Report for the Periodic Monitoring of Emissions to Air
Part 1: Executive Summary

Permit Number:

Operator: Federal Mogul Sintered Products Ltd

Installation: Main Stack

Monitoring dates:	28th August 2013
Contract Number:	P-RED13-113/EB/R1/Rev0
Client Organisation:	Federal Mogul Sintered Products Ltd
Address:	Holbrook Lane Coventry CV6 4BG
Monitoring Organisation:	Redwing Environmental Ltd
Address:	Unit 7, Manor Road Business Park Manor Road Atherstone Warwickshire CV9 1TE
Date of Report:	24th September 2013
Report Approved By:	Elena Berek
MCERTS Registration Number:	MM 02 029 Level 2 - Technical Endorsements 1, 2, 3 & 4
Function:	Director
Signed:	[redacted]

Contents

Part 1: Executive Summary

The following document details the emissions to air monitoring survey undertaken by Elena Berek and Tony Berek of Redwing Environmental Ltd at Federal Mogul Sintered Products Ltd on the 28th August 2013. All results pertain to the dates monitored only.

A summary of results is shown below:-

Analyte Monitored	Exhaust Reference
	Main Stack
Total Particulate Matter (mg/m^3)	0.14 ± 0.05
Total Metals (mg/m^3)	0.013 ± 0.005
Efflux Velocity (m/s)	37.0
Volume Flow Rate(m^3/hour)	4,923

Note 1: Reference conditions are standard temperature and pressure
Note 2: All tests have been sampled under our UKAS scope and analysed by a laboratory UKAS accredited to carry out the analysis

STACK HEIGHT CALCULATION

The original stack height calculation based on the proposed air flow from the installed fan and taking into account the building measured at 10.4m was 12 metres; this was to ensure that the emissions dispersed and were not impeded by the neighbouring building measured at 10.4 metres. However the efflux velocity was calculated to be 6m/s; this velocity would have suffered from aerodynamic downwash and any pollutants present could then flow down the outside of the discharge stack, thereby reducing its effective height.
Federal Mogul expressed concerns about supporting a 12m stack safely next to a 7m building so it was discussed with Coventry City Council about the use of a shorter stack with a much faster efflux velocity so that this would mimic a much taller stack and would not suffer from aerodynamic downwash and this was agreed.
Section 5.4.4 in D1 states that **Discharge stack heights needing a building correction** need only consider buildings within a range of $5U_m$. U_m is calculated to be between 1.2 and 2.8 (1.2 * 5 = 11 and 5 * 2.8 = 14) so it doesn't have to be considered and that would make the tallest building 7m. The Stack Height Calculation recommends a stack height of 7.7m but this is rounded up to 8m.

1.0 Monitoring Objectives

1.1 Overall aim of the monitoring campaign

The exhausts listed below were monitored with respect to Q-RED13-113EBv0 for the compliance check monitoring of emissions to air for Federal Mogul Sintered Products Ltd.

1.2 Substances to be monitored

The substances requested for monitoring at each emission point are listed below:

Table 1 - Monitoring Programme

Substances to be monitored	Emission Point Identification
	Main Stack
*Metals	✓
Velocity	✓
Particulate Matter	✓

*Metals required Cadmium, Manganese, Cobalt, Chromium, Copper, Iron, Molybdenum, Nickel, Vanadium & Tungsten

1.3 Any Special Requirements

None

1.4 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty expressed at 95% confidence	Units	Reference Conditions 273 K, 101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Main Stack	Total Particulate Matter	5	0.14	± 0.05	mg/m^3	273K, 101.3kPa	28/08/13	1040 - 1440	BS EN 13284-1	MCerts & UKAS accredited	
	Total Metals	1.0	0.013	± 0.005	mg/m^3			1040 - 1440	BS EN 14385		

1.5 Monitoring Deviations

Emission Point Reference	Were any required substances not monitored (Substance deviation)	Were any substances monitored but didn't follow specified method (Monitoring Deviations)	Other Relevant Issues
Main Stack	N/A	BS EN 13284-1 states that a nozzle < 6mm diameter shouldn't be used but due to the fast flow rate a 5mm nozzle was used to ensure that the Zambelli pump could be used around the 25 litres per minute as specified by the manufacturer	Some of the absorption efficiencies did not meet the 95% requirement, however, the total concentration was less than 30% of the Emission Limit Value and therefore is acceptable

