

**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: 4<sup>th</sup> February 2014

Contract Number: P-RED14-003/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: 26<sup>th</sup> February 2014

Report Approved By: Elena Berek  
MCERTS Registration Number: MM 02 029  
Level 2 - Technical Endorsements 1, 2, 3 & 4

Function: Director

Signed: 



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## 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 4<sup>th</sup> February 2014. 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 <sup>3</sup> )	0.24 ± 0.09
Total Metals (mg/m <sup>3</sup> )	0.002 ± 0.001
Efflux Velocity (m/s)	24.1
Volume Flow Rate(m <sup>3</sup> /hour)	5,344

**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

**Note 3:** The laboratory does not hold UKAS accreditation for Silicon, Iron, Molybdenum and Tungsten



## 1.0 Monitoring Objectives

### 1.1 Overall aim of the monitoring campaign

The exhausts listed below were monitored with respect to Q-RED14-003EBv0 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
	<i>Main Stack</i>
*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	0.24	± 0.09	mg/m <sup>3</sup>	273K, 101.3kPa	04/02/14	0920 – 1120	BS EN 13284-1	MCerts & UKAS accredited	Normal
	Total Metals	1.0	0.002	± 0.001	mg/m <sup>3</sup>			1200 - 1400	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 0121
	Manometer	RED 0404
	Thermocouple	RED 0274, 0344
	Barometer	RED 0403
Metals	Zambelli + Impingement	RED 0258

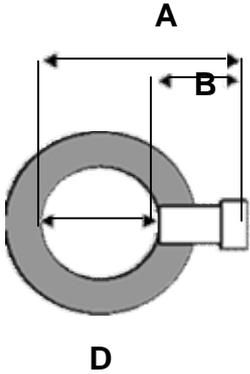
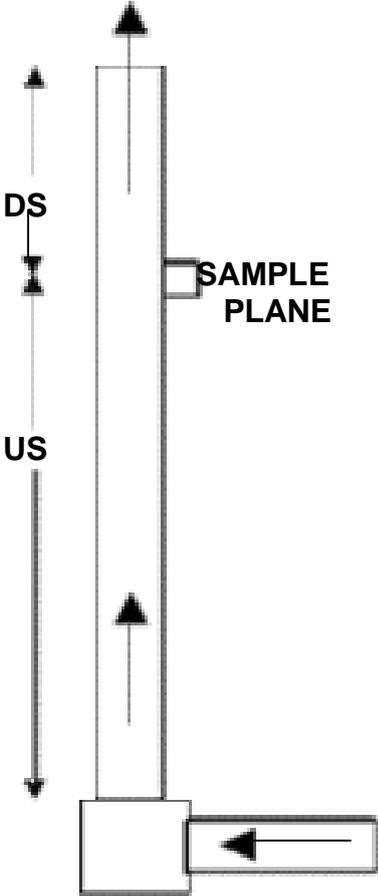


# **APPENDIX A**

## **Main Stack – Results**



**A1 - Diagram and Dimensions of the Stack**

 <p style="text-align: center;"><b>SKETCH OF SAMPLING POINT</b></p>	 <p style="text-align: center;"><b>Main Stack</b></p> <p>A – 0.35m              B – 0.07m              D = A – B = 0.28m</p> <p>DS = &gt;5 DD              US = &gt;5 DD</p> <p>S = No of Hydraulic DD downstream from sample plane              US = No of Hydraulic DD upstream of sample plane</p>
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## A2 - Flow criteria measurements

