

Stack 1 Emissions Testing Report June 2017

Pharmaceutical Waste and Illicit Substance Destruction Trial



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Stack 1 Emissions Testing Report June 2017

Pharmaceutical Waste and Illicit Substance Destruction Trial

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01-Aug-2017

Job No.: 60539866

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Quality Information

Document Stack 1 Emissions Testing Report June 2017


Ref 60539866

Date 01-Aug-2017

Prepared by James Lang Approved Signatory  _____

Reviewed by Paul Wenta

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	1-Aug-2017	Final Report	Chad Whitburn Compliance Services - Team Leader	

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1.0 Introduction

AECOM was appointed by Weston Aluminium Pty Ltd to conduct a series of measurements to determine air emissions from Stack 1 located at their Weston plant in Kurri Kurri, NSW while processing Pharmaceutical waste and Illicit Substances. Emission testing was a compliance requirement of Environmental Protection Licence (EPL) number 6423.

Testing was conducted on 8 June 2017 to determine emission concentrations for the following parameters:

Stack 1 (EPL Point 1)

- Total Particulate;
- Fine Particulate (PM₁₀);
- Sulfuric Acid Mist (H₂SO₄ as SO₃);
- Sulfur Dioxide (SO₂ as SO₃);
- Chlorine;
- Hydrogen Chloride;
- Gaseous Fluoride;
- Particulate Fluoride;
- Hazardous Substances (Metals);
- Volatile Organic Compounds (VOC);
- Oxides of Nitrogen;
- Carbon Monoxide;
- Carbon Dioxide;
- Oxygen;
- Cyanide;
- Polycyclic Aromatic Hydrocarbon (PAH); and
- Dioxins and Furans.

Laboratory analysis was conducted by the following laboratories, which hold NATA accreditation for the specified tests:

- Steel River Testing Pty. Ltd., NATA accreditation number 18079, performed the following analysis detailed in report number 13761-0-P, 13761-0-M:
 - Moisture;
 - Fine Particulate (PM₁₀); and
 - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1702503:
 - Fluoride;
 - Cyanide;
 - Sulfuric Acid Mist;
 - Sulfur Dioxide;
 - Hydrogen Chloride;

- Chlorine; and
- Volatile Organic Compounds.
- National Measurements Institute, NATA accreditation number 198, performed the following analysis detailed in report number ORG17_026 and DAU17-122:
 - Polycyclic Aromatic Hydrocarbons; and
 - Dioxins and Furans.
- SGS Australia Pty Ltd, NATA accreditation number 14429, performed the following analysis detailed in report number ME303133-R0:
 - Hazardous Substances (Metals).

2.0 Sampling Plane Requirements

The criteria for sampling planes are specified in AS 4323.1-1995 (R2014).

Table 1 Criteria for Selection of Sampling Planes (AS 4323. 1)

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (D)	Minimum distance downstream from disturbance, diameters (D)
Bend, connection, junction, direction change	>2D	>6D
Louvre, butterfly damper (partially closed or closed)	>3D	>6D
Axial fan	>3D	>8D (see Note)
Centrifugal fan	>3D	>6D

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners may be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

- a. *The gas flow is basically in the same direction at all points along each sampling traverse.*
- b. *The gas velocity at all sampling points is greater than 3 m/s.*
- c. *The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15° to the duct axis, when measured near the periphery of a circular sampling plane.*
- d. *The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.*
- e. *The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1.*
- f. *The gas temperature at the sampling plane should preferably be above the dewpoint.*

Stack 1 (EPA Identification No. 1) did not satisfy the requirements of AS 4323.1 Section 4.1 with regard to the upstream and downstream distances from disturbances. To compensate for this, additional sampling points were added in accordance with AS 4323.1 Section 4.2.

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3.0 Methodology

3.1 NATA Accredited Methods

The following methods are accredited with the National Association of Testing Authorities (NATA), Accreditation No. 2778 (14391), and are approved for the sampling and analysis of gases and aerosols. Specific details of the methods are available on request.

All sampling and analysis is conducted according to the methods in **Table 2**.

