
N ₂	79.1	78.7	22.1	22.0
H ₂ O		0.4		0.1
		Total	28.8	28.8

Calculation of dry and wet gas density from molecular weight results

Dry density	kg/m ³	1.29	At STP
Wet density	kg/m ³	1.29	(0°C & 101.3 kPa)
Dry density	kg/m ³	1.19	At Duct Conditions
Wet density (ρ _a)	kg/m ³	1.19	(see above)
Wet specific gravity (sg)		0.994	

PITOT TRAVERSE

Details of measurement equipment and supplementary measurements

Pitot type ('L' or 'S' type)	L
Pitot calibration factor	1.001
Pitot No.	PT14
Manometer No.	M17
Thermocouple No.	TC44
Stopwatch No.	SW18
Barometer No.	BM4
Tape measure No.	TM21
Angle of gas flow less than 15°?	Yes

Measurements and calculation of duct gas velocity

Traverse	Port	Distance from inside	Differential	Temperature		Gas
Point	CONDIT	wall of duct	Pressure	(T _s)	√ h	Velocit
		(fraction of D)	(h)	organist of A		(V _s)
			Pa	°C		m/s
1	A	0.05	177	23	13.3	17.3
2	A	0.15	-15	23	0.0	-5.0
3	A	0.25	153	23	12.4	16.1
4	A	0.35	165	23	12.8	16.7
5	A	0.45	174	24	13.2	17.2
6	A	0.55	165	24	12.8	16.7
7	A	0.65	27	23	5.2	6.7
8	A	0.75	27	23	5.2	6.7
9	A	0.85	-3	22	0.0	-2.2
10	A	0.95	9	23	3.0	3.9
11	В	0.05	17	23	4.1	5.4
12	В	0.15	20	23	4.5	5.8
13	В	0.25	-20	23	0.0	-5.8
14	В	0.35	0	23	0.0	0.0
15	В	0.45	17	23	4.1	5.4
16	В	0.55	-5	24	0.0	-2.9
17	В	0.65	8	24	2.8	3.7
18	В	0.75	23	23	4.8	6.2
19	В	0.85	197	23	14.0	18.2
20	В	0.95	192	22	13.9	18.0
vietion, a	Consideration of	hour continues of	H _{Duct}	T _{Duct}	$\sqrt{h_{\mathrm{Duct}}}$	(V _s)
	11/1/108	Averages	66.4	23	6.3	7.40

NOTE: Minimum pitot static reading less than 5 Pa (BS 3405:1983 Clause 6.3.2)

CALCULATION OF VELOCITY & FLOW RATE

 $V_{Duct} = K_{pt} \times (1-\epsilon) \times \sqrt{2/\rho_a} \times \sqrt{h}$ (Reference BS 1042:Section 2.1:1983, pages 8&9)

where

V_{Duct} = gas velocity at sampling point (m/s)

K_{pt} = pitot calibration factor (dimensionless)

 $1-\varepsilon =$ compressibility correction (assumed constant at 0.995)

 ρ_a = wet gas density under duct conditions (kg/m³)

h = differential pressure (Pa)

Average gas velocity (V_{Ducta})

8.2 m/s

Average volume flowrate $(Q_{Duct}) =$

V_{Ducta} x A

 $3.7 \text{ m}^3/\text{s}$

Conversion of actual duct gas flow to reference conditions

Actual Duct Flow Conditions			Reference Conditions		
Average temperature (T _{Duct})	°C	23	Temperature (T _{Ref})	°C	0
Total pressure (P _{Duct})	kPa	101.6	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (H ₂ O _{Duct})	% vol	0.4	Water vapour (H2ORef)	% vol	0.4

Calculation of gas flowrate at STP, QSTP

 $Q_{STP} = Q_{Duct} x [(273 x P_{Duct})/(101.3 x (273 + T_{Duct}))]$

 $Q_{STP} =$

 $3.4 \text{ m}^3/\text{s}$

Calculation of gas flow at reference conditions, QRef

 $\begin{array}{lll} Q_{Ref} & = & Q_{Duct} \; x & [273 + T_{Ref}]/[273 + T_{Duct}] \\ & & P_{Duct}/P_{Ref} \\ & & [100 - H_2 O_{Duct}]/[100 - H_2 O_{Ref}] \\ & & [20.9 - O_{2Duct}]/[20.9 - O_{2Ref}] \end{array}$

Pressure Water vapour Oxygen

Corrections Temperature

ORef

== ==

 $3.4 \text{ m}^3/\text{s}$

CPL LABORATORIES MONITORING REPORT FORM WATER VAPOUR (GRAVIMETRIC TECHNIQUE)

Company	Nationwide Crash Repair Centre	Date
Company	Coventry	Test Ref
Site	Booth 1	Prepared
Sample point	The state of the s	Checked
Test carried out by	D Martschenko, C Greenaway	

10-Jan-06
H ₂ 0 1,2
D Martschenko
G. Carroll

SAMPLING TIMES

MARKET TO THE PARTY OF THE PART		
Determination	1	2
	12:02	14:55
Time Start	12:34	15:25
Time End		

SAMPLING CONDITIONS

			-
Determination		1	2
Gas meter temperature (T _{meter})	°C	9	10
Atmospheric pressure (P _{atm})	kPa	101.7	101.5
	m ³	218.468	218.696
Final meter reading	m ³	218.284	218.469
Initial meter reading		1.000	0.983
Gas meter calibration factor	1	184.3	222.7
Volume of gas sampled (VG _{meter})	-1	10.110	

SAMPLE TUBE WEIGHTS

	1	2
	1	
		142.0
g	140.6	142.0
g	140.5	140.6
g	0.1	1.4
֡֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜	g	g 140.5

Sample gas volume at STP, VG_{STP}

 $VG_{STP} = VG_{meter} \times (273 \times P_{atm})/(101.3 \times (273 + T_{meter}))$

n i touton		1	2
Determination	CED	179.0	215.7
Volume of gas sampled (VG _{STP})	I, STP	1/9.0	213.7

Calculation of water vapour content in duct gas, $C_{\rm g}$

 C_g (% vol) = 100 x (M_t x MV_{STP}÷MW_{H2O})÷(VG_{STP} + (M_t x MV_{STP} ÷MW_{H2O}))

where MV_{STP} is the ideal gas molecular volume at STP (i.e. 22.412 m³/kgmole)

 $MW_{\rm H2O}$ is the molecular weight of water (i.e. 18 kg/kgmole)

WATER VAPOUR MEASUREMENTS

WATER VAFOUR MEASUREMENT		1	2
Determination		1	
Water vapour content	%,vol	0.1	0.8
	%,vol	0.4	to TV II o
Mean water vapour content	kg/m³	0.001	0.007
Water vapour concentration	kg/m ³	0.004	Jane Wind
Mean water vapour concentration			

2.2.4 Sampling measurements

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 1	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

10-Jan-06	
TE1	
12:02	
12:34	

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m²	0.454

Duct gas conditions

Ambient temperature (T _{Amb})	°C	9
Average duct gas temperature (T _{Duct})	°C	25
Duct static gas pressure (P Static)	kPa	0.03
Barometric pressure (P Baro)	kPa	101.7
Duct gas volume flowrate @ ref. conditions (Q Ref)	m³/s	3.42
Gas compressibility correction (ε)		0.995
Wet gas specific gravity (sg)		0.99

Reference conditions

Actual Duct Flow Conditions			Reference Conditions		la sue
Average temperature (T _{Duct})	°C	25	Temperature (T _{Ref})	°C	0
Total pressure (P Duct)	kPa	101.7	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (H ₂ O _{Duct})	% vol	0.1	Water vapour (H ₂ O _{Ref})	% vol	0.1

Sampling conditions

Nozzle diameter (d)	mm	6.0
Initial gas meter reading	m ³	218.284
Final gas meter reading	m ³	218.468
Gas meter factor		1.000
Sampled volume (SV _{Meter})	m'	0.184

Calculation of sample gas volume at reference conditions, SV Ref

				Corrections
SV_{Ref}	=	SV _{Meter} x	$[273 + T_{Ref}]/[273 + T_{Meter}]$	Temperature
			P_{Baro}/P_{Ref}	Pressure
			$[100-H_2O_{Meter}]/[100-H_2O_{Ref}]$	Water vapour
			[20.9-O _{2Duct}]/[20.9-O _{2Ref}]	Oxygen
			line)	

Sampled volume @ ref. conditions (SVR ef)	m ³	0.179
---	----------------	-------

Prepared by: D Martschenko Checked by: G. Carroll

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 1	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

	10-Jan-06	
	TE2	
111	14:55	
	15:25	-[

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

Duct gas conditions

Ambient temperature (Tmb)	°C	10
Average duct gas temperature (Tuct)	°C	27
Duct static gas pressure (Ptatic)	kPa	0.16
Barometric pressure (Paro) k		101.5
Duct gas volume flowrate @ ref. conditions (Q)	m ³ /s	3.42
Gas compressibility corrections		0.995
Wet gas specific gravity (sg)	Soften mitale	0.99

Reference conditions

Actual Duct Flow Conditions		Reference Conditions					
Average temperature (Tuct)	°C	27	Temperature (Tef)	°C	0		
Total pressure (Buct)	kPa	101.6	Pressure (PRef)	kPa	101.3		
Oxygen (O _{Duct})	% vol,dry	20.9	Oxygen (OzRef)	% vol, dry	20.9		
Water vapour (HO _{Duct})	% vol	0.8	Water vapour (HO _{Ref})	% vol	0.8		

Sampling conditions

Nozzle diameter (d)	mm	6.0
Initial gas meter reading	m ³	218.469
Final gas meter reading	m ³	218.696
Gas meter factor	and the language of	0.983
Sampled volume (S\mathbb{N}_{teter})	m ³	0.223

Calculation of sample gas volume at reference conditions, SV Ref

 $SV_{Ref} = SV_{Meter} \ x \\ [273 + T_{Ref}]/[273 + T_{Meter}] \\ P_{Baro}/P_{Ref} \\ [100-H_2O_{Meter}]/[100-H_2O_{Ref}] \\ [20.9-O_{2Ducd}]/[20.9-O_{2Ref}]$

Corrections Temperature Pressure Water vapour Oxygen

Sampled volume @ ref. conditions (SV) m³ 0.217

Prepared by: D Martschenko Checked by: G. Carroll

Static pressure before gas meter Water Vapour Concentration

0.00

1.001

MEASUREMENT OF TOTAL PARTICULATE

m.				

Moisture Content

Time	Posn.	Pitot	Duct	Duct	Duct	Meter	Duct	Baro	Nozzle	Iso.	Actual	Vol.sampled		reqd.	Cum.
	2152	rdg.	temp.	CO2	O2	temp.	static	press.	dia.	rate	flow	m ³	m ³	vol.	dev.
		Pa	°C	%	%	°C	Pa	kPa	mm	1/min	l/min	meter	cum.	m ³	%
0	2	25	23	0.0	20.9	8	30	101.7	5.95	10.2	10.8	218.284	0.000	0.000	
4	4	1	24	0.0	20.9	8	30	101.7	5.95	2.0	2.1	218.327	0.043	0.041	5.4
8	7	12	24	0.0	20.9	9	30	101.7	5.95	7.1	7.0	218.335	0.052	0.049	4.9
12	9	12	24	0.0	20.9	9	30	101.7	5.95	7.1	7.2	218.363	0.080	0.078	2.5
16	2	8	24	0.0	20.9	10	30	101.7	5.95	5.8	5.6	218.392	0.108	0.106	2.2
20	4	1	25	0.0	20.9	10	30	101.7	5.95	2.1	2.0	218.415	0.131	0.129	1.0
24	7	4	26	0.0	20.9	10	30	101.6	5.95	4.1	3.9	218.422	0.139	0.138	0.7
28	9	15	26	0.0	20.9	10	30	101.6	5.95	8.0	7.5	218.438	0.154	0.154	0.0

MASS OF PARTICULATES COLLECTED

Filter no.	NCR8
Filter + particulates, g	0.5378
Filter, g	0.5378
Mass collected, g	0

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

Filter, g	
Mass Change, g	

Filter no.