2.0 Part 2: Supporting Information

Appendix 1: Site Team Details

Elena Berek – Team Leader
MM 02 029 MCerts Level 2 TE1, TE2, TE3 & TE4
Tony Berek – Env Technician
MM 06 702 MCerts Level 1 (Recertification required)

Monitoring organisation method and Technical Procedure details

Substances Monitored	Standard reference number	Technical Procedure
Total Particulate Matter	BS EN 13284-1	TP-RED04-04
Metals	BS EN 14835	TP-RED09-112

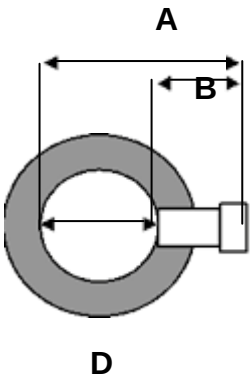
Equipment Checklist

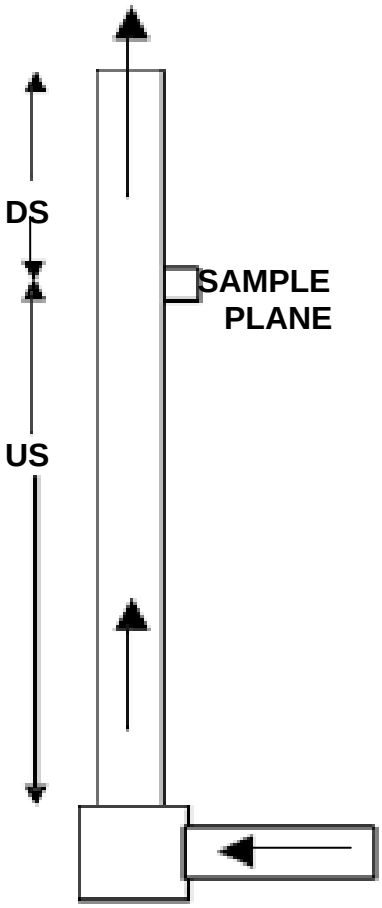
Equipment used		
Pollutant	**Apparatus**	**Model**
Total Particulate Matter	Zambelli 6000 +	RED 0258
	Pitot	RED 0237
	Thermometer	RED 0351, 0352
	Tape Measure	RED 0123
	Manometer	RED 0404
	Thermocouple	RED 0344, 0357, 0395, 0339
	Barometer	RED 0243
Metals	Zambelli + Impingement	RED 0258

APPENDIX A

Main Stack – Results

A1 - Diagram and Dimensions of the Stack





Main Stack

A – 0.35m

B – 0.07m

D = A – B = 0.28m

DS = >5 DD

US = >5 DD

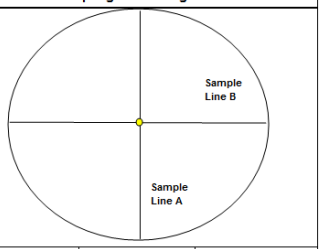
SKETCH OF SAMPLING POINT

S = No of Hydraulic DD downstream from sample plane

US = No of Hydraulic DD upstream of sample plane

A2 - Flow criteria measurements

Client	Federal Mogul
Site Address	Coventry
Job Number	P-RED13-113
Date	28th August 2013
Operator(s)	T Berek & E Berek

Stack Reference			Main Stack			**Isokinetic Sample Positions (%) multiply by diameter to obtain sample points**		**Sampling Plane Diagram**		
						1	50.00			
Number of Stacks			1			**2**	N/A			
Stack Configuration			Round			**3**	N/A			
Dimensions (mtrs)			0.28			**4**	N/A			
Outlet Diameter (if applicable) (metres)						**5**	N/A			
Number of Sample Ports			2			**6**	N/A			
Number of Samples per Axis / Port			1			**7**	N/A			
Nozzle Diameter (mm)			5.0			**8**	N/A			
Nozzle Area (m²)			0.00001963			**Average Isokinetic Flow Rate (ltrs/min)**			**Axis 1**	**Axis 2**
Stack Area (m²)			0.062						26.15	N/A
Pitot Coefficient	**0.84**	**Pitot Calibration Due Date**			**15th March 2014**				**Atmos. Pressure (kPa)**	
Position	**Distance**	**Axis 1**	**Temperature**	**Swirl Test**	**Axis 2**	**Temperature**	**Swirl Test**		102.5	
No.	**(cms)**	**(pa)**	**(C)**	**(°)**	**(pa)**	**(C)**	**(°)**		**Static Pressure (pa)**	
1	14.00	400	37.4	6.0					5.0	
2	N/A								**1 Axis**	**2 Axis**
3	N/A								**Velocity of flow (m/s)**	
4	N/A								22.21	N/A
5	N/A								**Volume Flow Rate (m³/s)**	
6	N/A								1.37	N/A
7	N/A								**Reduced Exit**	
8	N/A									
Averages		400	37.4						N/A	