Table 2 AECOM NATA Endorsed Methods

NSW EPA Approved Methods	USEPA Methods	Parameter Measured
NSW EPA TM-1 (AS 4323.1-1995)	USEPA (2000) Method 1 under approved circumstances	Selection of sampling positions
NSW EPA TM-2	USEPA (2000) Method 2 or 2C or USEPA (1999) Method 2F or 2G or 2H (as appropriate)	Velocity or volumetric flow rate or temperature or pressure of stack gases
NSW EPA TM-3	USEPA (2000) Method 8 (for sampling and analysis) or APHA (1998) Method 4110B (for analysis only if interference from fluorides, free ammonia and/or dimethyl aniline has been demonstrated to the satisfaction of the Chief Scientist) (as appropriate)	Sulfuric acid mist (H ₂ SO ₄) or sulphur trioxide (SO ₃)
NSW EPA TM-4	USEPA (2000) Method 6 or 6A or 6B or USEPA (1996) Method 6C or ISO (1989) Method 7934 or ISO (1992) Method 7935 or ISO (1993) Method 10396 or ISO (1998) Method 11632 (as appropriate)	Sulfur dioxide (SO ₂)
NSW EPA TM-7	USEPA (2000) 26A	Chlorine (Cl ₂)
NSW EPA TM-8	USEPA (2000) 26A	Hydrogen chloride (HCl)
NSW EPA TM-9	USEPA (2000) Method 13A or 13B (as appropriate)	Fluorine (F ₂) or any compound containing fluorine, except where emitted by a primary aluminium smelter while manufacturing aluminium from alumina
NSW EPA TM-12	USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate)	Type 1 substances (elements antimony (Sb), arsenic (As), cadmium (Cd), lead (Pb) or mercury (Hg) or any compound containing one or more of those elements)
NSW EPA TM-13	USEPA (2000) Method 29 (Analysis for tin and vanadium to be done by Inductively Coupled Argon Plasma Emission Spectroscopy (ICAP) as defined in USEPA Method 29) or USEPA (1986) Method 7910 (for vanadium only) or USEPA (1986) Method 7911 (for vanadium only) (as appropriate)	Type 2 substances (elements beryllium (Be), chromium (Cr), cobalt (Co), manganese (Mn), nickel (Ni), selenium (Se), tin (Sn) or vanadium (V) or any compound containing one or more of those elements)
NSW EPA TM-14	Cadmium (Cd) or mercury (Hg) or any compound containing one or more of those elements	USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate)

NSW EPA Approved Methods	USEPA Methods	Parameter Measured
NSW EPA TM-15 (AS 4323.2-1995)	USEPA (2000) Method 5 under approved circumstances	Solid particles (Total)
NSW EPA TM-22	USEPA (2000) Method 4	Moisture content in stack gases
NSW EPA TM-23	USEPA (2000) Method 3	Dry gas density or molecular weight of stack gases
NSW EPA TM-34	USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate)	Volatile organic compounds
NSW EPA OM-5	USEPA (1997) Method 201 or 201A (as appropriate)	'Fine' particulates (PM ₁₀)
NSW EPA OM-6	California EPA Air Resources Board (1997) Method 429	Polycyclic aromatic hydrocarbons (PAHs)
NSW EPA TM-32	USEPA Method 10	Determination of Carbon Monoxide emissions from stationary sources
NSW EPA TM-25	USEPA (1990) Method 3A	Determination of Oxygen concentrations from stationary sources
NSW EPA TM-24	USEPA (1990) Method 3A	Carbon dioxide (CO ₂) in stack gases
NSW EPA TM-11	USEPA(2000) Method 7C	Determination of Nitrogen dioxide or nitric oxide emissions from stationary sources
NSW EPA TM-18	USEPA (1995) Method 23	Dioxins and Furans

3.2 Deviations from NATA Accredited Methods

The following method is not accredited with the National Association of Testing Authorities (NATA), Accreditation No. 2778 (14391). Specific details of the methods are available on request.

All sampling and analysis is conducted according to the method in **Table 3**.

Table 3 NATA Method Deviations

USEPA Methods	Parameter Measured
USEPA (2011) Other Test Method 29	Sampling and analysis for Hydrogen Cyanide emissions from stationary sources

4.0 Sampling Location

4.1 Sampling Location Summary

Table 4 provides a summary of the location sampled by AECOM on 8 June 2017 at the Weston Aluminium plant in Kurri Kurri, NSW.