Client	Federal Mogul							
Site Address	Coventry							
Job Number	P-RED14-003							
Date	4th February 2014							
Operator(s)	E Berek & T Berek							
Stack Reference	Main Stack				Isokinetic Sample Positions (%) multiply by diameter to obtain sample points			
Number of Stacks	1				1	50.00		
Stack Configuration	Round				2	N/A		
Dimensions (mtrs)	0.28				3	N/A		
Outlet Diameter (if applicable) (metres)					4	N/A		
Number of Sample Ports	2				5	N/A		
Number of Samples per Axis / Port	1				6	N/A		
Nozzle Diameter (mm)	5.0				7	N/A		
Nozzle Area (m <sup>2</sup> )	0.0001963				8	N/A		
Stack Area (m <sup>2</sup> )	0.062				Average Isokinetic Flow Rate (ltrs/min)			
				Axis 1		Axis 2		
				28.39		28.42		
Pitot Coefficient	0.84		Pitot Calibration Due Date				31/03/2011	
Position	Distance	Axis 1	Temperature	Swirl Test	Axis 2	Temperature	Swirl Test	
No.	(cms)	(pa)	(C)	(°)	(pa)	(C)	(°)	
1	14.00	486	27.9	6.0	487	27.9	5.8	
2	N/A							
3	N/A							
4	N/A							
5	N/A							
6	N/A							
7	N/A							
8	N/A							
Averages		486	27.9		487	27.9		
Mean Flue Gas Temp (in K) $T_p = ((\text{Mean } T_1 + \text{Mean } T_2/2) + 273) =$				300.90				
Permitted Range of gas temperature readings (C) = $(0.95T_p - 273)$ to $(1.05T_p - 273) =$				12.86		to 42.95		
Highest Velocity Reading (m/s) =				24.8				
Lowest Velocity Reading (m/s) =				24.0				
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 2 <sup>nd</sup> run	N/A	End of 2 <sup>nd</sup> run	N/A	
Acceptable Leak Check < 2% Vol (l/min)	0.57			Manometer Leak Check			OK	
Range of Gas Temps	OK			Pitot Leak Check			OK	
Passed minimum Velocity requirements (>5pa)	YES			Overall Isokinetic Ratio (%) (must be 95 to 115%)			Run 1 98.4	
Negative Local Flow Present, YES or NO (Yes = Fail)	NO			Are there sufficient rails and kick board? (YES, NO or N/A)			Run 2 N/A	
Is the Platform area greater than 5m <sup>2</sup> ? (YES, NO or N/A)	NO			Is the area in front of the sample line the length of the probe + 1 metre? (YES or NO)			NO	
Passed Highest to lowest Velocity (3:1)	YES						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 0301			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 <sub>2</sub>		0.2	%
O <sub>2</sub>		19.7	%
Total		19.9	%
N <sub>2</sub> (100 - total)		80.1	%
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$		28.82	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	G47/270114-01											
Sample Point	Probe Distance	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	09:20	486	28.3	689130	27.8	6.9	7.1	N/A	N/A	N/A	N/A
		09:25	443	27.0	689272	28.2	7	7.3	N/A	N/A	N/A	N/A
		09:30	506	28.9	689407	28.5	7.2	7.7	N/A	N/A	N/A	N/A
		09:35	534	29.7	689551	29	7.5	8.1	N/A	N/A	N/A	N/A
		09:40	556	30.3	689699	29.2	8.6	8.5	N/A	N/A	N/A	N/A
		09:45	487	28.3	689851	29.7	9.2	8.8	N/A	N/A	N/A	N/A
		09:50	434	26.7	689992	30.6	9.9	9.7	N/A	N/A	N/A	N/A
		09:55	424	26.4	690126	31.1	10	10.1	N/A	N/A	N/A	N/A
		10:00	456	27.4	690258	31.3	10.2	10.3	N/A	N/A	N/A	N/A
		10:05	474	27.9	690395	31.4	10.2	10.3	N/A	N/A	N/A	N/A
		10:10	490	28.4	690535	31.7	10.3	10.7	N/A	N/A	N/A	N/A
		10:15	453	27.3	690677	32.1	10.3	11	N/A	N/A	N/A	N/A
		10:20	506	28.9	690814	32.2	10.4	11.2	N/A	N/A	N/A	N/A
		10:25	474	27.9	690958	32.4	10.7	11.8	N/A	N/A	N/A	N/A
		10:30	544	29.9	691098	32.5	11.1	12.5	N/A	N/A	N/A	N/A
		10:35	506	28.9	691248	32.7	11.2	12.7	N/A	N/A	N/A	N/A
		10:40	453	27.3	691392	33	11.3	12.9	N/A	N/A	N/A	N/A
		10:45	513	29.1	691529	33.2	11.3	13	N/A	N/A	N/A	N/A
		10:50	453	27.3	691674	32.8	11.5	13.2	N/A	N/A	N/A	N/A
		10:55	455	27.4	691811	33.2	11.5	13.4	N/A	N/A	N/A	N/A
		11:00	507	28.9	691947	33.4	11.8	13.5	N/A	N/A	N/A	N/A
		11:05	544	29.9	692092	33.5	12	13.5	N/A	N/A	N/A	N/A
		11:10	465	27.7	692242	32.2	11.9	12.5	N/A	N/A	N/A	N/A
		11:15	443	27.0	692380	31.4	11.9	11.8	N/A	N/A	N/A	N/A
		11:20			692470							
Finish												
Actual Sampling Time		120.00		28.28	3340.0	31.38	10.16	10.90	N/A	N/A	N/A	N/A