OVERALL BLANK

Total mass collected, g

Washing bottle no.	
Evaporating Basin + particulates, g	0
Evaporating Basin , g	0
Mass collected, g	0

NCR3 0.4682 0.4680 0.0002

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m ³ /s	3.69740048
(Q _{rel}), Flow in the duct, at reference conditions, m ³ /s	3.4188
(M), Mass flow at duct conditions, kg/h	0
(C), Concentration of particulate matter at reference conditions, mg/m3	0

TOTAL FIELD BLANK g

0.0002

MEASUREMENT OF TOTAL PARTICULATE

Time	Posn.	Pitot	Duct	Duct	Duct	Meter	Duct	Baro	Nozzle	Iso.	Actual	Vol.sampled	J. W. J.	reqd.	Cum.
	and the second	rdg.	temp.	CO2	02	temp. °C	static Pa	press. kPa	dia. mm	rate 1/min	flow I/min	m³ meter	m³ cum.	vol. m³	dev.
		Pa	°C	%	%										%
0	2	38	27	0.0	20.9	9	160	101.5	5.95	12.6	12.3	218.469	0.000	0.000	
4	4	1	27	0.0	20.9	10	160	101.5	5.95	2.0	2.0	218.518	0.049	0.050	-2.2
8	7	1	27	0.0	20.9	10	160	101.5	5.95	2.0	2.4	218.526	0.057	0.058	-2.4
12	9	24	27	0.0	20.9	10	160	101.5	5.95	10.0	10.0	218.536	0.067	0.067	-0.1
16	2	10	27	0.0	20.9	10	160	101.5	5.95	6.5	6.4	218.575	0.107	0.107	-0.3
20	4	17	27	0.0	20.9	10	160	101.5	5.95	8.4	8.5	218.601	0.132	0.133	-0.4
24	7	8	27	0.0	20.9	10	160	101.4	5.95	5.8	5.8	218.635	0.166	0.166	-0.1
28	9	21	27	0.0	20.9	10	160	101.5	5.95	9,4	9.3	218.658	0.190	0.190	0.0

MASS OF PARTICULATES COLLECTED

Filter no.	NCR4
Filter + particulates, g	0.5299
Filter, g	0.5298
Mass collected, g	1E-04

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

OVERALL BLANK

TOTAL FIELD BLANK g

Filter no.	NCR3
Filter + particulates, g	0.4682
Filter, g	0.4680
Mass Change, g	0.0002

Washing bottle no.	
Evaporating Basin + particulates, g	0
Evaporating Basin , g	0
Mass collected, g	0

Total mass collected, g

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m3/s	3.6974
(Q _{ref}), Flow in the duct, at reference conditions, m ³ /s	3.4188
(M), Mass flow at duct conditions, kg/h	0.0062
(C), Concentration of particulate matter at reference conditions, mg/m3	0.46

(M), Mass flow at duct conditions, kg/h = C x Q duct x 0.0036

(C), Concentration of particulate matter at reference conditions, mg/m^3

Total mass collected, g / Sampled volume at ref conditions, m³

2.2.5 Manual monitoring method results calculations

Formula 1 - Determination of Moisture Content

$$V_o = V_m.(273 \div T_m).(P_b \div 101.3)$$

%
$$H_20 = 100.(M_w \div 18) \div [(V_o \div 22.412) + (M_w \div 18)]$$

Where:

P_b - Mean meter conditions during test, kPa

Formula 2 - Determination of mean velocity

$$V = 0.0753.\sqrt{T}.\sqrt{h}$$

Where

V - Mean velocity during test, m/s

 \sqrt{T} - Mean square root of temperatures before and after test, K

√h - Mean square root of pitot-static readings before and after test, Pa

Formula 3 - Volume flow rate of duct gases, at duct temperatures

$$Q_{(duct)} = V.A$$

Where

Q_(duct) - Volume flow rate of duct gases, m³/s

V - Mean velocity, m/s

A - Area of duct (at the sampling plane), m²

Formula 4 - Volume flow rate of duct gases, specified reference conditions

$$Q_o = Q_{(duct)}.(T_{ref} \div T_{duct}).(P_{duct} \div P_{ref}).[(100 - \%H_20) \div 100].[(20.9 - O_{2duct}) \div (20.9 - O_{2rel})]$$

Where

Qo - Volume flow rate at reference conditions, and relative O2 and moisture correction, m³/s

T_{ref} - reference Temperature, K

T_{duct} - Mean temperature across the duct, K
P_{duct} - Relative static pressure in the duct, kPa

P_{ref} - Reference pressure, kPa %H₂0 - Water content, %

 O_{2duct} - Oxygen content as measured during the test, $\frac{\%v}{v}$ - Relative Oxygen content for the process, $\frac{\%v}{v}$

2.2.6 Uncertainty calculations

			Reference	12239 2239		1	m c		
mit value	10	mg.m ⁻³	oxygen	20.9 % by	volume	c = -	$\frac{m}{V} f_c$		
easured concentration	0.46	mg.m ⁻³						Uncertainty	at Requirement of
X (V) (SQ)			Ct double on a	ertainty Unit			ntage	limit value	standard
	Symbol		Standard unc	0.002 m ³	5		1.11		<=2%
mpled Volume	V _m	0.18 298	uV _m	0.002 III			0.34		<=1%
mpled gas Temperature	T _m	101.67	u1m uρ _m	0.1 kPa			0.10		<=1%
mpled gas Pressure	ρ _m H _m	0.1	uH _m	0.15 % b	volume		150.00		<=1%
mpled gas Humidity	O _{2.m}	20.9	uO _{2 m}		y volume	-	0.00		<=5%
kygen content ass particulate	m m	0.1	um	0.2 mg			200.00	9.20	<5% of limit value
ote - Sampled gas humidity, ten	nperature and pr			%	a si		2.00		<=2%
ncollected Mass	UCM	0		mg	100		0.00)	<=10%
termediate calculations									
actor for std conds	fs	0.92							
ncertainty components	symbol	sensitivity coeff		u (in units of fs)					
	$\rho_{\rm m}$	0.009		0.001	Г	(100-H _m) 27	73 0		
	H _m	0.009		0.001			101.3		
	Tm			0.003	L		0.38	3	
	ufs			0.003		$V = V_m f_s$	1.27	-	
orrected volume	V		uV	0.002 m °		* * ### 3	1.2	4	
actor for O2 correction	fc	Control of the second s				21-0,,,,			
ncertainty components	symbol			u 0.000	j	$f_e = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$			
	O _{2,n}			0.000		~ 2,8	0.0	0	
actor for O2 Correction	ufo	1.00		Sensitivity			0.0		
	Uncertainty,	i Value	Units		certainty in F	Result Und	certainty as	%	
arameter		0.17		2.78		mg.m ⁻³		7 %	
folume(standard conditions)	V		mg	4.60		mg.m ⁻³	200.0		
Mass actor for O2 Correction	m fc	1.00		0.46		mg.m ⁻³		0 %	
eak	L		mg.m ⁻³	1.00		mg.m ⁻³			
Incollected mass	UCM		mg	4.60	0.00	mg.m ⁻³			
					0.92	mg.m ⁻³			
expanded uncertainty	confi	ed with a level of dence of 95% ed with a level of dence of 95%		ı mg.m ⁻³	ieig n	7	easurement m	Equation	
Expanded uncertainty Expanded uncertainty Expanded uncertainty Test 2 Limit value	express confi	dence of 95% ed with a level of dence of 95%		mg.m ⁻³	6 by volume	7	easurement $= \frac{m}{V} f_c$	Equation	
Expanded uncertainty Expanded uncertainty Test 2	express confi	dence of 95% ed with a level of dence of 95%	1.84	mg.m ⁻³	% by volume	c	$= \frac{m}{V} f_c$		A.V = 6
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration	confi express confi	dence of 95% ed with a level of dence of 95% mg.m-3 mg.m-3	1.84 Reference oxyge	umg.m ⁻³ ce en 20.9 %	% by volume	C UI			ainty at Requirement due standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities	confi express confi	dence of 95% ed with a level of dence of 95% mg.m ⁻³ mg.m ⁻³ Value	1.84 Reference oxyge	mg.m ⁻³ ce 20.9 9	Jnits	C UI	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta	standard <=2%
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume	confi express confi	dence of 95% ed with a level of dence of 95% mg.m ⁻³ hg.m ⁻³ Value	Reference oxyge	mg.m ⁻³ ce 20.9 9 nncertainty U	Jnits n ³	C UI	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta	<=2% <=1%
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature	confi express confi	dence of 95% ed with a level of dence of 95% mg.m ⁻³ hg.m ⁻³ Value V _m 0.2 ⁻ T _m 30	Standard u 6 u 100 u 1	mg.m ⁻³ 20.9 9 nncertainty V _m 0.002 v _m 1 1 1 1 1 1 1 1 1	Jnits n ³	C Ui pe	$= \frac{m}{V} f_c$ Incertainty a ercentage	uncerta limit va 0.93 0.33 0.10	<pre>standard <=2% <=1% <=1%</pre>
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure	confi express confi	dence of 95% ed with a level of dence of 95% 0 mg.m ⁻³	Standard u 6 u 100 u 1	mg.m ⁻³ ce 20.9 9 mncertainty U v _m 0.002 rm 11 p _m 0.11 H _m 0.15	Jnits n ³ kPa kPa by volume	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta limit va 0.93 0.33 0.10 8.75	<pre>standard <=2% <=1% <=1% <=1%</pre>
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature	confi express confi	dence of 95% ed with a level of dence of 95% 10 mg.m ⁻³ 16 mg.m ⁻³ Value Value V _m 0.2 ² T _m 30 p _m 101.3 H _m 0.2 20	1.84 Reference oxyge Standard u 6 u 00 u 134 u 8 u 9 u 09	mg.m ⁻³ 20.9 9 mncertainty	Units n³ kPa by volume by volume	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	uncerta limit va 0.93 0.33 0.10 8.75 0.00	<pre>standard <=2% <=1% <=1% <=1% <=5%</pre>
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled yolume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate	confi express confi	dence of 95% ed with a level of dence of 95% and mg.m ⁻³ and mg.m ⁻³ was a level of dence of 95% and mg.m ⁻³ and mg.m	Standard u 6 uv 00 uT 44 u 8 ul 9 uO	mg.m ⁻³ ce 20.9 9 mncertainty U V _m 0.002 1 mn 1 1 p _m 0.11 H _m 0.15	Units n³ kPa by volume by volume	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	uncerta limit va 0.93 0.33 0.10 8.75 0.00	<pre>standard <=2% <=1% <=1% <=1%</pre>
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak	confi express confi	Description Column Colum	Standard u 6 uv 00 uT 44 u 8 ul 9 uO	mg.m ⁻³ cee 20.9 9 mncertainty U m 0.002 pm 0.11 Hm 0.15 2.m 0 mm 0.2	Units n³ kPa by volume by volume	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	uncerta limit va 0.93 0.33 0.10 8.75 0.00	<pre>standard <=2% <=1% <=1% <=1% <=5%</pre>
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass	confi express confi 0.4 Symbol Output Outp	Description Column Colum	Standard u 6	mg.m ⁻³ cee 20.9 9 mncertainty U m 0.002 pm 0.11 Hm 0.15 2.m 0 mm 0.2	Units n³ c RPa % by volume % by volume mg	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak	Symbol Symbol Output Confinence of the confin	dence of 95% ed with a level of dence of 95% 0 mg.m ⁻³	Standard u 6 u 00 u 17 14 u 8 u 9 u 0 1.1 u 0 1.1 u 0 1.2 u 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	mg.m ⁻³ 20.9 9 mocertainty V _m 0.002 V _m 1 V _m 0.1 V _m 0.15 V _m 0.15 V _m 0.2 V _m 0.2 V _m 0.2 V _m 0.1 V _m 0.15 V _m 0.1 V _m 0.15 V _m 0.1 V _m 0.2 V _m 0.3 V _m 0.3	Units n³ RPa % by volume % by volume mg %	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, t Leak Uncollected Mass Intermediate calculations	confi express confi 0.4 Symbol Output Outp	dence of 95%	Standard u 6 u 100 u 134 u 48 u 9 u 10 u 11 u 10 u	mg.m ⁻³ 20.9 9 Incertainty m	Units n³ RPa % by volume % by volume mg %	C Ur pe	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds	symbol Confinence of the conf	dence of 95%	Standard u 6 uv 00 uT 44 u 8 uil 9 u0 11 v he gas meter 2 0	mg.m ⁻³ ce 20.9 9 mcertainty m 0.002 rm 1 in pm 0.1 fm 0.15 rm 0 rm 0.2 rm 0 rm 0.2 rm 0 rm 0.2	Units n³ RPa % by volume % by volume mg %	C Ur	$= \frac{m}{V} f_c$ ncertainty arcentage (0) (1) (2) (2)	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds	symbol Confinence of the conf	dence of 95%	Standard u 6 uv 00 uT 44 u 9 uO 11 u he gas meter 2 0 90 90 90	u (in units of 0.001 0.001 0.001	Units n³ RPa % by volume % by volume mg %	C Ur	$= \frac{m}{V} f_c$ ncertainty a ercentage	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds	Symbol Outemperature and	Description Color	Standard u 6 uv 00 uT 44 u 9 uO 11 u he gas meter 2 0 90 90 90	u (in units of 0.001 0.001 0.003	Units n³ RPa % by volume % by volume mg %	C Ur pe	$=\frac{m}{V}f_{c}$ ncertainty a ercentage $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 &$	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, t Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components	Symbol Outemperature and	dence of 95%	Standard u Standard u 6	u (in units of 0.003 0.003 0.003	Units n³ k k Pa % by volume % by volume mg % mg	$f_{s} = \frac{(100 - H_{s})}{100}$	$=\frac{m}{V}f_{c}$ ncertainty a ercentage $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 &$	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds	Symbol Outemperature and	dence of 95%	Standard u 6 u 00 u 17 04 u 8 u 9 u 0 1.1 t be gas meter 2 0 90 90 90 90 90 90 90 90 90 90	u (in units of 0.001 0.001 0.003	Units n³ k k Pa % by volume % by volume mg % mg	C Ur pe	$=\frac{m}{V}f_{c}$ ncertainty a ercentage $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 &$	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume	Symbol Outemperature and	dence of 95%	Standard u Standard u 6	u (in units of 0.003 0.003 0.003	Units n³ k k Pa % by volume % by volume mg % mg	$f_s = \frac{(100 - H_n)}{100}$ $V = V_m f_s$	$= \frac{m}{V} f_c$ Incertainty a percentage (1) (20) (20) (20) (21) (20) (27) (27) (27) (27) (27) (37) (47) (57) (67) (77) (77) (77) (77) (77) (77) (7	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, t Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction	Symbol Outemperature and	dence of 95%	Standard u 6	u (in units of 0.001 0.001 0.003 0.003 uV 0.002	Units n³ k k Pa % by volume % by volume mg % mg	$f_s = \frac{(100 - H_n)}{100}$ $V = V_m f_s$	$= \frac{m}{V} f_c$ Incertainty a percentage (1) (20) (20) (20) (21) (20) (27) (27) (27) (27) (27) (37) (47) (57) (67) (77) (77) (77) (77) (77) (77) (7	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume	symbol UC	dence of 95%	Standard u 6 u 00 u 1 6 u 00 u 1 90 u 8 u 9 u 0 1.1 u he gas meter 2 0 90 90 90 90 90 90 90 90 90 90 90 90 9	u (in units of 0.001 0.001 0.003 uV 0.002	Units n³ k k Pa % by volume % by volume mg % mg	$f_{s} = \frac{(100 - H_{s})}{100}$	$=\frac{m}{V}f_{c}$ Incertainty a properties of the contract of t	as Uncerta limit va 0.93 0.33 0.10 0.00 0.00 9 2.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, t Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction	symbol UC	dence of 95%	Standard u 6 u 00 u 17 u 4 u 8 u 9 u 0 1.1 u 0 u 18 u 0 u 0 u 0 u 0 u 0 u 0 u 0 u 0 u 0 u 0	u (in units of 0.001 0.001 0.001 0.003 uV 0.000	Units n³ k k Pa % by volume % by volume mg % mg	$f_s = \frac{(100 - H_n)}{100}$ $V = V_m f_s$	$=\frac{m}{V}f_{c}$ Incertainty a properties of the contract of t	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components	symbol UC	dence of 95%	Standard u 6 u 100 u 17 44 u 8 u 9 u 0 11 t 0 90 90 90 90 90 90 90 90 90 90 90 90 9	u (in units of 0.001 0.001 0.003 0.003 uV 0.000 Sensitivity	Units m ³ k k k Pa % by volume % by volume mg % mg fs)	$f_{s} = \frac{(100 - H_{m})}{100}$ $V = V_{m} f_{s}$ $f_{s} = \frac{21 - O}{21 - O}$	$=\frac{m}{V}f_{c}$ Incertainty a property of the contract of the	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9 2.00 0.00 9 0.38 1.09	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, teak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components	symbol UC	dence of 95%	Standard u 6 u 10 u 17 u 18 u 18 u 19 u 10 u 11 u 10 u 10 u 10 u 10 u 10 u 10	u (in units of 0.001 0.001 0.003 0.003 uV 0.000 Sensitivity coeff	Jnits m³ k k Pa % by volume % by volume mg % mg fs)	$f_s = \frac{(100 - H_n}{100}$ $V = V_n f_s$ $f_z = \frac{21 - O}{21 - O}$ in Result	$=\frac{m}{V}f_{c}$ Incertainty a properties of the contract of t	as Uncerta limit va 0.93 0.33 0.10 8.75 0.00 0.00 9 2.00 0.00 0.00 0.00	standard
Expanded uncertainty Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Factor for O2 correction	sym Symbol Compensature and UC Symbol Compensature and UC Sym Sym Sym Compensature and UC Sym Sym Sym Sym Sym Sym Sym Sy	Description Color	1.84 Reference oxyge Standard u 6	u (in units of 0.001 0.003 0.003 0.003 uV 0.002 0.000	Uncertainty Uncertainty	$f_s = \frac{(100 - H_m)}{100}$ $V = V_m f_s$ $f_c = \frac{21 - O}{21 - O}$ $\sin \mathbf{Result}$	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 8.75 0.00 0.00 9 0.00 9 0.00 0.00	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Factor for O2 Correction Parameter	sym Symbol Compensature and UC Symbol Compensature and UC Sym Sym Sym Compensature and UC Sym Sym Sym Sym Sym Sym Sym Sy	Description Color	1.84 Reference oxyge Standard u 6	u (in units of 0.001 0.001 0.001 0.003 0.003 uV 0.002 u 0.000 Sensitivity coeff	Uncertainty Uncertainty Uncertainty 0	$f_s = \frac{(100 - H_m)}{100}$ $V = V_m f_s$ $f_z = \frac{21 - O}{21 - O}$ Fin Result $f_z = \frac{21 - O}{21 - O}$ $f_z = \frac{20 - O}{21 - O}$ $f_z = \frac{20 - O}{21 - O}$	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 0.00 0.00 9 2.00 0.00 9 0.00 9 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Factor for O2 correction Parameter Volume(standard condition	symbol Symbol Output Symbol Uncertain Sym Uncertain Sym Uncertain Sym Uncertain	dence of 95%	Standard u 6 u 00 u 1	u (in units of 0.001 0.001 0.001 0.003 0.003 uV 0.002 u 0.46 0.46 0.46 0.46	Units m ³ k k k p k by volume mg % mg Uncertainty 0. 0.	$f_{s} = \frac{000 - H_{s}}{100}$ $V = V_{m} f_{s}$ $f_{c} = \frac{21 - O}{21 - O}$ Fin Result 01 mg.m ⁻³ 92 mg.m ⁻³ 00 mg.m ⁻³	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 8.75 0.00 0.00 9 0.00 9 0.00 0.00	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured Concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, the concentration Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Factor for O2 Correction Parameter Volume(standard condition) Mass	symbol Symbol Output Symbol	dence of 95%	Standard u 6 u 00 u 17 6 u 48 u 9 u 00 11 u 9 u 90 10 11 u 90 10 10 10 10 10 10 10 10 10 10 10 10 10	u (in units of 0.001 0.001 0.001 0.003 0.003 uV 0.002 u 0.46 4.60 0.46 1.00	Uncertainty Uncertainty 0. 0. 0.	$f_{s} = \frac{(100 - H_{m})}{100}$ $V = V_{m} f_{s}$ $f_{s} = \frac{21 - O}{21 - O}$ Fin Result 0.1 mg.m ³ 9.2 mg.m ³ 0.0 mg.m ³ 0.1 mg.m ³	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 0.00 0.00 9 2.00 0.00 9 0.00 9 0.00 9	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Factor for O2 Correction Parameter Volume(standard condition Mass Factor for O2 Correction Leak Uncollected mass	symbol Symbol Outemperature and UCC Symbol Uncertain Sym Sym Sym Sym Sym Sym Sym Sy	dence of 95%	Standard u 6 u 00 u 1	u (in units of 0.001 0.001 0.001 0.003 0.003 uV 0.002 u 0.46 0.46 0.46 0.46	Uncertainty Uncertainty 0. 0. 0. 0.	$f_{s} = \frac{(100 - H_{m}}{100}$ $V = V_{m} f_{s}$ $f_{s} = \frac{21 - O}{21 - O}$ Fin Result 0.1 mg.m ³ 9.2 mg.m ³ 0.0 mg.m ³ 0.1 mg.m ³	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 0.00 0.00 9 0.00 9 0.00 9 0.00 9 0.00	standard
Expanded uncertainty Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components Parameter Volume(standard condition Mass Factor for O2 Correction Parameter Volume(standard condition Mass Factor for O2 Correction Leak	symbol Symbol Output Symbol	dence of 95%	Standard u 6 u 00 u 17 6 u 48 u 9 u 00 11 u 9 u 90 10 11 u 90 10 10 10 10 10 10 10 10 10 10 10 10 10	u (in units of 0.001 0.001 0.001 0.003 0.003 uV 0.002 u 0.46 4.60 0.46 1.00	Uncertainty Uncertainty 0. 0. 0. 0.	$f_{s} = \frac{(100 - H_{m})}{100}$ $V = V_{m} f_{s}$ $f_{s} = \frac{21 - O}{21 - O}$ Fin Result 0.1 mg.m ³ 9.2 mg.m ³ 0.0 mg.m ³ 0.1 mg.m ³	$=\frac{m}{V}f_{c}$ ncertainty a ercentage ercentage $\frac{(6)}{(6)}$ $\frac{(1)}{(20)}$ $\frac{(20)}{T_{a}}\frac{\rho_{a}}{101.3}$ Uncertaint	0.93 0.33 0.10 0.00 0.00 9 0.00 9 0.00 9 0.00 9 0.00	standard