Table 4 Sampling Location Summary

Discharge Description	Stack 1 (EPA Identification No. 1)
Duct Shape	Circular
Construction Material	Metal
Duct Diameter (mm)	1650
Minimum No. Sampling Points	16
Sampling Ports	2
Min. Points/Traverse	8
Disturbance	Yes
Distance from Upstream Disturbance	2D
Type of Disturbance	Fan entry
Distance from Downstream Disturbance	4D
Type of Disturbance	Stack Exit
Ideal Sampling Location	No
Correction Factors Applied	Yes
Total No. Points Sampled	20
Points/Traverse	10
Sampling Performed to Standard*	Yes ²

*AS 4323.1 Stationary source emissions Method 1 – Selection of sampling positions

¹ AS 4323.1 Section 4.1

² AS 4323.1 Section 4.2

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5.0 Equipment Calibration

AECOM has a calibration schedule to ensure the emission testing equipment is maintained in good order and with known calibration. Equipment used in this project was calibrated according to the procedures and frequency identified in the AECOM calibration schedule. Details of the schedule and the calibration calculations are available on request.

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6.0 Results

A summary of test results for June 2017 testing is presented in **Table 5**. Calculated Fine Particulate (PM₁₀) cut size is displayed in **Table 6**. Gas Data Concentrations and Mass Emission Rate summaries are reported in **Tables 7 & 8** respectively. Detailed results along with gas stream properties during the testing periods can be found in **Tables 9 to 12**. Speciated Volatile Organic Carbons and Dioxins and Furan results can be found in **Tables 13 & 14**, Hazardous Substances (Metals) results in **Table 15**, and Polycyclic Aromatic Hydrocarbons results in **Table 16**.

All emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atm pressure for comparison with regulatory limits outlined in the Weston Aluminium Environmental Protection Licence 6423.

Field notes recorded during the project are attached as **Appendix A**, with Laboratory Analysis Reports attached as **Appendix B**, and Raw & Calculated Gas Data as **Appendix C**.

Table 5 Stack Emissions Results Summary 8 June 2017

Parameter	Stack 1 EPL Point 1
Carbon Monoxide (CO) (ppm)	20 (100)
Chlorine (mg/m ³)	11
Cyanide	0.38 (0.5)
Fine Particulate (PM ₁₀) (mg/m ³)	3.7
Gaseous Fluoride (mg/m ³)	0.028 (2)
Hydrogen Chloride (mg/m ³)	<7.7 (400)
Oxides of Nitrogen (as Equivalent NO ₂) (mg/m ³)	12 (2500)
Oxygen (%)	20.6
Carbon Dioxide (%)	0.3
Particulate Fluoride (mg/m ³)	0.38
Sulfur Dioxide (SO ₂ as SO ₃) (mg/m ³)	<8
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) (mg/m ³)	<1.6 (100)
Total Particulate (mg/m ³)	8.7 (25)
Total Polycyclic Aromatic Hydrocarbons (mg/m ³)	0.11
Dioxins and Furans Lower Bound	0.000002
Dioxins and Furans Middle Bound	0.00023
Type 1 and 2 Substances in Aggregate (Metals) (mg/m ³)	0.071 (10)
Volatile Organic Compounds (VOC) (mg/m ³)	<0.35

Note – EPL Limits are in parenthesis

USEPA method 201A, section 6.3.5 (Determination of PM₁₀ Emissions) and USEPA Conditional Test Method 040, Section 17, Table 2 (Determination of PM_{2.5} Emissions) specifies that results are acceptable provided the calculated aerodynamic cut size (D₅₀) for the test lies between 9.0µm and 11.0µm. Post sampling cut size calculations performed for the sampling conducted are displayed in **Table 6**.

Cut size, or D₅₀, refers to the aerodynamic diameter of the particles contained in the gas stream which can be captured with a 50% efficiency and is a calculated value. For a Fine Particulate (PM₁₀) test particle sizes of 10µm and less are expected.

The cut size (D₅₀) is calculated prior to testing and is based on the pre-test measurements such as stack gas velocity, stack gas temperature, moisture content of the gas stream and stack gas density. This pre-test calculation of cut size (D₅₀) is used in conjunction with the pre-test measurements, some of which are stated above, to establish the sampling conditions or parameters.

Table 6 Calculated PM₁₀ Cut Size

Sampling Location	PM ₁₀ Cut Size (D ₅₀)
Stack 1	10.0

The calculated cut sizes meet the criteria for cut size conditions stated above.