Stack Reference ID	Main Stack			
	Federal Mogul			
	RUN 1			
Filter Reference No	G47/270114-01			
Date	4th February 2014			
Sample Period	09:20	to	11:20	
Velocity (m/s)	24.11			
Volume flow rate of Stack gas (m <sup>3</sup> /hr)	5344			
Average Stack Temp (°C)	27.9			
Temp Range ± 5% (°C)	12.86	to	42.95	
Lowest Velocity Reading (m/s)	24.03			
Highest Velocity Reading (m/s)	24.82			
Ratio (less than 3:1)	1.03	:	1	
Pre-conditioning temperature of Filter (°C)	180			
Instack sampling - Max Filter temperature (°C)	27.9			
Post-conditioning temperature Filter/Wash (°C)	160			
Oxygen %	19.7			
Carbon Dioxide %	0.20			
Moisture (%)	2.13			
Litres sampled	3340			
Corrected volume sampled - STP (m <sup>3</sup> )	3.258			
Blank Filter Run weight gain (mg)	0.030	Blank Concentration (mg/m <sup>3</sup> )	0.009	
Blank Wash Run weight gain (mg)	0.020		0.006	
Weighing uncertainty of balance (mg)	0.074	This must be <5% of ELV	ELV = 5	0.3
Overall Blank value (mg/m <sup>3</sup> )	0.015	This must be <20% of ELV	ELV = 5	1.0
Particulate weight collected on filter (mg)	0.10			
Particulate weight collected in Wash (mg)	0.68			
Total Particulate weight collected (mg)	0.78			
Total Particulate Concentration, dry gas at STP (mg/m <sup>3</sup> )	0.24			
Total Particulate Concentration, wet gas at STP (mg/m <sup>3</sup> )	0.23			
Total Particulate Concentration corrected for 11% Oxygen, dry gas (mg/m <sup>3</sup> )	N/A			
Total Particulate Mass Emission (kg/hour)	0.0013			



RUN No	One											
Filter ID	14/003/05 to 13											
Sample Point	Probe Distance	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)
Start		12:00	512	29.5	692470	22.3	11.1	11.7	70	70	9.6	N/A
		12:05	467	28.2	692618	23.2	11.3	11.5	70	70	8.1	N/A
		12:10	487	28.8	692758	23.9	11.4	11.7	70	70	7.4	N/A
		12:15	526	29.9	692902	24.2	11.6	11.6	70	70	8.1	N/A
		12:20	488	28.8	693052	24.9	11.7	11.4	70	70	8.9	N/A
		12:25	490	28.9	693196	26.7	11.8	11.5	70	70	9.8	N/A
		12:30	473	28.4	693340	28.2	11.9	11.1	70	70	10.6	N/A
		12:35	422	26.8	693482	29.1	12.1	11.4	70	70	11.6	N/A
		12:40	476	28.4	693616	29.9	12.2	11.2	70	70	12.4	N/A
		12:45	588	31.6	693758	30.5	12.2	11.3	70	70	13.3	N/A
		12:50	541	30.3	693916	31.1	12.3	11.4	70	70	14.1	N/A
		12:55	509	29.4	694068	31.6	12.3	11.3	70	70	14.9	N/A
		13:00	487	28.8	694215	31.9	12.4	11.4	70	70	15.6	N/A
		13:05	459	27.9	694359	32.2	12.3	11.5	70	70	16.3	N/A
		13:10	434	27.2	694498	32.4	12.4	11.4	70	70	17.1	N/A
		13:15	478	28.5	694634	32.6	12.5	11.4	70	70	17.8	N/A
		13:20	469	28.2	694777	32.9	12.4	11.5	70	70	16.4	N/A
		13:25	465	28.1	694918	33.1	12.3	11.4	70	70	15.2	N/A
		13:30	479	28.5	695059	33.2	12.5	11.3	70	70	14.1	N/A
		13:35	434	27.2	695201	33.4	12.3	11.4	70	70	12.8	N/A
		13:40	504	29.3	695337	33.5	12.4	11.3	70	70	11.5	N/A
		13:45	467	28.2	695483	33.5	12.3	11.4	70	70	12.4	N/A
		13:50	496	29.0	695624	33.2	12.4	11.3	70	70	13.2	N/A
		13:55	501	29.2	695769	32.8	12.5	11.3	70	70	14.6	N/A
		14:00			695855							
Finish												
Actual Sampling Time		120.00		28.59	3385.0	30.01	12.11	11.40	70.00	70.00	12.74	N/A