Appendix 3

Stack: Spray Booth 1

Equipment	Value	No X
Nozzle: internal diameter	>6 mm	X
Nozzle: uncertainty of area at nozzle entry	⊴0%	1
Nozzle: length with constant internal diameter	>10 mm	1
Nozzle: change in diameter angle	<30°	1
Nozzle: radius of the bend	.>1.5 times internal diameter	1
Nozzle: straight length before the first bend	>30 mm	1
Filter holder: distance to obstacles	>50mm	1
Filter:		
Efficiency on test aerosol of 0.3 μm	>99.5 %	1
Efficiency on test aerosol of 0.6 μm	>99.9%	1
Filter: filter material	No reaction and no absorption of the components	1
Condenser, drying tower: residual gas moisture	<10 gr/m ³	✓
Gas meter:		
Uncertainty of gas volume	<2%	1
Uncertainty of absolute pressure	⊴ %	1
Uncertainty of absolute temperature	⊴ %	1
Angle of the nozzle with regard to gas flow Isokinetic rate	<10°	1
Isokinetic rate		/
Leak rate	95% to 115% <2%	✓
Balance resolution		· /
Weighing uncertainties	0.01 mg to 0.1 mg <5 % of the LV ^a	
Weighing: temperature equilibrium duration	4h to 12h	X
Overall blank value	40 to 120 <10% of the LV ^a	✓
	<10% of the LV	· ·
Sampling location Duet and flows and a with record to duet access	c150	*7
Duct gas flow: angle with regard to duct access	<15°	X
Duct gas flow: negative velocity	not permitted	X
Duct gas flow: differential pressure at Pitot tube	> 5 Pa	X
Duct gas flow: ratio of max. to min. velocity	<3:1 > 5 hydraulic diameters	X
Straight length before the sampling plane	(recommended)	1
Straight length after the sampling plane	> 2 hydraulic diameters (recommended)	X
Straight length before emission point	> 5 hydraulic diameters	X
Correct number of sampling points for standard?	(recommended)	/
Flue Gas Characteristics		٧
Flue gas density: uncertainty	0.051/3	✓
Tue gas density, uncertainty	0.05 kg/rn ³	V
LV ^a : Limit Value set for the process	mg/m ³	10

---0000000---

End of Report



TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 1)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry

Spray Booth 2

Monitoring dates:

11th January 2006

Contract number:

Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address:

Stonybridge Trading Estate

Rowley Drive

Coventry

CV3 4FG

Monitoring Organisation: CPL Laboratories

Address:

Mill Lane

Wingerworth

Chesterfield

S42 6NG

Date of Report:

10th February 2006

Report Approved by:

C.M. Greenaway

MCERTS Registration Number:

02 048

Function:

Team Leader

Signed:

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	1.3		Operating Information
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		2.1.2	Monitoring organisation method details
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	2.2	Appendix 2	Emission Point – Spray Booth 2
		2.2.1	Diagram of the sampling location & position
		2.2.2	Flow criteria and gas measurements
		2.2.3	Water vapour measurements
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		2.2.5	Manual monitoring method results calculations
		2.2.6	Monitoring uncertainty calculations
	2.3	Appendix 3	Procedural requirements of ISO 9096: 2003

1.1 Monitoring Objectives

Mr M. Rose of Nationwide Craft Repair Centre, requested CPL Laboratories to monitor emissions to air from Spray Booth 2.

The monitoring was carried out on the 11th January 2006, to determine compliance with specified emission limits. The substances requested for monitoring at each emission point are listed below.

Substances To be	Emission Point Identification
Monitored	Spray Booth 2
Total parti	culate matter (TPM)

Special Requirements:	None

1.2 Monitoring Results

Emission point reference	Spray Booth 2		
Substance to be monitored	Total particulate matter (TPM)		
Emission limit value mg/m ³	10		
Periodic monitoring results	0.51		
mg/m ³	<0.51		
Uncertainty %	447		
	447		
Monitoring Method reference	ISO 9096: 2003		
Accreditation for use of method	UKAS		
	MCERTS		
Date of sampling	11/01/06		
Start & end times	10:30 - 11:10		
	11:10 – 11:42		
Reference conditions 273K, 101.3kPa	No correction for oxygen or moisture		
Operating status	Normal		

1.3 Operating Information

This process involves the paint spraying of automobiles within confined booths and extraction through a filter unit before outlet to air.