Mean Flue Gas Temp (in K) Tp = ((Mean T1 + Mean T2)/2)+273)) =		**310.40**	
Permitted Range of gas temperature readings (C) = (0.95Tp-273) to (1.05Tp-273) =	**21.88**	**to**	**52.92**
Highest Velocity Reading (m/s) =		**22.8**	
Lowest Velocity Reading (m/s) =		**22.1**	
Ratio Highest/Lowest (Max permitted = 3:1)			**1.03 : 1**

On site Checklist

Initial Leak Check	**<0.2**	**End of first run**	**<0.2**		**Start of 2nd run**	**N/A**	**End of 2nd run**	**N/A**
Acceptable Leak Check < 2% Vol (l/min)		**0.52**			**Manometer Leak Check**			**OK**
					Pitot Leak Check			**OK**
Range of Gas Temps		**OK**			**Overall Isokinetic Ratio (%) (must be 95 to 115%)**			**Run 1** / **Run 2**
Passed minimum Velocity requirements (>5pa)			**YES**					**98.1** / **N/A**
Negative Local Flow Present, YES or NO (Yes = Fail)			**NO**		**Are there sufficient rails and kick board? (YES , NO or N/A)**			**NO**
Is the Platform area greater than 5m²? (YES, NO or N/A)			**N/A**		**Is the area infront of the sample line the length of the probe + 1 metre? (YES or NO)**			**YES**
Passed Highest to lowest Velocity (3:1)			**YES**					

Site Equipment Used

Pitot Reference	**RED 0237**	**Manometer Reference**	**RED 0404**
Thermometer Reference	**RED 0351/0352**	**Thermocouple Reference**	**RED 0344**
Balance Reference	**N/A**	**Sampling Pump Reference**	**RED 0258**
Tape Measure Reference	**RED 0121**	**Barometer Reference**	**RED 0403**
DGM Thermocouple	**RED 0274**	**Impinger Outlet Thermocouple**	**RED 0338**
Calipers	**RED 0300**	**Condenser Thermocouple**	**N/A**

A3 - Gas Homogeneity test results (Not applicable)

A4 - Gas Measurements test results

Molecular weight of dry gas stream, M_d			
CO_2		0.3	%
O_2		19.7	%
Total		20	%
N_2 (100 - total)		80	%
M_d = 0.44(%CO2)+0.32(%O2)+0.28(%N2)		28.836	g/gmol

A5 - Water Vapour Measurements (Not required as < 5%)

A6 - Sampling Measurements (Stack gas temperature & Velocity during Particulate and Metals sampling)

RUN No	One											
Filter ID	G47/280813-01											
Sample Point	Probe Distance (cm)	Time	Pressure reading (Pa)	Sampling Rate (Litres/min)	Dry Gas Meter Reading (Litres)	Stack Gas Temperature (oC)	Dry Gas Meter Temperature (oC)	Ambient Temperature (oC)	Probe Temp (oC)	Oven Temp (oC)	Last Impinger Temp (oC)	Condensate Trap Temp (oC)
A1	14.0	10:40	388	25.7	919417	37.4	21.6	18.8	70	70	19.8	N/A
		10:50	335	23.9	919666	39.1	22.6	21.1	70	70	20.1	N/A
		11:00	390	25.7	919903	40.3	24.3	22.1	70	70	20.4	N/A
		11:10	448	27.6	920175	42.1	24.9	22.6	70	70	21.2	N/A
		11:20	413	26.5	920501	43.6	26.2	24.4	70	70	21.9	N/A
		11:30	377	25.3	920763	44.1	27	24.3	70	70	22	N/A
		11:40	400	26.1	920999	44.9	27.4	24.3	70	70	22.3	N/A
		11:50	453	27.8	921245	45.8	27.8	24.8	70	70	22.5	N/A
		12:00	408	26.3	921489	47	28.2	25	70	70	23.1	N/A
		12:10	379	25.4	921732	44.3	28.8	25.1	70	70	20.9	N/A
		12:20	444	27.5	922045	42.9	29.2	25.1	70	70	19.4	N/A
		12:30	421	26.8	922289	42.1	30.1	25.1	70	70	18.1	N/A
		12:40	408	26.3	922560	41	30.8	25.2	70	70	18	N/A
		12:50	412	26.5	922823	40.9	30.3	25.3	70	70	17.7	N/A
		13:00	421	26.8	923088	40.7	30.1	25.3	70	70	17.4	N/A
		13:10	439	27.3	923350	39.3	29.8	25.3	70	70	17.3	N/A
		13:20	427	26.9	923611	39.1	29.2	25.3	70	70	17.2	N/A
		13:30	440	27.3	923883	39.8	30.1	25.4	70	70	17.1	N/A
		13:40	389	25.7	924156	39.9	30.2	25.4	70	70	17.1	N/A
		13:50	409	26.4	924414	40	29.9	25.6	70	70	18	N/A
		14:00	379	25.4	924677	40.6	30.1	25.7	70	70	18.2	N/A
		14:10	431	27.1	924931	41.6	30.2	25.8	70	70	18.3	N/A
		14:20	420	26.7	925202	47.5	31	25.9	70	70	18.5	N/A
		14:30	410	26.4	925423	48	31.8	26	70	70	18.6	N/A
		14:40			925650							
Finish												
Actual Sampling Time		240.00		26.49	6233.0	42.17	28.40	24.54	70.00	70.00	19.38	N/A