Table 7 Calculated Gas Concentrations Data Summary, 8 June 2017

Parameter	Stack 1
Time Period	10:01-11:01
Nitrogen Oxide (NO) (mg/m ³)	4
Nitrogen Dioxide (NO ₂) (mg/m ³)	6
Nitrogen Oxides (NO _x) (mg/m ³)	10
Oxides of Nitrogen as Equivalent NO ₂ (mg/m ³)	12 (2500)
Carbon Monoxide (ppm)	20 (100)
Carbon Monoxide (mg/m ³)	25
Carbon Dioxide (%)	0.2
Oxygen (%)	20.6

Note – EPL Limits are provided in parenthesis.

Table 8 Gas Mass Emission Rates Summary, 8 June 2017

Parameter	Stack 1
Time Period	10:01-11:01
Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure)	26
Nitrogen Oxide (NO) (mg/s)	104
Nitrogen Dioxide (NO ₂) (mg/s)	156
Nitrogen Oxides (NO _x) (mg/s)	260
Oxides of Nitrogen as Equivalent NO ₂ (mg/s)	315
Carbon Monoxide (mg/s)	650

Table 9 Stack 1 Fine Particulate (PM₁₀), Total Particulate, Particulate Fluoride and gaseous Fluoride Results, 8 June 2017

Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	50.0 °C	323.2 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26 m ³ /s	
Fine Particulate (PM₁₀) Testing		
Test Period	10:55 -	12:37
Fine Particulate (PM ₁₀) Mass	4.6 mg	
Gas Volume Sampled	1.24 m ³	
Fine Particulate (PM ₁₀) Emission*1	3.7 mg/m ³	
Fine Particulate (PM ₁₀) Mass Emission Rate*2	96 mg/s	
Regulatory Limit	NA mg/m ³	
Total Particulate Testing		
Test Period	10:55 -	12:37
Total Particulate Mass	12.6 mg	
Gas Volume Sampled	1.45 m ³	
Total Particulate Emission*1	8.7 mg/m ³	
Total Particulate Mass Emission Rate*2	230 mg/s	
Regulatory Limit	25 mg/m ³	
Particulate Fluoride Testing		
Test Period	10:55 -	12:37
Particulate Fluoride Mass	0.401 mg	
Gas Volume Sampled	1.07 m ³	
Particulate Fluoride Emission*1	0.38 mg/m ³	
Particulate Fluoride Mass Emission Rate*2	9.9 mg/s	
Regulatory Limit	NA mg/m ³	
Gaseous Fluoride Testing		
Test Period	10:55 -	12:37
Gaseous Fluoride Mass	0.03 mg	
Gas Volume Sampled	1.07 m ³	
Gaseous Fluoride Emission*1	0.028 mg/m ³	
Gaseous Fluoride Mass Emission Rate*2	0.73 mg/s	
Regulatory Limit	2 mg/m ³	
Moisture Content (%)	2.7	
Gas Density (dry at 1 atmosphere)	1.29 kg/m³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post-test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 10 Stack Cyanide, Hydrogen Chloride and Chlorine Results, 8 June 2017

Sampling Conditions:			
Stack internal diameter at test location	1650	mm	
Stack gas temperature (average)	53.6	°C	326.8 K
Stack pressure (average)	1021	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	32	m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26	m ³ /s	
Cyanide Testing			
Test Period	12:55	-	14:37
Cyanide Mass	0.7	mg	
Gas Volume Sampled	1.83	m ³	
Cyanide Emission ^{*1}	0.38	mg/m ³	
Cyanide Mass Emission Rate ^{*2}	10	mg/s	
Regulatory Limit	0.5	mg/m ³	
Hydrogen Chloride Testing			
Test Period	12:55	-	14:37
Hydrogen Chloride Mass	<10	mg	
Gas Volume Sampled	1.31	m ³	
Hydrogen Chloride Emission ^{*1}	<7.7	mg/m ³	
Hydrogen Chloride Mass Emission Rate ^{*2}	<200	mg/s	
Regulatory Limit	400	mg/m ³	
Chlorine Testing			
Test Period	12:55	-	14:37
Chlorine Mass	14.6	mg	
Gas Volume Sampled	1.34	m ³	
Chlorine Emission ^{*1}	11	mg/m ³	
Chlorine Mass Emission Rate ^{*2}	290	mg/s	
Regulatory Limit	NA	mg/m ³	
Moisture Content (%)	2.8		
Gas Density (dry at 1 atmosphere)	1.29	kg/m³	
Dry Molecular Weight	28.9	g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post-test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 11 Stack 1 Hazardous Substances (Metals), Sulfuric Acid Mist (H₂SO₄ as SO₃) and Sulfur Dioxide (SO₂ as SO₃) Results, 8 June 2017

Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	45.5 °C	318.7 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	27 m ³ /s	
Hazardous Substances (Metals) Testing		
Test Period	8:50 -	10:33
Hazardous Substances (Metals) Mass	0.092 mg	
Gas Volume Sampled	1.3 m ³	
Hazardous Substances (Metals) Emission ^{*1}	0.071 mg/m ³	
Hazardous Substances (Metals) Mass Emission Rate ^{*2}	1.9 mg/s	
Regulatory Limit	10 mg/m ³	
Sulfuric Acid Mist (H₂SO₄ as SO₃) Testing		
Test Period	8:50 -	10:33
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass	<2 mg	
Gas Volume Sampled	1.25 m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Emission ^{*1}	<1.6 mg/m ³	
Sulfuric Acid Mist (H ₂ SO ₄ as SO ₃) Mass Emission Rate ^{*2}	<44 mg/s	
Regulatory Limit	100 mg/m ³	
Sulfur Dioxide (SO₂ as SO₃) Testing		
Test Period	8:50 -	10:33
Sulfur Dioxide (SO ₂ as SO ₃) Mass	<10 mg	
Gas Volume Sampled	1.25 m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Emission ^{*1}	<8 mg/m ³	
Sulfur Dioxide (SO ₂ as SO ₃) Mass Emission Rate ^{*2}	<220 mg/s	
Regulatory Limit	NA mg/m ³	
Moisture Content (%)	2.6	
Gas Density (dry at 1 atmosphere)	1.29 kg/m³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post-test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 12 Stack 1 Polycyclic Aromatic Hydrocarbon (PAH), Dioxins and Furans Results, 8 June 2017

Sampling Conditions:	
Stack internal diameter at test location	1650 mm
Stack gas temperature (average)	47.7 °C 320.9 K
Stack pressure (average)	1021 hPa
Stack gas velocity (average, stack conditions)	15 m/s
Stack gas flowrate (stack conditions)	32 m ³ /s
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	27 m ³ /s
Polycyclic Aromatic Hydrocarbons Testing	
Test Period	8:30 - 14:37
Polycyclic Aromatic Hydrocarbons Mass	0.4 mg
Gas Volume Sampled	3.7 m ³
Polycyclic Aromatic Hydrocarbons Emission* ¹	0.11 mg/m ³
Polycyclic Aromatic Hydrocarbons Mass Emission Rate* ²	3 mg/s
Regulatory Limit	NA mg/m ³
Dioxins and Furans Lower Bound Testing	
Test Period	8:30 - 14:37
Dioxins and Furans Lower Bound Mass	0.0000074 ng
Gas Volume Sampled	3.7 m ³
Dioxins and Furans Lower Bound Emission* ¹	0.000002 ng/m ³
Dioxins and Furans Lower Bound Mass Emission Rate* ²	0.000054 ng/s
Regulatory Limit	NA ng/m ³
Dioxins and Furans Middle Bound Testing	
Test Period	8:30 - 14:37
Dioxins and Furans Middle Bound Mass	0.0008474 ng
Gas Volume Sampled	3.7 m ³
Dioxins and Furans Middle Bound Emission* ¹	0.00023 ng/m ³
Dioxins and Furans Middle Bound Mass Emission Rate* ²	0.0062 ng/s
Regulatory Limit	NA ng/m ³
Moisture Content (%)	1.6
Gas Density (dry at 1 atmosphere)	1.29 kg/m³
Dry Molecular Weight	28.9 g/g-mole

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post-test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 13 Stack 1 Speciated Volatile Organic Compounds Results, 8 June 2017

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.7
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.7
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.7
Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.7
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.7
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.7
MIBK	<1.0	<1.0	<1.0	<0.18	<4.7
Toluene	<1.0	<1.0	<1.0	<0.18	<4.7
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
m- & p-xylene	<2.0	<0.2	<2.0	<0.35	<9.1
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.7
Styrene	<1.0	<1.0	<1.0	<0.18	<4.7
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-decane	<1.0	<1.0	<1.0	<0.18	<4.7
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,2-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.7
Total	<1		<1	<0.35	<9.1

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value. i.e. a blank value of <0.5 has had 0.25 subtracted from the analysed value.