Spray Booth 2
11/01/06
Panel Spraying
Approximately 30 to 60 mins
Not Applicable
Paints
Filters
Automobiles

Comparison with Operator CEMs	
Operator CEMs Particulate matter mg/m ³	Not Applicable
Particulate matter mg/m ³	0.51
Periodic monitoring results	<0.51

1.4 Monitoring Deviations

Emission point reference	Spray Booth 2	
Substance deviations	None	
Monitoring deviations	Note 1	Note 4
Other relevant issues	Note 2	Note 3

Notes

- 1. Nozzle diameter less than 6mm
- 2. Less than 2 duct diameters straight length after the sampling plane
- 3. Less than 5 duct diameters straight length before the emission point
- 4. Weighing uncertainties greater than 5% of the LV



TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 2)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry Spray Booth 2

Monitoring dates: 11th January 2006

Contract number: Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address: Stonybridge Trading Estate

Rowley Drive

Coventry CV3 4FG

Monitoring Organisation: CPL Laboratories

Address: Mill Lane

Wingerworth Chesterfield S42 6NG

Date of Report: 10th February 2006

Report Approved by: C Greenaway

MCERTS Registration Number: 02 048

Function: Team Leader

Signed:

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2 Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Monitoring organisation staff details

Sampling Team Members

Name	MCert Status	MCert Registration No.	Responsibility
C M Greenaway	Level 2 With TE 1, 2, 3, 4	MM 02 048	Team Leader
D Martschenko	-	molleanidal Israesi)	Technician

2.1.2 Monitoring organisation method details

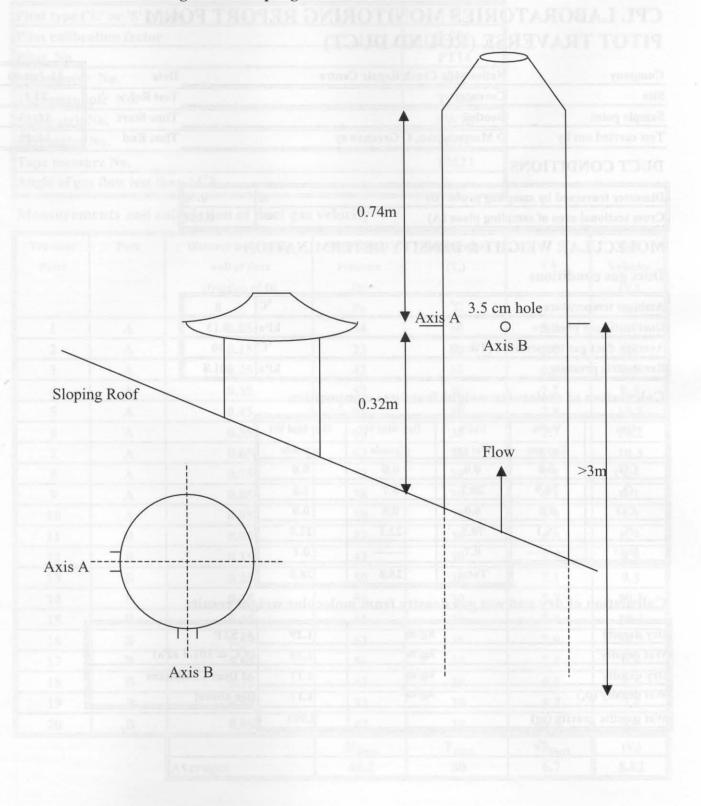
Pollutant		Measurement Method	No. tests / blanks
Total Particulate Matter (TPM)	ST 6	ISO 9096: 2003	2/1

2.1.3 Monitoring organisation equipment checklist

06/007	CL-081
--------	--------

2.2 Appendix 2

2.2.1 Diagram of Sampling Location and Position



2.2.2 Flow criteria and gas measurements

CPL LABORATORIES MONITORING REPORT FORM PITOT TRAVERSE (ROUND DUCT)

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 2	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End
		Time Linu

11-Jan-06	
FL1	
14:45	
14:49	٦

DUCT CONDITIONS

Diameter traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

MOLECULAR WEIGHT & DENSITY DETERMINATION

Duct gas conditions

Ambient temperature	°C	8
Duct static gas pressure	kPa	0.13
Average duct gas temperature (Tduct)	°C	30
Barometric pressure	kPa	101.8

Calculation of molecular weight from gas composition

Gas	Vol% Dry gas	Vol% Wet gas	Dry Mol Wt g/gmole	Wet Mol Wt
CO ₂	0.0	0.0	0.0	0.0
O ₂	20.9	20.7	6.7	6.6
CO	0.0	0.0	0.0	0.0
N ₂	79.1	78.5	22.1	22.0
H ₂ O		0.7		0.1
		Total	28.8	28.8

Calculation of dry and wet gas density from molecular weight results

David and the	1		
Dry density	kg/m ³	1.29	At STP
Wet density	kg/m ³	1.28	(0°C & 101.3 kPa)
Dry density	kg/m ³	1.17	At Duct Conditions
Wet density (ρ _a)	kg/m ³	1.17	(see above)
Wet specific gravity (sg)		0.993	(2,2,2,2,2)

PITOT TRAVERSE

Details of measurement equipment and supplementary measurements

Pitot type ('L' or 'S' type)	L
Pitot calibration factor	1.001
Pitot No.	PT14
Manometer No.	M17
Thermocouple No.	TC44
Stopwatch No.	SW18
Barometer No.	BM4
Tape measure No.	TM21
Angle of gas flow less than 15°?	Yes

Measurements and calculation of duct gas velocity

Traverse	Port	Distance from inside	Differential	Temperature		Gas
Point		wall of duct	Pressure	(T _s)	√ h	Velocity
		(fraction of D)	(h)	w. at 12		(V _s)
		Wastinger (SOL)	Pa	°C	((0.10)	m/s
1	A	0.05	34	30	5.8	7.7
2	A	0.15	23	30	4.8	6.3
3	A	0.25	42	30	6.5	8.5
4	A	0.35	52	30	7.2	9.5
5	A	0.45	61	30	7.8	10.3
6	A	0.55	60	30	7.7	10.2
7	A	0.65	62	30	7.9	10.3
8	A	0.75	52	29	7.2	9.5
9	A	0.85	38	29	6.2	8.1
10	A	0.95	30	29	5.5	7.2
11	В	0.05	23	30	4.8	6.3
12	В	0.15	42	30	6.5	8.5
13	В	0.25	50	30	7.1	9.3
14	В	0.35	59	30	7.7	10.1
15	В	0.45	61	30	7.8	10.3
16	В	0.55	62	30	7.9	10.3
17	В	0.65	56	30	7.5	9.8
18	В	0.75	42	29	6.5	8.5
19	В	0.85	32	29	5.7	7.4
20	В	0.95	42	29	6.5	8.5
			H _{Duct}	T _{Duct}	$\sqrt{h_{Duct}}$	(V _s)
		Averages	46.2	30	6.7	8.82

CALCULATION OF VELOCITY & FLOW RATE

 $V_{Duct} = K_{pt} \ x \ (1-\epsilon) \ x \ \sqrt{2/\rho_a} \ x \ \sqrt{h} \ (Reference BS \ 1042:Section \ 2.1:1983, pages \ 8\&9)$ $Where \qquad V_{Duct} = \qquad gas \ velocity \ at \ sampling \ point \ (m/s)$ $K_{pt} = \qquad pitot \ calibration \ factor \ (dimensionless)$ $1-\epsilon = \qquad compressibility \ correction \ (assumed \ constant \ at \ 0.995)$ $\rho_a = \qquad wet \ gas \ density \ under \ duct \ conditions \ (kg/m^3)$ $h = \qquad differential \ pressure \ (Pa)$ $Average \ gas \ velocity \ (V_{Ducta}) = \qquad 8.8 \ m/s$ $Average \ volume \ flowrate \ (Q_{Duct}) = \qquad V_{Ducta} \ x \ A$ $= \qquad 4.0 \ m^3/s$

Conversion of actual duct gas flow to reference conditions

Actual Duct Flow Conditions		Reference Conditions			
Average temperature (T _{Duct})	°C	30	Temperature (T _{Ref})	°C	0.0
Total pressure (P _{Duct})	kPa	101.9	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (H ₂ O _{Duct})	% vol	0.7	Water vapour (H ₂ O _{Ref})	% vol	0.7

Calculation of gas flowrate at STP, QSTP

 $Q_{STP} = Q_{Duct} x [(273 \times P_{Duct})/(101.3 \times (273 + T_{Duct}))]$ $Q_{STP} = 3.6 \text{ m}^3/\text{s}$

Calculation of gas flow at reference conditions, $\boldsymbol{Q}_{\text{Ref}}$

 $Q_{Ref} = Q_{Duct} x \qquad [273 + T_{Ref}]/[273 + T_{Duct}] \qquad Temperature \\ P_{Duct}/P_{Ref} \qquad Pressure \\ [100 - H_2 O_{Duct}]/[100 - H_2 O_{Ref}] \qquad Water vapour \\ [20.9 - O_{2Duct}]/[20.9 - O_{2Ref}] \qquad Oxygen$ $QRef = 3.6 m^3/s$

2.2.3 Water vapour measurements

CPL LABORATORIES MONITORING REPORT FORM WATER VAPOUR (GRAVIMETRIC TECHNIQUE)

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 2	Prepared
Test carried out by	D Martschenko, C Greenaway	Checked

	11-Jan-06
	H ₂ 0 1,2
D	Martschenko
	G. Carroll

SAMPLING TIMES

Determination	1	2
Time Start	10:30	11:10
Time End	11:06	11:42

SAMPLING CONDITIONS

Determination	100	1	2
Gas meter temperature (T _{meter})	°C	10	12
Atmospheric pressure (P _{atm})	kPa	101.8	101.8
Final meter reading	m ³	218.898	219.092
Initial meter reading	m ³	218.696	218.899
Gas meter calibration factor	Della della	0.983	0.983
Volume of gas sampled (VG _{meter})	1	198.5	189.8

SAMPLE TUBE WEIGHTS

Determination	The same of the same	1	2
Tube	ad tale Trans	m Day J	
Final weight (M _{fl})	g	145.6	129.1
Initial weight (M _{i1})	g	144.7	127.8
Weight gain $(M_{fl}-M_{il}=M_{gl})$	g	0.9	1.3

Sample gas volume at STP, VGSTP

 $VG_{STP} = VG_{meter} \times (273 \times P_{atm})/(101.3 \times (273 + T_{meter}))$

Determination		1	2
Volume of gas sampled (VG _{STP})	I, STP	192.3	183.0

Calculation of water vapour content in duct gas, Cg

 C_g (% vol) = 100 x (M_t x MV_{STP}+MW_{H2O})+(VG_{STP} + (M_t x MV_{STP} +MW_{H2O}))

where MV_{STP} is the ideal gas molecular volume at STP (i.e. 22.412 m³/kgmole)

MW_{H2O} is the molecular weight of water (i.e. 18 kg/kgmole)

WATER VAPOUR MEASUREMENTS

Determination	Missing Links	1	2
Water vapour content	%,vol	0.6	0.9
Mean water vapour content	%,vol	0.7	
Water vapour concentration	kg/m ³	0.005	0.007
Mean water vapour concentration	kg/m³	0.006	

2.2.4 Sampling measurements

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 2	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

	11-Jan-06	
	TE1	
THE	10:30	
	11:06	

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

Duct gas conditions

Ambient temperature (Tmb)	°C	9
Average duct gas temperature (Tuct)	°C	32
Duct static gas pressure (Ptatic)	kPa	0.13
Barometric pressure (Paro)	kPa	101.8
Duct gas volume flowrate @ ref. conditions (Q)	m^3/s	3.61
Gas compressibility corrections		0.995
Wet gas specific gravity (sg)		0.99

Reference conditions

Actual Duct Flow Conditions		Reference Conditions			
Average temperature (Tuct)	°C	32	Temperature (Teef)	°C	0
Total pressure (Buct)	kPa	101.9	Pressure (PRef)	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (ḤO _{Duct})	% vol	0.6	Water vapour (HO _{Ref})	% vol	0.6

Sampling conditions

Nozzle diameter (d)	mm	3.99
Initial gas meter reading	m ³	218.696
Final gas meter reading	m ³	218.898
Gas meter factor	and the land of the land	0.983
Sampled volume (SV _{teter})	m ³	0.198

Calculation of sample gas volume at reference conditions, §Y

				Corrections
SV_{Ref}	=	SV _{Meter} x	$[273 + T_{Ref}]/[273 + T_{Meter}]$	Temperature
			P_{Baro}/P_{Ref}	Pressure
			$[100-H_2O_{Meter}]/[100-H_2O_{Ref}]$	Water vapour
			$[20.9 - O_{2Ducd}]/[20.9 - O_{2Ref}]$	Oxygen

Sampled volume @ ref. conditions (SVeR	m ³	0.194
--	----------------	-------

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 2	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

-		
	11-Jan-06	
	TE2	
	11:10	
	11:42	

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

Duct gas conditions

Ambient temperature (T _{Amb})	°C	12
Average duct gas temperature (T _{Duct})	°C	30
Duct static gas pressure (P Static)	kPa	. 0.13
Barometric pressure (P Baro)	kPa	101.8
Duct gas volume flowrate @ ref. conditions (Q Ref)	m ³ /s	3.61
Gas compressibility correction (ε)		0.995
Wet gas specific gravity (sg)		0.99

Reference conditions

Actual Duct Flow Conditions			Reference Conditions					
Average temperature (T _{Duct})	°C	30	Temperature (T _{Ref})	°С	0			
Total pressure (P _{Duct})	kPa	101.9	Pressure (P _{Ref})	kPa	101.3			
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9			
Water vapour (H ₂ O _{Duct})	% vol	0.9	Water vapour (H ₂ O _{Ref})	% vol	0.7			