Stack Reference ID	Main Stack				
	Federal Mogul				
	RUN 1				
Filter Reference No	G47/280813-01				
Date	28th August 2013				
Sample Period	10:40	to	14:40		
Velocity (m/s)	22.21				
Volume flow rate of Stack gas (m³/hr)	4923				
Average Stack Temp (°C)	37.4				
Temp Range ± 5% (°C)	21.88	to	52.92		
Lowest Velocity Reading (m/s)	22.15				
Highest Velocity Reading (m/s)	22.84				
Ratio (less than 3:1)	1.03	:	1		
Pre-conditioning temperature of Filter (°C)	180				
Instack sampling - Max Filter temperature (°C)	42.2				
Post-conditioning temperature Filter/Wash (°C)	160				
Oxygen %	19.7				
Carbon Dioxide %	0.30				
Moisture (%)	2.34				
Litres sampled	6233				
Corrected volume sampled - STP (m³)	5.713				
Blank Filter Run weight gain (mg)	0.010	Blank Concentration (mg/m³)	0.002		
Blank Wash Run weight gain (mg)	0.080		0.014		
Weighing uncertainty of balance (mg)	0.074	This must be <5% of ELV	ELV =	20	1.0
Overall Blank value (mg/m³)	0.016	This must be <10% of ELV	ELV =	20	2.0
Particulate weight collected on filter (mg)	0.29				
Particulate weight collected in Wash (mg)	0.54				
Total Particulate weight collected (mg)	0.83				
Total Particulate Concentration, dry gas at STP (mg/m³)	0.15				
Total Particulate Concentration, wet gas at STP (mg/m³)	0.14				
Total Particulate Concentration corrected for 11% Oxygen, dry gas (mg/m³)	N/A				
Total Particulate Mass Emission (Kg/hour)	0.0007				

Metals	Amount Collected (ug)	Total Concentration (mg/m3)	Blank Regeant Concentration (mg/m3)	Blank Rinse Concentration (mg/m3)
Cadmium	0.68	0.00012	0.000	0.000
Manganese	16.60	0.00292	0.000	0.000
Cobalt	2.60	0.00046	0.000	0.000
Chromium	8.10	0.00143	0.000	0.000
Copper	3.68	0.00065	0.000	0.000
Iron	0.00	0.00000	0.000	0.000
Molybdenum	14.00	0.00246	0.000	0.000
Nickel	0.00	0.00000	0.000	0.000
Vanadium	9.29	0.00164	0.000	0.000
Tungsten	10.00	0.00176	0.000	0.000
Silicon	8.00	0.00141	0.000	0.000
Total Metals (mg/m^3)	**0.01284**			