Table 14 Stack 1 Speciated Dioxins And Furans Results, 8 June 2017

Analyte	Mass ng	Toxic Equivalency Factor (1 - TEFs)	Total Toxic Equivalence (1 - TEQs) ng	Concentration ng/m ³	Total Toxic Equivalence (1-TEQs) ng/m ³
2,3,7,8-TCDF	<0.002	0.1	0.0001	<0.00054	0.000027
Total TCDF isomers	0.015				
2,3,7,8-TCDD	<0.001	1	0.0005	<0.00027	0.00013
Total TCDD isomers	<0.0007				
1,2,3,7,8-PeCDF	<0.001	0.05	0.000025	<0.00027	0.0000067
2,3,4,7,8-PeCDF	<0.0002	0.5	0.00005	<0.000054	0.000013
Total PeCDF isomers	<0.004				
1,2,3,7,8-PeCDD	<0.0003	0.5	0.000075	<0.000081	0.00002
Total PeCDD isomers	<0.002				
1,2,3,4,7,8-HxCDF	<0.0003	0.1	0.000015	<0.000081	0.000004
1,2,3,6,7,8-HxCDF	<0.0003	0.1	0.000015	<0.000081	0.000004
2,3,4,6,7,8-HxCDF	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,7,8,9-HxCDF	<0.0002	0.1	0.00001	<0.000054	0.0000027
Total HxCDF isomers	<0.002				
1,2,3,4,7,8-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,6,7,8-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,7,8,9-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
Total HxCDD isomers	<0.002				
1,2,3,4,6,7,8-HpCDF	<0.0007	0.01	0.0000035	<0.00019	0.00000094
1,2,3,4,7,8,9-HpCDF	<0.0004	0.01	0.000002	<0.00011	0.00000054
Total HpCDF isomers	<0.002				
1,2,3,4,6,7,8-HpCDD	<0.0009	0.01	0.0000045	<0.00024	0.0000012
Total HpCDD isomers	<0.002				
OCDF	0.0013	0.001	0.0000013	0.00035	0.00000035
OCDD	0.0061	0.001	0.0000061	0.0016	0.0000016

I-TEQ_{DF}

Lower Bound (excluding LOD Values)

0.000074 ng

Middle Bound (including half LOD Values)

0.00085 ng

Table 15 Stack 1 Elemental Metals Results, 8 June 2017

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m ³)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m ³)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m ³)	Total (mg)	Total (mg/m ³)	Mass Emission Rate (mg/s)
Antimony	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Arsenic	0.0001	0.000077	<0.0001	<0.000077			0.0001	0.000077	0.0021
Beryllium	<0.0002	<0.00015	0.000047	0.000036			0.000047	0.000036	0.00097
Cadmium	0.035	0.027	0.0013	0.001			0.04	0.031	0.84
Chromium	0.027	0.021	0.0013	0.001			0.03	0.023	0.62
Cobalt	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Copper	0.002	0.0015	0.00025	0.00019			0.002	0.0015	0.04
Lead	0.0011	0.00085	0.00095	0.00073			0.002	0.0015	0.04
Magnesium	<0.124	<0.096	0.0033	0.0025			0.0033	0.0025	0.067
Manganese	0.0052	0.004	<0.0016	<0.0012			0.0052	0.004	0.11
Mercury	<0.0001	<0.000077	0.00049	0.00038	<0.0001	<0.000077	0.00049	0.00038	0.01
Nickel	0.0083	0.0064	0.00095	0.00073			0.009	0.0069	0.19
Selenium	0.0047	0.0036	0.00025	0.00019			0.005	0.0039	0.11
Thallium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Tin	0.0004	0.00031	0.00015	0.00012			0.0006	0.00046	0.012
Vanadium	<0.0088	<0.0068	<0.0057	<0.0044			<0.0002	<0.00015	<0.004
Zinc	0.92	0.71	0.014	0.011			0.9	0.69	19
Total Hazardous Metals*	0.081	0.063	0.0053	0.0041	<0.0001	<0.000077	0.092	0.071	1.9
Total Metals	1	0.77	0.023	0.018			1	0.77	21