Sampling conditions

Nozzle diameter (d)	mm	4.0
Initial gas meter reading	m ³	218.899
Final gas meter reading	m ³	219.092
Gas meter factor		0.983
Sampled volume (SV Meter)	m ³	0.190

Calculation of sample gas volume at reference conditions, SVef

 $SV_{Ref} = SV_{Meter} \times [273 + T_{Ref}]/[273 + T_{Meter}]$ P_{Bard}/P_{Ref} $[100-H_2O_{Meter}]/[100-H_2O_{Ref}]$ $[20.9-O_{2Duct}]/[20.9-O_{2Ref}]$

Corrections
Temperature
Pressure
Water vapour
Oxygen

0.184	m ³	Sampled volume @ ref. conditions (SVR ef)
	111	Sampled volume a rel. conditions (SVR ef)

Prepared by:

D Martschenko

Checked by:

G. Carroll

Static pressure before gas meter Water Vapour Concentration

factor

1.001

MEASUREMENT OF TOTAL PARTICULATE

78	LL.	٠	1
- 1	es	τ	-1

Moisture Content

Time	Posn.	Pitot rdg. Pa	Duct temp. °C	Duct CO2 %	O2 %	Meter temp. °C	Duct static Pa	Baro press. kPa	Nozzle dia, mm	Iso. rate I/min	Actual flow 1/min	Vol.sampled m ³ meter	m ³ cum.	reqd. vol. m ³	Cum. dev. %
0	2	47	29	0.0	20.9	8	130	101.7	3.99	6.2	6.2	218.696	0.000	0.000	
4	4	55	29	0.0	20.9	8	130	101.7	3.99	6.7	6.8	218.721	0.025	0.025	-0.1
8	7	68	29	0.0	20.9	9	130	101.7	3.99	7.5	7.6	218.749	0.052	0.052	0.4
12	9	20	34	0.0	20.9	9	130	101.7	3.99	4.0	4.1	218.779	0.083	0.082	0.7
16	2	38	35	0.0	20.9	10	130	101.8	3.99	5.6	5.6	218.795	0.099	0.098	0.8
20	4	68	35	0.0	20.9	10	130	101.8	3.99	7.5	7.6	218.818	0.121	0.121	0.7
24	7	64	32	0.0	20.9	10	130	101.8	3.99	7.3	7.4	218.848	0.152	0.150	1.0
28	9	30	31	0.0	20.9	10	130	101.8	3.99	5.0	5.1	218.878	0.182	0.180	1.2

MASS OF PARTICULATES COLLECTED

Filter no.	NCR6
Filter + particulates, g	0.5277
Filter, g	0.5276
Mass collected, g	1E-04

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

Filter no.	NCR3
Filter + particulates, g	0.4682
Filter, g	0.4680
Mass Change, g	0.0002

OVERALL BLANK

Total mass collected, g	0.0001
Total mass collected, g	

washing bottle no.	
Evaporating Basin + particulates, g	0
Evaporating Basin , g	0
Mass collected, g	0

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m3/s	3.97869515
(Q _{ret}), Flow in the duct, at reference conditions, m ³ /s	3.6096
(M), Mass flow at duct conditions, kg/h	0.0074
(C), Concentration of particulate matter at reference conditions, mg/m3	0.51

TOTAL FIELD BLANK g

0.0002

MEASUREMENT OF TOTAL PARTICULATE

Time	Posn.	Pitot rdg. Pa	Duct temp. °C	CO2	O2 %	Meter temp. °C	Duct static Pa	Baro press. kPa	Nozzle dia. mm	Iso. rate l/min	Actual flow 1/min	Vol.sampled m ³ meter	m³ cum.	reqd. vol. m ³	Cum dev. %
0	2	44	30	0.0	20.9	11	130	101.8	3.99	6.1	6.0	218.899	0.000	0.000	- 4
4	4	56	31	0.0	20.9	12	130	101.8	3.99	6.9	7.1	218.923	0.024	0.024	-1.0
8	7	56 -	30	0.0	20.9	12	130	101.8	3.99	6.9	7.0	218,951	0.052	0.052	1.1
12	9	36	31	0.0	20.9	12	130	101.8	3.99	5.5	5.8	218.979	0.080	0.079	1.0
16	2	15	31	0.0	20.9	12	130	101.8	3.99	3.6	3.6	219.002	0.103	0.101	1.9
20	4	58	30	0.0	20.9	12	130	101.8	3.99	7.0	7.0	219.017	0.118	0.116	1.7
24	7	70	30	0.0	20.9	12	130	101.8	3.99	7.7	7.9	219.044	0.146	0.144	1.3
28	9	18	30	0.0	20.9	12	130	101.8	3.99	3.9	4.0	219.076	0.177	0.175	1.5

MASS OF PARTICULATES COLLECTED

Filter no.	NCR7
Filter + particulates, g	0.5254
Filter, g	0.5254
Mass collected, g	0

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

Total mass collected, g

OVERALL BLANK

Filter no.	NCR3
Filter + particulates, g	0.4682
Filter, g	0.4680
Mass Change, g	0.0002

Washing bottle no.	
Evaporating Basin + particulates, g	0
Evaporating Basin , g	0
Mass collected g	

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m ³ /s	3.97869515
(Q _{ret}), Flow in the duct, at reference conditions, m ³ /s	3.6096
(M), Mass flow at duct conditions, kg/h	0
(C), Concentration of particulate matter at reference conditions, mg/m'	0

TOTAL FIELD BLANK g

0.0002

(M), Mass flow at duct conditions, $kg/h = C \times Q \text{ duct } \times 0.0036$

(C), Concentration of particulate matter at reference conditions, mg/m³

Total mass collected, g / Sampled volume at ref conditions, m³

2.2.5 Manual monitoring method results calculations

Formula 1 - Determination of Moisture Content

$$V_o = V_m.(273 \div T_m).(P_b \div 101.3)$$

%
$$H_20 = 100.(M_w \div 18) \div [(V_o \div 22.412) + (M_w \div 18)]$$

Where:

Formula 2 - Determination of mean velocity

$$V = 0.0753.\sqrt{T}.\sqrt{h}$$

Where

V - Mean velocity during test, m/s

√T - Mean square root of temperatures before and after test, K

√h - Mean square root of pitot-static readings before and after test, Pa

Formula 3 - Volume flow rate of duct gases, at duct temperatures

$$Q_{(duct)} = V.A$$

Where

Q_(duct) - Volume flow rate of duct gases, m³/s

V - Mean velocity, m/s

A - Area of duct (at the sampling plane), m²

Formula 4 - Volume flow rate of duct gases, specified reference conditions

$$Q_o = Q_{(duct)} \cdot (T_{ref} \div T_{duct}) \cdot (P_{duct} \div P_{ref}) \cdot [(100 - \%H_20) \div 100] \cdot [(20.9 - O_{2duct}) \div (20.9 - O_{2rel})]$$

Where

- Volume flow rate at reference conditions, and relative O2 and moisture correction, m3/s

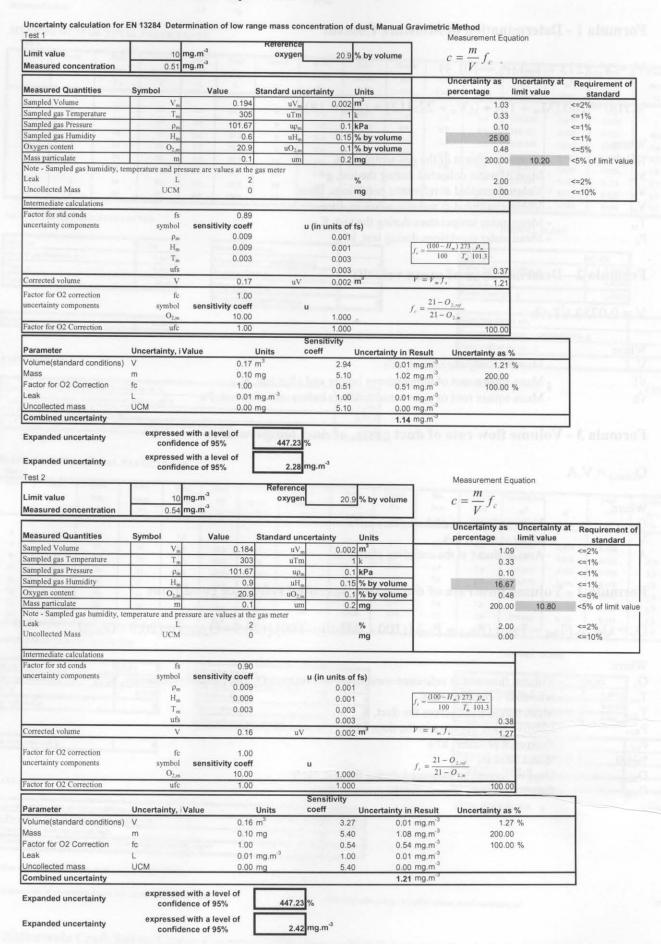
 Q_o - Volume flow rate at refere T_{ref} - reference Temperature, K

 T_{duct} - Mean temperature across the duct, K P_{duct} - Relative static pressure in the duct, kPa

 P_{ref} - Reference pressure, kPa $^{\circ}$ H₂0 - Water content, $^{\circ}$

 O_{2duct} - Oxygen content as measured during the test, %v/v - Relative Oxygen content for the process, %v/v

2.2.6 Uncertainty calculations



Appendix 3

Stack: Spray Booth 2

Equipment	Value	No X
Nozzle: internal diameter	>6 mm	X
Nozzle: uncertainty of area at nozzle entry	⊴0%	1
Nozzle: length with constant internal diameter	>10 mm	1
Nozzle: change in diameter angle	<30°	1
Nozzle: radius of the bend	.>1.5 times internal diameter	1
Nozzle: straight length before the first bend	>30 mm	1
Filter holder: distance to obstacles	>50mm	1
Filter:		
Efficiency on test aerosol of 0.3 μm	>99.5 %	1
Efficiency on test aerosol of 0.6 μm	>99.9%	1
Filter: filter material	No reaction and no absorption of the components	1
Condenser, drying tower: residual gas moisture	<10 gr/m ³	1
Gas meter:		141
Uncertainty of gas volume	<2%	1
Uncertainty of absolute pressure	⊴ %	1
Uncertainty of absolute temperature	⊴ %	1
Angle of the nozzle with regard to gas flow Isokinetic rate	<10°	1
Isokinetic rate	95% to 115%	1
Leak rate	<2%	1
Balance resolution	0.01 mg to 0.1 mg	1
Weighing uncertainties	<5 % of the LV a	X
Weighing: temperature equilibrium duration	4h to 12h	1
Overall blank value	<10% of the LV a	1
Sampling location	STO7001 the E v ti	
Duct gas flow: angle with regard to duct access	<15°	1
Duct gas flow: negative velocity	not permitted	1
Duct gas flow: differential pressure at Pitot tube	> 5 Pa	/
Duct gas flow: ratio of max. to min. velocity	<3:1	1
Straight length before the sampling plane	> 5 hydraulic diameters (recommended)	1
Straight length after the sampling plane	> 2 hydraulic diameters (recommended)	X
Straight length before emission point	> 5 hydraulic diameters (recommended)	X
Correct number of sampling points for standard?		1
Flue Gas Characteristics		
Flue gas density: uncertainty	0.05 kg/rn ³	✓
LV ^a : Limit Value set for the process	mg/m ³	10

---0000000---

End of Report



TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 1)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry Spray Booth 3

Monitoring dates: 11-12th January 2006

Contract number: Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address: Stonybridge Trading Estate

Rowley Drive

Coventry CV3 4FG

Monitoring Organisation: CPL Laboratories

Address: Mill Lane

Wingerworth Chesterfield S42 6NG

Date of Report: 10th February 2006

Report Approved by: C. M. Greenaway

MCERTS Registration Number: 02 048

Function: Team Leader

Signed:

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	2.3	Appendix 3	Procedural requirements of ISO 9096: 2003

1.1 Monitoring Objectives

Mr M. Rose of Nationwide Craft Repair Centre, requested CPL Laboratories to monitor emissions to air from Spray Booth 3.

The monitoring was carried out on the 11-12th January 2006, to determine compliance with specified emission limits. The substances requested for monitoring at each emission point are listed below.

Substances	Emission Point Identification	
To be	A RECEIVED A CONTRACT OF THE PARTY OF THE PA	
Monitored	Spray Booth 3	
Total partic	culate matter (TPM)	

Special Requirements: None

1.2 Monitoring Results

Emission point reference	Spray Booth 3	
Substance to be monitored	Total particulate matter (TPM)	
Emission limit value mg/m ³		
Periodic monitoring results mg/m ³	<0.52	< 0.56
Uncertainty %	400	400
Monitoring Method reference	ISO 9096: 2003	
Accreditation for use of method	UKAS	
	MCERTS	
Date of sampling	11/01/06	12/01/06
Start & end times	13:57 – 14:27	9:05 – 9:37
Reference conditions 273K, 101.3kPa	No correction for oxygen or moisture	
Operating status	Normal	

1.3 Operating Information

This process involves the paint spraying of automobiles within confined booths and extraction through a filter unit before outlet to air.