A7 - Gas Analyser Site Calibration Measurements
Not applicable

A8 – Instrumental Gas Analyser Results
Not applicable

A9 – Laboratory Results
Not applicable

A10 – Calculations

Calculations for Metals						Run 1	Units
Sample Gas Volume, dry V_{mstd}							
$V_{mstd} = (V2 - V1) * \frac{T_{std}}{T_m} * \frac{P_m}{P_{std}}$					V_{mstd} =	5.713	m^3
					P_m =	102.5	kPa
Volume of gas sample through gas meter, Vm (V2 – V1)					T_m =	301.4	°K
Average dry gas meter temperature, Tm					V2 =	925.650	m^3
Measured Atmospheric pressure Pm					V1 =	919.417	m^3
Tstd – 273K							
Pstd – 101.3kPa							
Metals Concentration Calculations, Absorption efficiency							
					Metals (Solid)	66.6	ug
					Metals (Gases) in Impingers 1 + 2	0.0262	ug/ml
					Metals (Gases) in Impinger 3	0.011	ug/ml
$B_{El} = \frac{M_{Elsol} + M_{E\,lg\,as}}{V_o}$					Metals (Gases) in Probe Rinse	0.000	ug/ml
					Impingers 1 + 2 Volume (v_1) =	200	ml
					Impinger 3 Volume (v_2) =	98	ml
B_{El} =	Mass concentration of Specific Element				Probe Rinse Volume (v_3) =	78	ml
	or total metals (mg/m^3)						
M_{Elsol} =	Mass of Specific Element (Solid)				Metals (Gases) =	6.35	ug
M_{Elgas} =	Sum of Specific Elements from rinses and impingers (Gases)						
					B_{El} =	0.013	mg/m^3
					Is Concentration >30% of ELV	0.1	%
					ELV (%) =	1.00	mg/m^3
Absorption Efficiency (AE) =	Impingers 1 + 2 Concentration	* 100					
	Imp (1 + 2) + Imp 3 Concentration				AE (%) =	82.6	%
					AE should be >90% for a pass this is not valid if Concentration is less than 30% of the ELV		

ISOKINETIC EQUATIONS Page 1				Units
Absolute pressure of stack gas, Ps				
Barometric pressure, P_b		102.5		kPa
Stack static pressure, P_{static}		5.0		Pa
$P_s = P_b + (P_{static}/1000)$		102.505		kPa
Moisture				
$V_{mstd} = (V2 - V1) * \frac{T_{std}}{T_m} * \frac{P_m}{P_{std}}$ Volume of gas sample through gas meter, Vm (V2 – V1) Average dry gas meter temperature, Tm Measured Atmospheric pressure Pm Tstd – 273K Pstd – 101.3kPa		V_{mstd} =	0.0572	m^3
		P_m =	102.5	kPa
		T_m =	289.6	°K
		V2 =	0.0600	m^3
		V1 =	0.0000	m^3
$V_{wc}(g/m3) = \frac{m_{wc}}{V_{mstd}}$ in g/m^3 Where V_{wc} = water vapour content in grams per cubic meter in standardised conditions of temperature and pressure and on dry basis m_{wc} = weight gain in grams		V_{wc} =	19.2	g/m^3
		m_{wc} =	1.1	g
		V_{mstd} =	0.0572	m^3
$V_{wc}(\%) = \frac{\frac{m_{wc} * V_{mol(std)}}{Mw}}{\frac{m_{wc} * V_{mol(std)} + V_{m(std)}}{Mw}} * 100$ Where Vwc = The water vapour content in % volume on wet basis Mw = the molecular weight of water (18g/mol) Vmol = is the molar volume at standard conditions, in m^3/mol at Pstd and Tstd (0.0224)		V_{wc} =	2.3	%
		m_{wc} =	1.1	g
		$V_{mol(std)}$ =	0.0224	m^3
		Mw =	18	g/mol
		V_{mstd} =	0.0572	m^3
Molecular weight of dry gas stream, M_d				
CO_2		0.3		%
O_2		19.7		%
Total		20		%
N_2 (100 - total)		80		%
M_d = 0.44(%CO2)+0.32(%O2)+0.28(%N2)		28.836		g/gmol