Metals	Amount Collected (ug)	Total Concentration (mg/m <sup>3</sup> )	Blank Reagent Concentration (mg/m <sup>3</sup> )	Blank Rinse Concentration (mg/m <sup>3</sup> )
Cadmium	0.86	0.00026	0.000	0.000
Manganese	0.00	0.00000	0.000	0.000
Cobalt	0.00	0.00000	0.000	0.000
Chromium	0.67	0.00020	0.000	0.000
Copper	3.11	0.00095	0.000	0.000
Iron	2.00	0.00061	0.000	0.000
Molybdenum	0.00	0.00000	0.000	0.000
Nickel	0.00	0.00000	0.000	0.000
Vanadium	0.00	0.00000	0.000	0.000
Tungsten	0.00	0.00000	0.000	0.000
Silicon	0.00	0.00000	0.000	0.000
<b>Total Metals (mg/m<sup>3</sup>)</b>		<b>0.00203</b>		

### A7 - Gas Analyser Site Calibration Measurements

Not applicable

### A8 – Instrumental Gas Analyser Results

Not applicable



## A9 – Laboratory Results



Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

### Scientific Analysis Laboratories Ltd Certificate of Analysis

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Report Number: 376544-1

Date of Report: 21-Feb-2014

Customer: Redwing Environmental  
Unit 7  
Manor Road Business Park  
Manor Road  
Atherstone  
Warwickshire  
CV9 1TE

Customer Contact: Ms Elena Berek

Customer Job Reference: P-RED14-003  
Customer Purchase Order: PO-RED14-012  
Date Job Received at SAL: 12-Feb-2014  
Date Analysis Started: 13-Feb-2014  
Date Analysis Completed: 21-Feb-2014

The results reported relate to samples received in the laboratory  
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation  
This report should not be reproduced except in full without the written approval of the laboratory  
Tests covered by this certificate were conducted in accordance with SAL SOPs  
All results have been reviewed in accordance with QP22



Report checked  
and authorised by :  
Mary Drury  
Project Manager

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Mary Drury  
Project Manager

Validity unknown  
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Date: 2014.02.21 17:19:25 GMT  
Reason: Issued  
Location: SAL

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SAL Reference: 376544						
Customer Reference: P-RED14-003						
Filter Analysed as Filter						
Miscellaneous						
SAL Reference		376544 008	376544 009			
Customer Sample Reference		14/003/12	14/003/13			
Test Sample		AR	AR			
Date Sampled		04-FEB-2014	04-FEB-2014			
Determinand	Method	LOD	Units	Symbol		
Silicon	ICP/OES	1	µg	N	<1	<1