Emission point reference	Spray Booth 3 11-12/01/06	
Date		
Process type	Panel Spraying	
Process duration	Approximately 30 to 60 mins	
Fuel	Not Applicable	
Feedstock	Paints	
Abatement	Filters	
Load	Automobiles	

Comparison with Operator CEMs	ndigorie 1712. No construction for ou
Operator CEMs Particulate matter mg/m ³	Not Applicable
Particulate matter mg/m ³	< 0.52
Periodic monitoring results	< 0.56

1.4 Monitoring Deviations

Emission point reference	Spray Booth 3	
Substance deviations	None	
Monitoring deviations	Note 1	Note 4
Other relevant issues	Note 2	Note 3

Notes

- 1. Nozzle diameter less than 6mm
- 2. Less than 2 duct diameters straight length after the sampling plane
- 3. Less than 5 duct diameters straight length before the emission point
- 4. Weighing uncertainties greater than 5% of the LV



TEST REPORT



Report for the Periodic Monitoring of Emissions to Air

(Part 2)

Operator:

Nationwide Crash Repair Centre

Installation:

Coventry

Spray Booth 3

11-12th January 2006 Monitoring dates:

Contract number: Q0036117

Client Organisation: Nationwide Crash Repair Centre

Address:

Stonybridge Trading Estate

Rowley Drive

Coventry

CV3 4FG

Monitoring Organisation:

CPL Laboratories

Address:

Mill Lane

Wingerworth

Chesterfield

S42 6NG

Date of Report:

10th February 2006

Report Approved by:

C Greenaway

MCERTS Registration Number:

02 048

Function:

Team Leader

Signed:

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2 Part 2: Supporting Information

2.1 Appendix 1: General Information

2.1.1 Monitoring organisation staff details

Sampling Team Members

Name	MCert Status	MCert Registration No.	Responsibility
C M Greenaway	Level 2 With TE 1, 2, 3, 4	MM 02 048	Team Leader
D Martschenko	-	General Information	Technician

2.1.2 Monitoring organisation method details

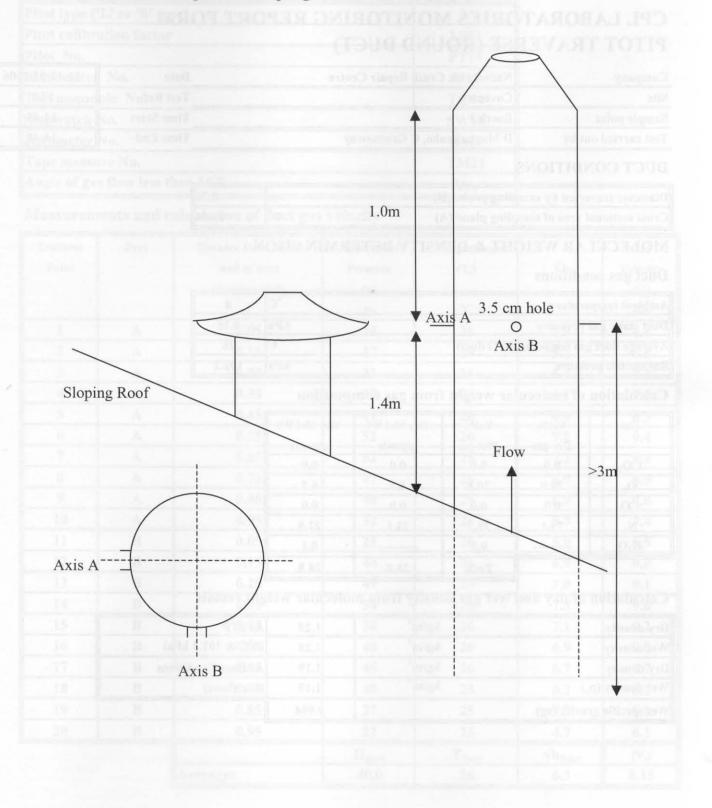
Pollutant		Measurement Method	No. tests / blanks
Total Particulate Matter (TPM)	ST 6	ISO 9096: 2003	2/1

2.1.3 Monitoring organisation equipment checklist

06/007	CL-081	
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2.2 Appendix 2

2.2.1 Diagram of Sampling Location and Position



2.2.2 Flow criteria and gas measurements

CPL LABORATORIES MONITORING REPORT FORM PITOT TRAVERSE (ROUND DUCT)

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 3	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

11-12/01/2006	
FL1	
14:45	
14:49	

DUCT CONDITIONS

Diameter traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m²	0.454

MOLECULAR WEIGHT & DENSITY DETERMINATION

Duct gas conditions

Ambient temperature	°C	8
Duct static gas pressure	kPa	0.16
Average duct gas temperature (Tduct)	°C	26
Barometric pressure	kPa	102.2

Calculation of molecular weight from gas composition

Gas	Vol% Dry gas	Vol% Wet gas	Dry Mol Wt g/gmole	Wet Mol Wt g/gmole
CO ₂	0.0	0.0	0.0	0.0
O ₂	20.9	20.8	6.7	6.7
CO	0.0	0.0	0.0	0.0
N ₂	79.1	78.7	22.1	22.0
H ₂ O		0.5		0.1
1		Total	28.8	28.8

Calculation of dry and wet gas density from molecular weight results

Dry density	kg/m ³	1.29	At STP
Wet density	kg/m ³	1.28	(0°C & 101.3 kPa)
Dry density	kg/m ³	1.19	At Duct Conditions
Wet density (ρ _a)	kg/m ³	1.19	(see above)
Wet specific gravity (sg)		0.994	

PITOT TRAVERSE

Details of measurement equipment and supplementary measurements

Pitot type ('L' or 'S' type)	L
Pitot calibration factor	1.001
Pitot No.	PT14
Manometer No.	M17
Thermocouple No.	TC44
Stopwatch No.	SW18
Barometer No.	BM4
Tape measure No.	TM21
Angle of gas flow less than 15°?	Yes

Measurements and calculation of duct gas velocity

Traverse Point	Port	Distance from inside	Differential	Temperature	√h	Gas
Point		wall of duct	Pressure	(T _s)	V h	Velocity
. Indiale		(fraction of D)	(h)			(V _s)
		- 11911 S. Miller S. Mill	Pa	°C	Theodille	m/s
1	A	0.05	24	26	4.9	6.4
2	A	0.15	27	26	5.2	6.8
3	A	0.25	32	26	5.7	7.4
4	A	0.35	37	26	6.1	7.9
5	A	0.45	41	26	6.4	8.3
6	A	0.55	52	26	7.2	9.4
7	A	0.65	52	25	7.2	9.4
8	A	0.75	47	25	6.9	8.9
9	A	0.85	48	25	6.9	9.0
10	A	0.95	32	26	5.7	7.4
11	В	0.05	25	26	5.0	6.5
12	В	0.15	48	26	6.9	9.0
13	В	0.25	49	26	7.0	9.1
14	В	0.35	54	26	7.3	9.6
15	В	0.45	50	26	7.1	9.2
16	В	0.55	48	26	6.9	9.0
17	В	0.65	45	26	6.7	8.7
18	В	0.75	40	25	6.3	8.2
19	В	0.85	27	25	5.2	6.8
20	В	0.95	22	25	4.7	6.1
			H _{Duct}	T _{Duct}	$\sqrt{h_{Duct}}$	(V _s)
		Averages	40.0	26	6.3	8.15

CALCULATION	OF VELOCITY	18	FLOWRA	TE
CILLOUDINI	OI VELOCIII		TILLY VY IVA	

Conversion of actual duct gas flow to reference conditions

Actual Duct Flow Conditions			Reference Conditions		
Average temperature (T _{Duct})	°C	26	Temperature (T _{Ref})	°C	0
Total pressure (P _{Duct})	kPa	102.4	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (H ₂ O _{Duct})	% vol	0.5	Water vapour (H ₂ O _{Ref})	% vol	0.5

Calculation of gas flowrate at STP, QSTP

 $Q_{STP} = Q_{Duct} \times [(273 \times P_{Duct})/(101.3 \times (273 + T_{Duct}))]$ $Q_{STP} = \frac{3.4 \text{ m}^3}{}$

Calculation of gas flow at reference conditions, Q_{Ref}

 $Q_{Ref} = Q_{Duct} x \qquad [273 + T_{Ref}]/[273 + T_{Duct}] \qquad Temperature$ $P_{Duct}/P_{Ref} \qquad Pressure$ $[100-H_2O_{Duct}]/[100-H_2O_{Ref}] \qquad Water vapour$ $[20.9-O_{2Duct}]/[20.9-O_{2Ref}] \qquad Oxygen$ $QRef = 3.4 m^3/s$

2.2.3 Water vapour measurements

CPL LABORATORIES MONITORING REPORT FORM WATER VAPOUR (GRAVIMETRIC TECHNIQUE)

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 3	Prepared
Test carried out by	D Martschenko, C Greenaway	Checked

11-12/01/2006
H ₂ 0 1,2
D Martschenko
G. Carroll

SAMPLING TIMES

Determination	1 (0)	2
Time Start	13:57	09:05
Time End	14:27	09:37

SAMPLING CONDITIONS

Determination		1	2
Gas meter temperature (T _{meter})	°C	12	4
Atmospheric pressure (P _{atm})	kPa	102.1	102.4
Final meter reading	m ³	219.293	219.576
Initial meter reading	m ³	219.092	219.393
Gas meter calibration factor		0.983	0.983
Volume of gas sampled (VG _{meter})	1	196.7	179.8

SAMPLE TUBE WEIGHTS

Determination	151	1	2
Tube			
Final weight (Mfl)	g	146.2	130.3
Initial weight (M _{i1})	g	145.6	129.3
Weight gain $(M_{fl}-M_{il}=M_{gl})$	g	0.6	1.0

Sample gas volume at STP, VGSTP

 $VG_{STP} = VG_{meter} \times (273 \times P_{atm})/(101.3 \times (273 + T_{meter}))$

Determination		1	2
Volume of gas sampled (VG _{STP})	I, STP	190.1	179.4

Calculation of water vapour content in duct gas, Cg

 C_g (% vol) = 100 x (M_t x MV_{STP}+MW_{H2O})+(VG_{STP} + (M_t x MV_{STP} +MW_{H2O}))

where MV_{STP} is the ideal gas molecular volume at STP (i.e. 22.412 m³/kgmole)

MW_{H2O} is the molecular weight of water (i.e. 18 kg/kgmole)

WATER VAPOUR MEASUREMENTS

Determination	Family 1-801	1	2
Water vapour content	%,vol	0.4	0.7
Mean water vapour content	%,vol	0.5	
Water vapour concentration	kg/m³	0.003	0.006
Mean water vapour concentration	kg/m ³	0.004	

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 3	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

11-Jan-06	
TE1	
13:57	
14:27	

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

Duct gas conditions

Ambient temperature (T _{mb})	°C	11
Average duct gas temperature (Tuct)	°C	32
Duct static gas pressure (R _{tatic})	kPa	0.16
Barometric pressure (Raro)	kPa	102.0
Duct gas volume flowrate @ ref. conditions (Q _f)	m ³ /s	3.39
Gas compressibility correction®)		0.995
Wet gas specific gravity (sg)		0.99

Reference conditions

Actual Duct Flow Conditions			Reference Conditions		
Average temperature (Touce)	°C	32	Temperature (T _{Ref})	°C	0
Total pressure (Pouct)	kPa	102.2	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (ḤO _{Duct})	% vol	0.4	Water vapour (HO _{Ref})	% vol	0.4

Sampling conditions

Nozzle diameter (d)	mm	3.99	
Initial gas meter reading	m ³	219.092	
Final gas meter reading	\mathbf{m}^3	219.293	
Gas meter factor		0.983	
Sampled volume (SV _{Meter})	m ³	0.197	

Calculation of sample gas volume at reference conditions, Saf

			Corrections
=	SV _{Meter} x	$[273 + T_{Ref}]/[273 + T_{Meter}]$	Temperature
		P_{Baro}/P_{Ref}	Pressure
		[100-H ₂ O _{Meter}]/[100-H ₂ O _{Ref}]	Water vapour
		$[20.9 - O_{2Duct}]/[20.9 - O_{2Ref}]$	Oxygen
	-	= SV _{Meter} x	$ m P_{Baro}/P_{Ref}$ $ m [100-H_2O_{Meter}]/[100-H_2O_{Ref}]$

Sampled volume @ ref. conditions (SV)	m ³	0.192
---------------------------------------	----------------	-------

Prepared by: D Martschenko Checked by: G. Carroll

CPL LABORATORIES MONITORING REPORT FORM TOTAL PARTICULATE

Company	Nationwide Crash Repair Centre	Date
Site	Coventry	Test Ref
Sample point	Booth 3	Time Start
Test carried out by	D Martschenko, C Greenaway	Time End

	_
12-Jan-06	
TE2	
09:05	
09:37	╗

Duct conditions

Dimension traversed by sampling probe (D)	m	0.76
Cross sectional area of sampling plane (A)	m ²	0.454

Duct gas conditions

Ambient temperature (T _{Amb})	°C	4
Average duct gas temperature (T _{Duct})	°C	34
Duct static gas pressure (P _{Static})	kPa	0.16
Barometric pressure (P _{Baro})	kPa	102.3
Duct gas volume flowrate @ ref. conditions (Q _{Ref})	m³/s	3.39
Gas compressibility correction (ε)		0.995
Wet gas specific gravity (sg)		0.99