ISOKINETIC EQUATIONS Page 2		Run 1	Units
Velocity of stack gas to ISO 10780			
$V = K \times C \times \sqrt{(T_s * \Delta P)/(P_s * M_s)}$	V_{wet} =	22.21	m/s
	V_{dry} =	1.37	m/s
ΔP - is the mean pitot pressure difference (kPa)	K =	0.84	
T_s - is the mean flue gas temperature (°K)	C =	129	
P_s – is the absolute gas pressure (kPa)	T_s =	310.40	°K
M_s – molar mass of gas 29g/gmol	ΔP =	0.4	kPa
K – pitot tube coefficient	P_s =	102.505	kPa
C – 129(m/s).[kg/(kmol.K)] ½	M_s =	28.836	
Actual Flow of stack gas, Q_a			
$Q_a = A * V * 3600$ Where A = Area of Stack & V = Velocity	A =	0.06	m^2
	V =	22.21	m/s
	Q_a =	4923	m^3/hour
Sample Gas Volume, dry V_{mstd}			
$V_{mstd} = (V2 - V1) * \frac{T_{std}}{T_m} * \frac{P_m}{P_{std}}$	V_{mstd} =	5.713	m^3
	P_m =	102.5	kPa
Volume of gas sample through gas meter, Vm (V2 – V1)	T_m =	28.4	°K
Average dry gas meter temperature, Tm	V2 =	925.65	m^3
Measured Atmospheric pressure Pm	V1 =	919.42	m^3
Tstd – 273K			
Pstd – 101.3kPa			
Isokinetic Sample Rate (litres/minute)			
Isokinetic Rate (l/min) = $V * A_n * 60 * 1000$	Nozzle diameter	5.0	mm
	V =	1.37	m/s
Isokinetic Ratio (%) = Actual flow rate (l/min) / Required flow rate (l/min) * 100	A_n =	0.000019625	m^2
	Isokinetic rate =	26.15	l/min
V = Velocity (m/s)	Actual & required sampled volume	6233	litres
An = Nozzle area m^2		6357	litres
Acceptable Isokinetic range 95 to 115%	IR (%) =	98.1	%
Particulate Concentration, C			
C_{dry} = **Total mass of particulate collected (M_n) / V_{mstd}**	M_f	0.29	mg
M_f = mass collected on filter	M_p	0.54	mg
M_p = mass collected in probe rinse	M_n	0.83	mg
M_n = Total mass (M_f + M_p)	C_{dry} =	0.15	mg/m^3
C_{wet} = **(C_{dry} * (100 - %Moisture)) / 100**	C_{wet} =	0.14	mg/m^3
Particulate Mass Emission, E			
E = (C_{wet} * Q_a) / 1000	E =	0.0007	Kg/hour

A11 – Uncertainty Budgets

Total Particulate Matter Run 1 – Uncertainty

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

	Value	Units
Limit value (ELV)	20	**$mg.m^{-3}$**
Measured concentration	**0.15**	**$mg.m^{-3}$ (at ref conditions)**
Reference Oxygen	21	**% by Volume**

Measured Quantities	Symbol	Value	Units
Sampled Volume	V_m	6.23	**m^3**
Gas Meter Temperature	T_m	301.40	**K**
Sampled Gas Pressure	ρ_m	102.5	**kPa**
Sampled Gas Humidity	H_m	0	**% by volume**
Oxygen content	$O_{2,m}$	19.7	**% by volume**
Mass of Particulate	m	0.83	**mg**
Leak	L	0.2	**%**
Uncollected Mass (Instack filter - no rinse)	UCM	0.01	**mg**

Standard Uncertainty	Symbol	Value	Units	Uncertainty as a %	Uncertainty Required	Uncertainty Met
Sampled Volume	uV_m	0.01	**m^3**	**0.16**	**? 2%**	**Yes**
Sampled Gas Temperature	uTm	2	**K**	**0.66**	**? 1%**	**Yes**
Sampled Gas Pressure	$u\rho_m$	0.005	**kPa**	**0.00**	**? 1%**	**Yes**
Sampled Gas Humidity	uH_m	1	**% by volume**	**1.00**	**? 1%**	**Yes**
Oxygen content	$uO_{2,m}$	0.2	**% by volume**	**1.02**	**? 5%**	**Yes**
Mass of Particulate	um	0.07	**mg**	**8.95**	**<5% of limit value**	**No**
Leak	L	n/a	**n/a**	**0.20**	**? 2%**	**Yes**
Uncollected Mass (Instack filter - no rinse)	UCM	n/a	**n/a**	**1.20**	**? 10% of ELV**	**Yes**

Parameter		Value	Units	Sensitivity Coeff	Uncertainty Contribution	Units	Uncertainty as %
Corrected Volume (STP)	V	5.713	m^3	0.03	0.00	$mg.m^{-3}$	1.21
Mass of Particulate	m	0.83	mg	0.18	0.01	$mg.m^{-3}$	8.95
Factor for O2 Correction	fc	1.00		0.15	0.02	$mg.m^{-3}$	15.38
Leak	L	0.00	$mg.m^{-3}$	1.00	0.00	$mg.m^{-3}$	0.12
Uncollected mass	UCM	0.01	mg	0.18	0.00	$mg.m^{-3}$	0.70
Combined measurement uncertainty				**1.04**	**0.03**	$mg.m^{-3}$	

Expanded uncertainty as percentage of measured value	**35.71**
Expanded uncertainty in units of measurement (mg/m^3)	**0.05**
Expanded uncertainty as percentage of limit value	**0.26**

expressed with a level of confidence of 95%
(Using a coverage factor k=2)