SAL Reference: 376544						
Customer Reference: P-RED14-003						
Impinger Analysed as Impinger (3.3%HNO3/1.5%H2O2)						
(5%HNO3/5%H2O2)						
Miscellaneous						
SAL Reference		376544 003	376544 004	376544 007		
Customer Sample Reference		14/003/07	14/003/08	14/003/11		
Test Sample		AR	AR	AR		
Date Sampled		04-FEB-2014	04-FEB-2014	04-FEB-2014		
Determinand	Method	LOD	Units	Symbol		
Volume	Vol	1	ml	N	170	100 99

SAL Reference: 376544						
Customer Reference: P-RED14-003						
Filter Analysed as Filter						
Filter Suite						
SAL Reference		376544 001	376544 002			
Customer Sample Reference		14/003/05	14/003/06			
Test Sample		AR	AR			
Date Sampled		04-FEB-2014	04-FEB-2014			
Determinand	Method	LOD	Units	Symbol		
Cadmium	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5
Chromium	ICPMS (HF BS EN 14385)	1	µg	U	<1	<1
Cobalt	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5
Copper	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5
Iron	ICPMS (HF BS EN 14385)	1	µg	N	(13.64) 2	(13.64) <1
Manganese	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	(13) <0.5
Molybdenum	ICPMS (HF BS EN 14385)	0.5	µg	N	(13.64) <0.5	(13.64) <0.5
Nickel	ICPMS (HF BS EN 14385)	1.0	µg	U	<1.0	<1.0
Tungsten	ICPMS (HF BS EN 14385)	1	µg	N	(64) <1	(64) <1
Vanadium	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5

SAL Reference: 376544						
Customer Reference: P-RED14-003						
Probe Wash Analysed as Probe Wash (27.5%HNO3)						
(27.5%HNO3)						
Suite A						
SAL Reference		376544 005	376544 006			
Customer Sample Reference		14/003/09	14/003/10			
Test Sample		AR	AR			
Date Sampled		04-FEB-2014	04-FEB-2014			
Determinand	Method	LOD	Units	Symbol		
Cadmium	ICPMS (HF BS EN 14385)	0.5	µg	U	0.8	0.9
Chromium	ICPMS (HF BS EN 14385)	2	µg	U	<2	<2
Cobalt	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5
Copper	ICPMS (HF BS EN 14385)	0.5	µg	U	1.1	8.9
Iron	ICPMS (HF BS EN 14385)	1	µg	N	(64) <1	(64) <1
Manganese	ICPMS (HF BS EN 14385)	2	µg	U	<2	<2
Molybdenum	ICPMS (HF BS EN 14385)	0.5	µg	N	(64) <0.5	(64) <0.5
Nickel	ICPMS (HF BS EN 14385)	2	µg	U	<2	<2
Tungsten	ICPMS (HF BS EN 14385)	1.0	µg	N	(64,13) <1.0	(13,64) <1.0
Vanadium	ICPMS (HF BS EN 14385)	0.5	µg	U	<0.5	<0.5



SAL Reference: 376544							
Customer Reference: P-RED14-003							
Impinger (5% $\text{HNO}_3$ /5% $\text{H}_2\text{O}_2$ )		Analysed as Impinger (3.3% $\text{HNO}_3$ /1.5% $\text{H}_2\text{O}_2$ )					
Suite A							
SAL Reference		376544 003	376544 004	376544 007			
Customer Sample Reference		14/003/07	14/003/08	14/003/11			
Test Sample		AR	AR	AR			
Date Sampled		04-FEB-2014	04-FEB-2014	04-FEB-2014			
Determinand	Method	LOD	Units	Symbol			
Cadmium	ICPMS (BS EN 14385)	0.5	$\mu\text{g/l}$	U	<0.5	0.6	<0.5
Chromium	ICPMS (BS EN 14385)	0.5	$\mu\text{g/l}$	U	1.5	4.1	<0.5
Cobalt	ICPMS (BS EN 14385)	0.2	$\mu\text{g/l}$	U	<0.2	<0.2	<0.2
Copper	ICPMS (BS EN 14385)	1	$\mu\text{g/l}$	U	3	15	<1
Iron	ICPMS (BS EN 14385)	1	$\mu\text{g/l}$	N	<1	<sup>(64)</sup> <1	<sup>(64)</sup> <1
Manganese	ICPMS (BS EN 14385)	2	$\mu\text{g/l}$	U	<2	<2	<2
Molybdenum	ICPMS (BS EN 14385)	1	$\mu\text{g/l}$	N	<sup>(64)</sup> <1	<sup>(64)</sup> <1	<sup>(64)</sup> <1
Nickel	ICPMS (BS EN 14385)	2	$\mu\text{g/l}$	U	<2	<2	<2
Tungsten	ICPMS (BS EN 14385)	10	$\mu\text{g/l}$	N	<sup>(26)</sup> <30	<sup>(26)</sup> <30	<sup>(26,13)</sup> <30
Vanadium	ICPMS (BS EN 14385)	0.3	$\mu\text{g/l}$	U	<0.3	<0.3	<0.3