Reference conditions

Actual Duct Flow Conditions			Reference Conditions		
Average temperature (T _{Duct})	°C	34	Temperature (T _{Ref})	°C	0
Total pressure (P _{Duct})	kPa	102.5	Pressure (P _{Ref})	kPa	101.3
Oxygen (O _{2Duct})	% vol,dry	20.9	Oxygen (O _{2Ref})	% vol, dry	20.9
Water vapour (H ₂ O _{Duct})	% vol	0.7	Water vapour (H ₂ O _{Ref})	% vol	0.7

Sampling conditions

Nozzle diameter (d)	mm	4.0
Initial gas meter reading	m ³	219.393
Final gas meter reading	m ³	219.576
Gas meter factor		0.983
Sampled volume (SV _{Meter})	m ³	0.180

Calculation of sample gas volume at reference conditions, $\mathrm{SV}_{\mathrm{Ref}}$

			Corrections
SV _{Ref} =	SV _{Meter} x	$[273 + T_{Ref}]/[273 + T_{Meter}]$	Temperature
		P_{Baro}/P_{Ref}	Pressure
		$[100-H_2O_{Meter}]/[100-H_2O_{Ref}]$	Water vapour
		$[20.9-O_{2Duct}]/[20.9-O_{2Ref}]$	Oxygen

Sampled volume @ ref. conditions (SVR _{ef})	m 0.180
---	---------

Prepared by:	D Martschenko	Checked by:	G. Carroll

 Static pressure before gas meter
 0
 Pa
 Pitot
 1.001

 Water Vapour Concentration
 0.00
 kg/m3
 factor

 Moisture Content
 0.5
 %

MEASUREMENT OF TOTAL PARTICULATE

Test 1

Time	Posn.	Pitot	Duct	Duct	Duct	Meter	Duct	Baro	Nozzle	Iso.	Actual	Vol.sampled		reqd.	Cum.
		rdg.	temp.	CO2	02	temp.	static	press.	dia.	rate	Пом	m ³	m ³	vol.	dev.
		Pa	°C	%	%	% °C		kPa	mm	l/min	l/min	meter	cum.	m ³	%
0	2	30	31	0.0	20.9	10	160	102.0	3.99	5.0	4.9	219.092	0.000	0.000	
4	4	62	31	0.0	20.9	10	160	102.0	3.99	7.2	7.1	219.112	0.020	0.020	-2.1
8	7	57	32	0.0	20.9	10	160	102.0	3.99	6.9	7.1	219.141	0.048	0.049	-1.4
12	9	42	32	0.0	20.9	10	160	102.0	3.99	5.9	6.0	219.169	0.077	0.076	0.4
16	2	35	31	0.0	20.9	11	160	102.0	3.99	5.4	5.5	219.193	0.101	0.100	0.8
20	- 4	68	32	0.0	20.9	11	160	102.0	3.99	7.5	7.5	219.215	0.123	0.122	1.0
24	7	48	32	0.0	20.9	11	160	102.0	3.99	6.3	6.6	219.245	0.153	0.152	0.8
28	9	32	32	0.0	20.9	11	160	102.1	3.99	5.2	5.2	219.272	0.179	0.177	1.1

MASS OF PARTICULATES COLLECTED

Filter no.	NCR1		
Filter + particulates, g	0.486		
Filter, g	0.486		
Mass collected, g	0		

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

Total mass collected, g	0

Washing bottle no. Evaporating Basin + particulates, g (Evaporating Basin , g (Mass collected, g (

NCR3

0.4682

0.4680

0.0002

OVERALL BLANK

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m ³ /s	3.6751
(Q _{ref}), Flow in the duct, at reference conditions, m ³ /s	3.3927
(M), Mass flow at duct conditions, kg/h	0
(C), Concentration of particulate matter at reference conditions, mg/m3	0

TOTAL FIELD BLANK

Filter no.

Filter, g

Filter + particulates, g

Mass Change, g

0.0002

MEASUREMENT OF TOTAL PARTICULATE

Test 2

Time	Posn.	Pitot	Duct	Duct	Duct	Meter	Duct	Baro	Nozzle	Iso.	Actual	Vol.sampled	1	reqd.	Cum
HIV	eh (F)	rdg. Pa	emp. °C	% %	CO2 O2 temp. % °C	static Pa	press. kPa			flow 1/min	m' m' m' cum.		vol. m³	dev.	
0	2	25	32	0.0	20.9	3	160	102.4	3.99	4.4	4.4	219.393	0.000	0.000	
4	4	50	33	0.0	20.9	3	160	102.4	3.99	6.3	6.4	219.411	0.017	0.018	-1.6
8	7	50	34	0.0	20.9	4	160	102.3	3.99	6.3	6.3	219.436	0.043	0.043	0.4
12	9	40	34	0.0	20.9	4	160	102.3	3.99	5.6	5.7	219.462	0.068	0.068	0.2
16	2	25	33	0.0	20.9	4	160	102.3	3.99	4.5	4.5	219.484	0.091	0.091	0.3
20	4	55	34	0.0	20.9	4	160	102.3	3.99	6.6	6.8	219.502	0.109	0.108	0.5
24	7	53	34	0.0	20.9	4	160	102.3	3.99	6.5	6.4	219.529	0.136	0.135	0.8
28	9	35	35	0.0	20.9	4	160	102.4	3.99	5.3	5.3	219.555	0.161	0.161	0.5

MASS OF PARTICULATES COLLECTED

Filter no.	NCR2
Filter + particulates, g	0.551
Filter, g	0.551
Mass collected, g	0

Washing bottle no.	
Washing filter + particulates, g	0
Washing filter, g	0
Mass collected, g	0
Proportionalised weight	0

	7/
Total mass collected, g	0

OVERALL BLANK

Filter no.	NCR3
Filter + particulates, g	0.4682
Filter, g	0.4680
Mass Change, g	0.0002

Washing bottle no.	
Evaporating Basin + particulates, g	0
Evaporating Basin , g	0
Mass collected, g	0

CALCULATIONS

(Q duct), Flow in the duct, at duct conditions, m ³ /s	3.6751
(Q _{ref}), Flow in the duct, at reference conditions, m ³ /s	3.3927
(M), Mass flow at duct conditions, kg/h	0
(C), Concentration of particulate matter at reference conditions, mg/m'	0

TOTAL FIELD BLANK g

0.0002

(M), Mass flow at duct conditions, kg/h = C x Q duct x 0.0036

(C), Concentration of particulate matter at reference conditions, mg/m³

Total mass collected, g / Sampled volume at ref conditions, m³

2.2.5 Manual monitoring method results calculations

Formula 1 - Determination of Moisture Content

$$V_o = V_m.(273 \div T_m).(P_b \div 101.3)$$

$$\% H_2 0 = 100.(M_w \div 18) \div [(V_o \div 22.412) + (M_w \div 18)]$$

Where:

Formula 2 - Determination of mean velocity

$$V = 0.0753.\sqrt{T}.\sqrt{h}$$

Where

V - Mean velocity during test, m/s

√T - Mean square root of temperatures before and after test, K
√h - Mean square root of pitot-static readings before and after test, Pa

Formula 3 - Volume flow rate of duct gases, at duct temperatures

$$Q_{(duct)} = V.A$$

Where

 $Q_{(duct)}$ - Volume flow rate of duct gases, m³/s

V - Mean velocity, m/s

A - Area of duct (at the sampling plane), m²

Formula 4 - Volume flow rate of duct gases, specified reference conditions

$$Q_o = Q_{(duct)}.(T_{ref} \div T_{duct}).(P_{duct} \div P_{ref}).[(100 - \%H_20) \div 100].[(20.9 - O_{2duct}) \div (20.9 - O_{2rel})]$$

Where

Q_o - Volume flow rate at reference conditions, and relative O₂ and moisture correction, m³/s

T_{ref} - reference Temperature, K

 T_{duct} - Mean temperature across the duct, K P_{duct} - Relative static pressure in the duct, kPa

P_{ref} - Reference pressure, kPa %H₂0 - Water content, %

 O_{2duct} - Oxygen content as measured during the test, %v/v - Relative Oxygen content for the process, %v/v