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

Table 16 Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 8 June 2017

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)	(mg/s)
Naphthalene	290000	290	0.29	78	0.078	2100	2.1
2 - Methylanthalene	20000	20	0.02	5.4	0.0054	140	0.14
Acenaphthylene	46000	46	0.046	12	0.012	330	0.33
Acenaphthene	3200	3.2	0.0032	0.86	0.00086	23	0.023
Fluorene	4700	4.7	0.0047	1.3	0.0013	34	0.034
Phenanthrene	34000	34	0.034	9.2	0.0092	250	0.25
Anthracene	260	0.26	0.00026	0.07	0.00007	1.9	0.0019
Fluoranthene	4500	4.5	0.0045	1.2	0.0012	33	0.033
Pyrene	1100	1.1	0.0011	0.3	0.0003	8	0.008
Benz(a)anthracene	38	0.038	0.000038	0.01	0.00001	0.28	0.00028
Chrysene	110	0.11	0.00011	0.03	0.00003	0.8	0.0008
Benzo(b)fluoranthene	55	0.055	0.000055	0.015	0.000015	0.4	0.0004
Benzo(k)fluoranthene	32	0.032	0.000032	0.0086	0.0000086	0.23	0.00023
Benzo(e)pyrene	49	0.049	0.000049	0.013	0.000013	0.36	0.00036
Benzo(a)pyrene	360	0.36	0.00036	0.097	0.000097	2.6	0.0026
Perylene	<20	<0.02	<0.00002	<0.0054	<0.0000054	<0.14	<0.00014
Indeno(123:cd)pyrene	32	0.032	0.000032	0.0086	0.0000086	0.23	0.00023
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0054	<0.0000054	<0.14	<0.00014
Benzo(ghi)perylene	28	0.028	0.000028	0.0076	0.0000076	0.2	0.0002
Sum of reported PAH's	400000	400	0.4	110	0.11	2900	2.9



Appendix A

Field Sheets and Final
Calculations (73 pages)

Appendix A Field Sheets and Final Calculations (73 pages)

Weston Aluminium

AECOM's Project Number: 60539866

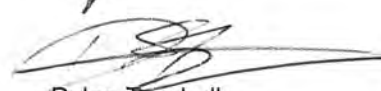
Emission Source: Stack 1

Date Sampled: 8-Jun-17

ANALYTE(S)	METHOD
Fine Particulate (PM10)	NSW EPA OM - 5
Total Particulate	NSW EPA TM - 15
Particulate Fluoride	NSW EPA TM - 9
Gaseous Fluoride	NSW EPA TM - 9

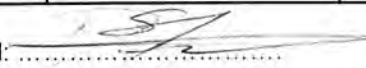
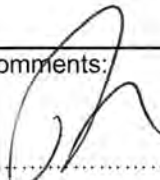
Observations made during testing period:

Sampling Performed By:


James Lang
Dylan Turnbull

STACK ANALYSIS - PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Fine Particulate (PM10)
 Test 2: Total Particulate
 Test 3: Particulate Fluoride
 Test 4: Gaseous Fluoride

Measurement/Observations				
Stack Internal Dimensions:				
Diameter	1650 mm	Cross Sectional Area :		2.14 m ²
OR	Length Width			
Length/Width (mm)		Minimum No. of		
Equivalent Diameter	N/A mm	sampling points=		16
Distance from sampling plane to nearest disturbances:		Total No. of sampling points = 20		
		PM2.5/10= 12		
Upstream (m) =	4	No. of sampling traverses/ports		
No. Diameters =	2.4	sampled =		2
Type of Upstream Disturbance:	Fan	PM2.5/10=		2
Downstream (m) =	6	No. of sampling points on each		
No. Diameters =	3.6	traverse/port =		10
Type of Down Stream Disturbance:	Stack Exit			
Position of each sampling point, for each traverse:		Exclusion of any sample point numbers - comments:		
	A	B	PM10/2.5 A	PM2.5/10 B
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	111	81	73	43
2	195	165	241	211
3	292	262	488	458
4	413	383	1162	1132
5	584	554	1409	1379
6	1066	1036	1577	1547
7	1238	1208		
8	1358	1328		
9	1455	1425		
10	1539	1509	Check of total points against minimum, (yes/no) - comments:	
11				
12				
13				
14				
15				
16				
17				
18				
19			General Comments:	
20				
Signed: 		Checked: 		

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Fine Particulate (PM10)
 Test 2: Total Particulate
 Test 3: Particulate Fluoride
 Test 4: Gaseous Fluoride

Sampling time start: 10:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	10:30	1	20.3	0.3
2	10:31	1	20.3	0.3
3	10:32	1	20.3	0.3
4	10:33	1	20.3	0.3
5	10:34	1	20.3	0.3
6	10:35	1	20.3	0.3
7	10:36	1	20.3	0.3
8	10:37	1	20.3	0.3
Averages:		1.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 2.00 %