### Index to symbols used in 376544-1

Value	Description
AR	As Received
13	Results have been blank corrected.
26	LOD raised because the analysis was performed by an alternative technique
64	Analysis was performed by an alternative technique
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited



## A10 – Calculations

Calculations for Metals		Run 1	Units
<b>Sample Gas Volume, dry <math>V_{mstd}</math></b>			
$V_{mstd} = (V2 - V1) * \frac{T_{std}}{T_m} * \frac{P_m}{P_{std}}$			
Volume of gas sample through gas meter, $V_m$ ( $V2 - V1$ ) Average dry gas meter temperature, $T_m$ Measured Atmospheric pressure $P_m$ $T_{std} - 273K$ $P_{std} - 101.3kPa$		$V_{mstd} =$ 3.280 $P_m =$ 102.5 $T_m =$ 285.1 $V2 =$ 695.855 $V1 =$ 692.470	m <sup>3</sup> kPa °K m <sup>3</sup> m <sup>3</sup>
<b>Metals Concentration Calculations, Absorption efficiency</b>			
		Metals (Solid)	2.0 ug
		Metals (Gases) in Impingers 1 + 2	0.0045 ug/ml
		Metals (Gases) in Impinger 3	0.020 ug/ml
		Metals (Gases) in Probe Rinse	0.000 ug/ml
		Impingers 1 + 2 Volume ( $v_1$ ) =	170 ml
		Impinger 3 Volume ( $v_2$ ) =	100 ml
		Probe Rinse Volume ( $v_3$ ) =	78 ml
		Metals (Gases) =	2.74 ug
		$B_{EI} =$	0.001 mg/m <sup>3</sup>
		Is Concentration >30% of ELV	0.1 %
		ELV (%) =	1.00 mg/m <sup>3</sup>
Absorption Efficiency (AE) =	$\frac{\text{Impingers 1 + 2 Concentration}}{\text{Imp (1 + 2) + Imp 3 Concentration}} * 100$	AE (%) =	28.0 %
		AE should be >90% for a pass this is not valid if Concentration is less than 30% of the ELV	