2.2.6 Uncertainty calculations

st 1		3	Reference		0.0/ harris		m_{c}			
nit value	0.52 n	ng.m ⁻³	oxygen	20.9	9 % by volume	C	$=\frac{m}{V}f_c$			
easured concentration	0.52	ng.m		_		Un	certainty as	Uncerta	ainty at	Requirement of
easured Quantities	Symbol	Value	Standard unce		Units	pe	rcentage	limit va		standard
mpled Volume	V _m	0.192	uV _m		2 m³	-	0.33			=2% =1%
mpled gas Temperature	T _m	305	uTm		1 k 1 kPa	-	0.10			=1%
mpled gas Pressure	ρ _m H _m	101.84	uρ _m uH _m		5 % by volume		37.50	NO.		=1%
mpled gas Humidity kygen content	O _{2 m}	20.9	uO _{2 m}		0 % by volume		0.00	0	<	=5%
ass particulate	m	0.1	um	0.	.2 mg		200.00	0 10	.40 <	5% of limit value
te - Sampled gas humidity, ten	nperature and pres	ssure are values at the	gas meter		0/		2.0	0		=2%
ak	UCM	2			% mg	LEG TA	0.0			=10%
ncollected Mass	OCM				9			T		
termediate calculations actor for std conds	fs	0.90			SULL PROPERTY.		THE POST	18 240		
ncertainty components	symbol	sensitivity coeff		u (in units o				1		
SANO CONTRARIO DE CAMBRO POR ANTIGO	$\rho_{\rm m}$	0.009		0.00		(100-H _n	1273 0	1000		
	H _m	0.009		0.00		$f_s = \frac{100 \text{ M/m}}{100}$	$\frac{7213}{T_m} \frac{P_m}{101.3}$			
	T _m ufs	0.003		0.00		-	0.3	7		
orrected volume	V	0.17	uV		02 m³	$V = V_m J_s$	1.2	_		
	fc	1.00				25 40				
actor for O2 correction ncertainty components	symbol	sensitivity coef		u		$f_c = \frac{21 - O_2}{21 - O_2}$	ref			
	O _{2,m}	10.00		0.00		21-0				
actor for O2 Correction	ufc	1.00		0.00			0.0	00		
	real year land			Sensitivity		n Pacult	Uncertainty a	e %		
arameter	Uncertainty, i		- Citito	coeff	Uncertainty is	n Result 01 mg.m ⁻³		22 %		
/olume(standard conditions)	V		7 m ³) mg			01 mg.m 04 mg.m ⁻³	200.0			
Mass Factor for O2 Correction	m fc	1.0				00 mg.m ⁻³		00 %	in a	
eak	L		1 mg.m ⁻³	1.0	.00 0.0	01 mg.m ⁻³				
Uncollected mass	UCM	0.0) mg	5.3		00 mg.m ⁻³				
Combined uncertainty					1.0	04 mg.m ⁻³				
	confid	d with a level of lence of 95% d with a level of lence of 95%	2.08	% mg.m ⁻³			Maccurama	oot Equat	ion	
Expanded uncertainty Test 2	expressed confid	ence of 95% d with a level of lence of 95%	2.08 Reference	mg.m ⁻³	20.9 % by volu	ıme	Measureme $c = \frac{m}{m} f$		ion	
Expanded uncertainty Test 2 Limit value	confid expresse confid	ence of 95% d with a level of	2.08	mg.m ⁻³	20.9 % by volu	ime	Measureme $c = \frac{m}{V} f$		ion	
Expanded uncertainty Fest 2 Limit value	confid expresse confid	d with a level of lence of 95%	2.08 Reference	mg.m ⁻³		ime	$c = \frac{m}{V} f$ Uncertaint	c y as Ui	ncertainty	
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities	confid expresse confid	ence of 95% d with a level of lence of 95% o mg.m ⁻³ kmg.m ⁻³	2.08 Reference oxyge	mg.m ⁻³	Units	me	$c = \frac{m}{V} f$	y as Uir		standard
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume	confidence	ence of 95% d with a level of lence of 95% o mg.m ⁻³ Value	2.08 Reference oxyge Standard u	mg.m ⁻³	Units	ime	$c = \frac{m}{V} f$ Uncertaint	y as Ui	ncertainty	
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature	confidence	ence of 95% d with a level of lence of 95% o mg.m ⁻³ Value	Standard ut 18 ut 107 ut 1	mg.m ⁻³ ce en uncertainty	Units 0.002 m³	ime	$c = \frac{m}{V} f$ Uncertaint	y as Uir	ncertainty	standard <=2%
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure	confide expressed confiders of the confi	ence of 95% d with a level of lence of 95% of mg.m ⁻³ fmg.m ⁻³ Value	2.08 Reference oxyget Standard ut 18 ut 107 ut 114 ut 114 ut 115 ut 11	mg.m ⁻³ ce en incertainty V _m ρ _m	Units	i iggar	$c = \frac{m}{V} f$ Uncertaint	y as Uir 1.11 0.33	ncertainty	standard <=2% <=1%
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity	confidence	ence of 95% d with a level of lence of 95% mg.m ⁻³ Value 0 m 102	2.08 Reference oxyget Standard ut 18 ut 107 ut 114 ut 114 ut 115 ut 11	mg.m ⁻³ ce en incertainty V _m Γm P _m H _m	Units 0.002 m³ 1 k 0.1 kPa	ume	$c = \frac{m}{V} f$ Uncertaint percentage	y as Uie lir 1.11 0.33 0.10 21.43 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5%
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate	Symbol V T P H O2	with a level of lence of 95% d with a level of lence of 95% d mg.m ⁻³ Value Mark 102 Mark 102 Mark 102 Mark 102 Mark 102	2.08 Reference oxyget Standard u 18 u 19 u 10 u 11 u 10 u	mg.m ⁻³ ce en incertainty V _m Γm P _m H _m	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu	ume	$c = \frac{m}{V} f$ Uncertaint percentage	y as Uir 1.11 0.33 0.10 21.43	ncertainty	<=2% <=1% <=1% <=1%
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity,	Symbol V T P H O2	with a level of lence of 95% d with a level of lence of 95% d mg.m ⁻³ Value Mark 102 Mark 102 Mark 102 Mark 102 Mark 102	2.08 Reference oxyge Standard u 18 u 107 u 14 u 0.7 ul 0.7 ul 0.9 u 0.9 the gas meter	mg.m ⁻³ ceen incertainty V _m ρ _m H _m	Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg	ume	$c = \frac{m}{V} f$ Uncertaint percentage	y as Unit of the line of the l	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5%
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak	Symbol V T P H O2	with a level of lence of 95% and mg.m ⁻³ Value Walue Description of the control of the control of 95% and mg.m ⁻³ Value Description of the control of 95% and mg.m ⁻³ Value Description of 95% and mg.m ⁻³ Value Description of 95% and 9	2.08 Reference oxyget Standard u 18 u 19 u 10 u 11 u 10 u	mg.m ⁻³ ceen incertainty V _m ρ _m H _m	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0 % by volu	ume	$c = \frac{m}{V} f$ Uncertaint percentage	y as Uie lir 1.11 0.33 0.10 21.43 0.00	ncertainty nit value	standard <=2% <=1% <=19 <=19 <=5% <=5% of limit va
Expanded uncertainty Fest 2 Limit value Measured Concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass	confid expressed confid 0.56 Symbol V T P P H O2	with a level of lence of 95% and mg.m ⁻³ Value Walue Description of the control of the control of 95% and mg.m ⁻³ Value Description of the control of 95% and mg.m ⁻³ Value Description of 95% and mg.m ⁻³ Value Description of 95% and 9	2.08 Reference oxyget Standard u 18 u' 107 u' 14 u 0.7 ul 0.9 uO 0.1 the gas meter 2	mg.m ⁻³ ceen incertainty V _m ρ _m H _m	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg %	ume	$c = \frac{m}{V} f$ Uncertaint percentage	yas Uile 1.11 0.33 0.10 21.43 0.00 200.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content	Symbol V T P H O2	with a level of lence of 95% mg.m ⁻³ Value M 0 m 102 m 2 m 2 m 2 M 5 M 6 M 7 Value 3 M 102 M 102 M 102 M 102 M 103 M 104 M 105 M	2.08 Reference oxyge Standard u 18 u' 107 u' 14 u 0.7 ul 0.9 uO 0.1 the gas meter 2 0	mg.m ⁻³ ceeen uncertainty y _m m p _m H _m 2.2m um	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg	ume	$c = \frac{m}{V} f$ Uncertaint percentage	yas Uile 1.11 0.33 0.10 21.43 0.00 200.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Daygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds	confid expresses confid 11 0.56 Symbol V T P H O ₂ 1 temperature and to the symbol	with a level of lence of 95% mg.m ⁻³ Value M 0 m 102 m 2 m 2 m 2 m 102 m 5 m 102 m 102 m 102 m 102 m 103	2.08 Reference oxyge Standard u 18 u' 107 u1 14 u 0.7 ul 0.9 uO 0.1 the gas meter 2 0	mg.m ⁻³ ceeen uncertainty V _m p _m H _m 2-m u (in un	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg	ume	$c = \frac{m}{V} f$ Uncertaint percentage	yas Uile 1.11 0.33 0.10 21.43 0.00 200.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Daygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds	Symbol V T P H O2 Itemperature and p	with a level of lence of 95% Description of the	2.08 Reference oxyge Standard u 18 u 18 u 107 u 1.14 u 10.7 u 10.9 u 10.1 u 10.9 u 10.0 u 10.0 u 10.0 u 10.0 u	mg.m ⁻³ cee en uncertainty V _m p _m H _m 2.m u (in un	Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg % mg	ume ume	$c = \frac{m}{V} f$ Uncertaint percentage	yas Uile 1.11 0.33 0.10 21.43 0.00 200.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds	Symbol V T P P H O2 temperature and y Symbol	with a level of lence of 95% d with a level of lence of 95% mg.m ⁻³ Value M 0 m 102 m 102 m 2 m 2 m 0.0 fs ool sensitivity color m 0.0	2.08 Reference oxyge Standard u 18 u 19 u 107 u 114 u 10.7 u 10.9 u 0.0 1 u the gas meter 2 0 189 189 189 189 189	mg.m ⁻³ cee en uncertainty V _m P _m H _m 2.2m un (in un	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg	ume ume	$c = \frac{m}{V} f$ Uncertaint percentage	yas Uile 1.11 0.33 0.10 21.43 0.00 200.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Daygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds	confidence	with a level of lence of 95% d with a level of lence of 95% d mg.m ⁻³ Value M O M 102 M Triple	2.08 Reference oxyge Standard u 18 u 18 u 107 u 1.14 u 10.7 u 10.9 u 10.1 u 10.9 u 10.0 u 10.0 u 10.0 u 10.0 u	mg.m ⁻³ cee en uncertainty V _m Fm P _{pm} H _m 22m um u (in un	Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg % mg nits of fs) 0.001	$f_s = \frac{100}{1}$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_m}{2} \frac{273}{T_m} \frac{\rho_m}{101.3}$	yas Uir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations	confidence	with a level of lence of 95% d with a level of lence of	2.08 Reference oxyge Standard u 18 u 1907 u 114 u 10.7 u 10.9 u 10.0 u 10.0 u 10.0 u 10.0 u 10.0 u 10.0 u	mg.m ⁻³ ceeen uncertainty V _m Fm P _m H _m 2.m u (in un	Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.003	$f_s = \frac{100}{1}$	$c = \frac{m}{V} f$ Uncertaint percentage	y as Unit 1.11 0.33 0.10 21.43 0.00 200.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume	Symbol V T P H O2 Itemperature and p UCN	with a level of lence of 95% d with a level of lence of 95% mg.m ⁻³ Value m 0 m 102 m 22 m 22 m 24 M fs 0 sensitivity cc cc m 0.0 fs 0 sensitivity cc cc cc cc cc dc dc dc dc dc	2.08 Reference oxyge Standard u 18 u' 107 u1 14 u 0.7 ul 0.9 uO 0.1 the gas meter 2 0 89 eff 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009 1009	mg.m ⁻³ ceeen uncertainty V _m Fm P _m H _m 2.m u (in un	/ Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.003	$f_s = \frac{100}{1}$ $V = V_m$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_n}{00} \frac{273}{T_n} \frac{\rho_n}{101.3}$	yas Uir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured Concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction	Symbol V T P O2 temperature and to the symbol Symbol UCT	with a level of lence of 95% d with a level of lence of 95% d mg.m ⁻³ Value Mark 102 Mark 102 Mark 102 Mark 102 Mark 102 Mark 103 Fin 0.5	2.08 Reference oxyge Standard u 18 u 18 u 107 u 114 u 10.7 u 10.9 u 1	mg.m ⁻³ cee en uncertainty V _m p _m H _m u (in un	/ Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.003	$f_{r} = \frac{(100)}{1}$ $V = V_{m}$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_m}{2} \frac{273}{T_m} \frac{\rho_m}{101.3}$ $f_s = -O_{2,ref}$	yas Uir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume	confidence	with a level of lence of 95% d with a level of lence of 95% mg.m ⁻³ Value m 0 3 m 102 m 2 m 102 m 0 0 sensitivity color sensitivity color sensitivity color sensitivity colors	2.08 Reference oxyge Standard u 18 u 18 u 107 u 114 u 10.7 u 10.9 u 1	mg.m ⁻³ ceeen uncertainty V _m Fm P _m H _m 2.m u (in un	/ Units 0.002 m³ 1 k 0.11 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.003	$f_{r} = \frac{(100)}{1}$ $V = V_{m}$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_n}{00} \frac{273}{T_n} \frac{\rho_n}{101.3}$	yas Ulir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Fest 2 Limit value Measured Concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Pressure Sampled gas Humidity Oxygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction	confidence	with a level of lence of 95% d with a level of lence of 95% with a level of lence of	2.08 Reference oxyge Standard u 18 u 107 u 1.14 u 1.07 u 1.09 u 1.00 u	mg.m ⁻³ cee en uncertainty V _m p _m H _m u (in un	"Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.002 m³	$f_{r} = \frac{(100)}{1}$ $V = V_{m}$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_m}{2} \frac{273}{T_m} \frac{\rho_m}{101.3}$ $f_s = -O_{2,ref}$	yas Uir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Daygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components	confidence	with a level of lence of 95% d with a level of lence of 95% with a level of lence of	2.08 Reference oxyge Standard u 18 u 1907 u 114 u 10.7 u 10.9 u	mg.m ⁻³ celen uncertainty V _m P _m H _m 2 u (in un	/ Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.003 0.002 m³ 0.000 0.000	$f_{e} = \frac{(100)}{1}$ $V = V_{m}$ $f_{e} = \frac{21}{21}$	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_m}{000} \frac{273}{T_m} \frac{\rho_m}{101.3}$ J_s $\frac{-O_{2,ref}}{-O_{2,m}}$	yas Ulir 1.11 0.33 0.10 21.43 0.00 200.00 2.00 0.00	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
Expanded uncertainty Test 2 Limit value Measured concentration Measured Quantities Sampled Volume Sampled gas Temperature Sampled gas Humidity Daygen content Mass particulate Note - Sampled gas humidity, Leak Uncollected Mass Intermediate calculations Factor for std conds uncertainty components Corrected volume Factor for O2 correction uncertainty components	confidence	with a level of lence of 95% d with a level of lence of 95% was mg.m ⁻³ Value Marcology Marco	2.08 Reference oxyge Standard u 18 u' 107 u' 14 u 0.7 u' 10.9 uO 0.1 u 1.14 the gas meter 2 0 2.89 2.66 3.89 3.16 3.00 4.16 3.00 4.16 3.00 4.16 3.00 4.16 4.00 4.1	mg.m ⁻³ celen uncertainty y _m m p _m H _m 2.m u (in un	/ Units 0.002 m³ 1 k 0.1 kPa 0.15 % by volu 0.2 mg % mg mits of fs) 0.001 0.001 0.003 0.003 0.002 m³ 0.000 0.000 lvity Uncertai	$f_{e} = \frac{(100}{1}$ $V = V_{n}$ $f_{e} = \frac{21}{21}$ inty in Result	$c = \frac{m}{V} f$ Uncertaint percentage $\frac{-H_m}{2} \frac{273}{T_m} \frac{\rho_m}{101.3}$ $f_s = -O_{2,ref}$	y as Unit of the line of the l	ncertainty nit value	standard <=2% <=1% <=1% <=1% <=5% <=5% <=5% <5% of limit vi
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Appendix 3

Stack: Spray Booth 3

No X	Value	Equipment
X	>6 mm	Nozzle: internal diameter
1	⊴0%	Nozzle: uncertainty of area at nozzle entry
1	>10 mm	Nozzle: length with constant internal diameter
✓	<30°	Nozzle: change in diameter angle
meter 🗸	.>1.5 times internal diameter	Nozzle: radius of the bend
1	>30 mm	Nozzle: straight length before the first bend
1	>50mm	Filter holder: distance to obstacles
		Filter:
1	>99.5 %	Efficiency on test aerosol of 0.3 μm
1	>99.9%	Efficiency on test aerosol of 0.6 μm
orption	No reaction and no absorption of the components	Filter: filter material
1	<10 gr/m ³	Condenser, drying tower: residual gas moisture
		Gas meter:
1	<2%	Uncertainty of gas volume
1	⊴ %	Uncertainty of absolute pressure
1	⊴ %	Uncertainty of absolute temperature
1	<10°	Angle of the nozzle with regard to gas flow Isokinetic rate
1	95% to 115%	Isokinetic rate
1	<2%	Leak rate
1	0.01 mg to 0.1 mg	Balance resolution
X	<5 % of the LV a	Weighing uncertainties
1	4h to 12h	Weighing: temperature equilibrium duration
1	<10% of the LV a	Overall blank value
		Sampling location
1	<15°	Duct gas flow: angle with regard to duct access
1	not permitted	Duct gas flow: negative velocity
1	> 5 Pa	Duct gas flow: differential pressure at Pitot tube
1	<3:1	Duct gas flow: ratio of max. to min. velocity
1	> 5 hydraulic diameters (recommended)	Straight length before the sampling plane
X	> 2 hydraulic diameters (recommended)	Straight length after the sampling plane
X	> 5 hydraulic diameters (recommended)	Straight length before emission point
1	(accommended)	Correct number of sampling points for standard?
		Flue Gas Characteristics
1	0.05 kg/rn ³	Flue gas density: uncertainty
MALES IN DIS		
10	mg/m ³	LV ^a : Limit Value set for the process
	mg/m ³	LV ^a : Limit Value set for the process

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End of Report