Metals – Uncertainty

Uncertainty calculation for Determination of mass concentration of Metals, Reference method

Limit value (ELV)	1	**$mg.m^{-3}$**	**Reference oxygen**	21	**% by volume**
Measured concentration	0.014	**$mg.m^{-3}$ (at reference conditions)**			

Measured Quantities	**Symbol**	**Value**	**Standard uncertainty**		**Units**	**Uncertainty as percentage**
Sampled Volume Gas	V_m	5.71	uV_m	0.001	**m^3**	0.02
Sampled gas Temperature	T_m	301.4	uTm	2	k	2.00
Sampled gas Pressure	ρ_m	102.5	$u\rho_m$	1	**kPa**	0.98
Sampled gas Humidity	H_m	0	uH_m	1	**% by volume**	1.00
Oxygen content	$O_{2,m}$	19.50	$uO_{2,m}$	0.1	**% by volume**	0.51
Metals Found on Filters	C	0.07	uC	0.010656	**mg**	
Metals found in Solution	C	0.006	uC	0.001015584	**mg**	16.00
Impinger 1 & 2 solution volume	VS	0.200	uVS	0.001	**l**	0.50
Impinger 3 solution volume	VS	0.098	uVS	0.001	**l**	1.02
Probe Rinse volume	VS	0.078	uVS	0.001	**l**	1.28
Total Mass of metals	m	0.073	um	0.01	**mg**	16.09
Note - Sampled gas humidity, temperature and pressure are values at the gas meter						
Leak	L	0			**%**	0.00

Parameter		**Value**	**Units**	**Sensitivity coeff**	**Uncertainty contribution**		**Uncertainty as %**
Corrected Volume (standard conditi	V	5.24	m^3	0.00	0.00	$mg.m^{-3}$	1.55
Mass	m	0.073	mg	0.19	0.00	$mg.m^{-3}$	16.09
Factor for O2 Correction	fc	1.00		0.01	0.00	$mg.m^{-3}$	6.67
Leak	L	0.00	$mg.m^{-3}$	1.00	0.00	$mg.m^{-3}$	0.00
Combined uncertainty					**0.00**	$mg.m^{-3}$	

Expanded uncertainty as percentage of measured value	**34.97**	**% measured of value**	
Expanded uncertainty in units of measurement	**0.005**	**$mg.m^{-3}$**	**expressed with a level of confidence of 95% using a coverage factor k = 2**
Expanded uncertainty as percentqge of limit value	**0.49**	**% ELV**	

A12 - Method Outline

Leak tests for extractive techniques

All extractive-sampling techniques were tested for leaks before sampling proceeded. Any leaks present were eliminated prior to sampling and will be reported.

Leak checks are carried out during the calibrating procedure, as the concentration of the calibration gas is known it is easily noticed if air is entering the sample line and diluting the gas.

Particulate matter BS EN 13284-1: 2002

Total particulate matter was sampled using a Zambelli isokinetic sampling system in accordance with BS EN 13284-1: 2002 – Determination of Low Range Mass Concentration of dust (< 50mg/m^3).

The Zambelli sampling system monitors temperature, static pressure and velocities within the duct using an S-type pitot tube and K-type thermocouple. The sampling rate is continuously monitored and adjusted relative to the duct velocity to ensure isokinetic-sampling conditions are maintained throughout the monitoring period.

Exhaust gases were drawn under isokinetic conditions from the exhaust points using the Zambelli sampling probe, particulate matter was then collected on a pre-weighed quartz filter (or most suitable filter for process) contained within the filter cassette holder, and the total particulate matter determined gravimetrically.

It is also necessary to wash the probe and nozzle out with water and then acetone between sampling and the weight of the probe washing added to that collected on the sample filter. Analysis of an acetone/water blank will be carried out and the result corrected accordingly.
The sample positions were calculated with respect to BS EN 13284-1: 2002 – Stationary source emissions – Determination of Low Range Mass Concentration of dust.
Sampling may be carried out internally or externally, the method used was in stack sampling and there were no deviations from the method therefore the uncertainty for the monitoring procedure is reported to be within the requirements specified by the Hazardous Waste Directive (HWD) as stated in the Environment Agency Technical Document M2

Uncertainty: ± 30%

BS EN 14385:2004 – Determination of the total emission of As, Cd, Cr, Co, Cu, Mn, Ni, Pb, Sb, Tl and V

A known volume of flue gas will be extracted isokinetically and representatively from a duct or chimney during a certain period of time at a controlled flow rate following BS EN 13284-1:2001

The dust in the sampled gas volume will be collected onto a filter. Thereafter, the gas stream will be passed through a series of absorbers containing absorption solutions and the filter passing fractions of the specific elements are collected within these solutions.