## A11 – Uncertainty Budgets

### Total Particulate Matter Run 1 – Uncertainty

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER							
	Value	Units					
Limit value (ELV)	5	mg.m <sup>-3</sup>					
Measured concentration	0.24	mg.m <sup>-3</sup> (at ref conditions)					
Reference Oxygen	21	% by Volume					
Measured Quantities	Symbol	Value	Units				
Sampled Volume	V <sub>m</sub>	3.34	m <sup>3</sup>				
Gas Meter Temperature	T <sub>m</sub>	283.16	K				
Sampled Gas Pressure	ρ <sub>m</sub>	102.5	kPa				
Sampled Gas Humidity	H <sub>m</sub>	0	% by volume				
Oxygen content	O <sub>2,m</sub>	19.7	% by volume				
Mass of Particulate	m	0.78	mg				
Leak	L	0.2	%				
Uncollected Mass (Instack filter - no rinse)	UCM	0.03	mg				
Standard Uncertainty	Symbol	Value	Units	Uncertainty as a %	Uncertainty Required	Uncertainty Met	
Sampled Volume	uV <sub>m</sub>	0.01	m <sup>3</sup>	0.30	≤ 2%	Yes	
Sampled Gas Temperature	uT <sub>m</sub>	2	K	0.71	≤ 1%	Yes	
Sampled Gas Pressure	uρ <sub>m</sub>	0.005	kPa	0.00	≤ 1%	Yes	
Sampled Gas Humidity	uH <sub>m</sub>	1	% by volume	1.00	≤ 1%	Yes	
Oxygen content	uO <sub>2,m</sub>	0.2	% by volume	1.02	≤ 5%	Yes	
Mass of Particulate	um	0.07	mg	9.53	<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	3.85	≤ 10% of ELV	No	
Parameter	Value	Units	Sensitivity Coeff	Uncertainty Contribution	Units	Uncertainty as %	
Corrected Volume (STP)	V	3.258	m <sup>3</sup>	0.07	0.00	mg.m <sup>-3</sup>	1.26
Mass of Particulate	m	0.78	mg	0.31	0.02	mg.m <sup>-3</sup>	9.53
Factor for O2 Correction	fc	1.00		0.24	0.04	mg.m <sup>-3</sup>	15.38
Leak	L	0.00	mg.m <sup>-3</sup>	1.00	0.00	mg.m <sup>-3</sup>	0.12
Uncollected mass	UCM	0.02	mg	0.31	0.01	mg.m <sup>-3</sup>	2.22
<b>Combined measurement uncertainty</b>				<b>1.12</b>	<b>0.04</b>	<b>mg.m<sup>-3</sup></b>	
<b>Expanded uncertainty as percentage of measured value</b>			<b>36.56</b>	expressed with a level of confidence of 95% (Using a coverage factor k=2)			
<b>Expanded uncertainty in units of measurement (mg/m<sup>3</sup>)</b>			<b>0.09</b>				
<b>Expanded uncertainty as percentage of limit value</b>			<b>1.75</b>				



## Metals – Uncertainty

Uncertainty calculation for Determination of mass concentration of Metals, Reference method						
Limit value (ELV)	1	mg.m <sup>-3</sup>	Reference oxygen	21	% by volume	
Measured concentration	0.001	mg.m <sup>-3</sup> (at reference conditions)				
Measured Quantities	Symbol	Value	Standard uncertainty	Units	Uncertainty as percentage	
Sampled Volume Gas	V <sub>m</sub>	3.28	uV <sub>m</sub>	0.001	m <sup>3</sup>	0.03
Sampled gas Temperature	T <sub>m</sub>	285.1	uT <sub>m</sub>	2	K	2.00
Sampled gas Pressure	p <sub>m</sub>	102.5	up <sub>m</sub>	1	kPa	0.98
Sampled gas Humidity	H <sub>m</sub>	0	uH <sub>m</sub>	1	% by volume	1.00
Oxygen content	O <sub>2,m</sub>	19.50	uO <sub>2,m</sub>	0.1	% by volume	0.51
Metals Found on Filters	C	0.00	uC	0.00032	mg	
Metals found in Solution	C	0.003	uC	0.0004376	mg	16.00
Impinger 1 & 2 solution volume	VS	0.170	uVS	0.001	l	0.59
Impinger 3 solution volume	VS	0.100	uVS	0.001	l	1.00
Probe Rinse volume	VS	0.078	uVS	0.001	l	1.28
Total Mass of metals	m	0.005	um	0.00	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 cond)	V	m <sup>3</sup>	0.00	0.00	mg.m <sup>-3</sup>	1.56
Mass	m	mg	0.31	0.00	mg.m <sup>-3</sup>	16.09
Factor for O2 Correction	fc	1.00	0.00	0.00	mg.m <sup>-3</sup>	6.67
Leak	L	0.00	mg.m <sup>-3</sup>	1.00	0.00	0.00
<b>Combined uncertainty</b>				<b>0.00</b>	mg.m <sup>-3</sup>	
Expanded uncertainty as percentage of measured value			<b>34.98</b>	% measured of value		
Expanded uncertainty in units of measurement			<b>0.001</b>	mg.m <sup>-3</sup>		
Expanded uncertainty as percentage of limit value			<b>0.05</b>	% ELV		
expressed with a level of confidence of 95% using a coverage factor k = 2						



## 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<sup>3</sup>).

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:  $\pm 30\%$

### 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.

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