The sample probe and all relevant parts of the sampling train will be heated so that the temperature will be 20°C above the exhaust gas.

Three impingers (absorbers) with approximately 25% of the absorber solution (peroxide & nitric acid) will be positioned after the sample probe. An empty impinger will be added after the last filled impinger as a protection for the downstream sample pump.

The solution from each impinger will be analysed independently, the element mass concentration in the third impinger will be less than 10% of the total concentration in the sampled gas.

Quality Assurance

Redwing Environmental Ltd is accredited to ISO 9001:2008, ISO 14001:2004 and ISO 17025:2005.

Disclaimer

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APPENDIX B

Main Stack – Stack Height Calculations

Federal Mogul

Proposed Stack

-Calculation Method- HMIP Guidance Note D1 "Guidelines on Discharge Stack Heights for Polluting Emissions"

Pollutants

Pollutant	(mg/Nm^3)	g/s
Particulate Matter	20	0.031113553

Non- Pollutant Parameters

Actual Stack Gas Flow Rate (m^3/s)	1.56
Normalised Flow Rate (Nm^3/s)	1.37
Temperature (oC)	37
Actual Velocity (m/s)	37.00
Building Height	7

Guideline Concentrations

Pollutant	OES/MEL (mg/m^3)	Guideline Concentrations (mg/m^3)
Particulate Matter	N/A	0.3

Note (1) Guideline concentration for particulate matter from Table 1 of HMIP Guidance Note D1

Background Concentrations

Pollutant	Background Concentrations (mg/m^3)
Particulate Matter	0.1

In the D1 Document there are various Background Concentrations for suspended Particulate Matter. For the area where Federal Mogul is located we have designated it as a Highly developed large Urban area. The other choices are (a - Urban area of limited size with parkland or largely Rural surroundings, b - Highly developed large urban area, c - Partially developed, d - Rural area little development. The Air Quality for the Coventry area was researched and for PM_{10} it was found to be 0.10mg/m^3 so the Background concentration was set to this

Federal Mogul					
Pollution Index Calculations Proposed Stack					
Particulate Matter					
Td		**W**		**V**	
Stack Gas		Stack Gas		Stack Gas	
Temp. (K) =	310	Velocity(m/s) =	37.00	Volume (m3/s) =	1.56
Pollution Index		**Pi = (D/(Gd-Bc))*1000**			
D		**Gd**		**Bc**	
Pollutant Discharge rate g s-1 =	0.031113553	Guideline Conc. mg m-3 =	0.3	Background Conc. mg m-3 =	0.1
Pi = 156		**m3 s-1**		Log10 Pi =	2.19192

Federal Mogul

Uncorrected Stack Height Calculations Proposed Stack

Uncorrected Stack Height Based on Plume Bouyancy (Ub)

Heat Release(Q) = (V(1-(283/Td)))/2.9 (MW)

-Where V=Actual Discharge Volume Rate (m^3/s) = 1.37

Td=Temperature of Discharged Gases in oK = 310

Q(MW) = 0.041 Log10 Q = -1.38567536

Ub = 10^a * Pi^b

a= -0.8467 b= 0.4831

Min Ub(m)=1.95*Q^0.19= 1.06 **Ub(m) calc = 2.8**

Ub(m) = 2.8

Uncorrected Stack Height Based on Plume Momentum (Um)

Momentum = (283/Td)*V*w

-Where V=Actual Discharge Volume Rate (m3/s) = 1.37

Td=Temperature of Discharged Gases in oK = 310

w=Discharge Velocity in m/sec = 37.00

Momentum = 46.27506452 Log10 M = 1.665347033

Log10Um = X + (y.log10 Pi + z)0.5

x = -2.117461542 Therefore Log10 Um = 0.076493

y = 4.860823451 Um(m) = 1.192594

z = -8.160301428

Min Um(m)=0.82M^0.32= 2.8 **Um(m) calc= 1.19**

Um(m)= 2.8

Federal Mogul

Corrected Stack Height Proposed Stack

Uncorrected Stack Height is Lesser of Um and Ub=	1.2	m
Building Height is	7	m
Corrected Stack Height C=	7.72	m
Round Up to Nearest m	**8**	**m**