Measurements

CO: 0.0001 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0001 %,(wet)	N ₂ : 77.8 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 19.9 %,(wet)
H ₂ O: 2.00 % (=M2)	
Therefore, stack gas density (GD) = 1.28 kg/m ³ (0°C, wet, 1 atm pressure)	
Therefore, stack gas density (GD) = 1.29 kg/m ³ (0°C, dry, 1 atm pressure)	

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Fine Particulate (PM10)
 Test 2: Total Particulate
 Test 3: Particulate Fluoride
 Test 4: Gaseous Fluoride

Sampling time start: 12:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	12:45	7	20.8	0.1
2	12:46	7	20.8	0.1
3	12:47	7	20.8	0.1
4	12:48	7	20.8	0.1
5	12:49	7	20.8	0.1
6	12:50	7	20.8	0.1
7	12:51	7	20.8	0.1
8	12:52	7	20.8	0.1
Averages:		7.0 ppm	20.8 %	0.1 %

Moisture content (M3): 0.97
 Moisture percentage (M2): 2.65 %

Measurements

CO: 0.0007 %,(dry)	N ₂ : 79.1 %,(dry)
CO ₂ : 0.1 %,(dry)	O ₂ : 20.8 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0007 %,(wet)	N ₂ : 77.0 %,(wet)
CO ₂ : 0.1 %,(wet)	O ₂ : 20.2 %,(wet)
H ₂ O: 2.65 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

**Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses
Fine Particulates**

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Fine Particulate (PM10)

Time :		12:45	Barometric Pressure :		1020 hPa
Page No. :		1 of 1	Pitot Correction Factor :		0.84
Sampling Port No:		1 to 2	Stack Gas Density:		1.28 kg/m ³
Pitot Tube Type :		S	(0 °C, Wet, 1 Atm)		
Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	43	0.161	53.0	326.2	14.5
1/2	211	0.168	53.0	326.2	14.8
1/3	458	0.138	53.0	326.2	13.5
1/4	1132	0.149	53.0	326.2	14.0
1/5	1379	0.130	53.0	326.2	13.1
1/6	1547	0.170	53.0	326.2	14.9
2/1	43	0.194	53.0	326.2	16.0
2/2	211	0.200	53.0	326.2	16.2
2/3	458	0.183	53.0	326.2	15.5
2/4	1132	0.153	53.0	326.2	14.2
2/5	1379	0.139	53.0	326.2	13.5
2/6	1547	0.146	53.0	326.2	13.8
Average			53.0	326.2	14.5

Static Pressure (Dwyer) (Pa): kPa
 Static Pressure (U-tube, if required) : 7 mm
 Absolute pressure in stack (hPa) : 1021.02 hPa

STACK ANALYSIS - PM10 CALCULATIONS

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

1. Gas Analysis

%CO ₂	0.1		
%O ₂	20.8		
%N ₂ +%CO	79.4		
Fraction Moisture Content, Bws	0.03	M _s =	0.97

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.86
Mol. Wt. of Stack Gas (wet)	28.64

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	102000	30.11
Stack Static Pressure (Pg)	102069	30.13
Absolute Stack Pressure		30.13

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	53.0	127.4
Average Meter Temperature:	25.6	
Stack Gas Viscosity		194.5

5. Cyclone Flow Rate

	ft ³ /min	m ³ /min	L/min	L/s
Cyclone Flow Rate	0.49	0.0174	17.40	0.29

6. Nozzle Velocity, Rmin and Rmax

Nozzle Number	Nozzle Diameter (inches)	Nozzle Velocity		Rmin [-]	Rmax [-]	Vmin ft/sec	Vmin m/s	Vmax ft/sec	Vmax m/s
		ft/sec	m/s						
0	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
1	0.134	84.01	27.65	0.757	1.230	63.57	20.86	103.34	33.90
2	0.154	63.85	21.02	0.733	1.245	46.81	15.36	79.49	26.08
3	0.165	55.06	18.12	0.715	1.256	39.36	12.91	69.13	22.68
4	0.197	38.85	12.79	0.646	1.292	25.11	8.24	50.18	16.46
5	0.220	30.97	10.19	0.564	1.326	17.45	5.73	41.07	13.47
6	0.236	26.98	8.88	0.477	1.353	13.49	4.43	36.49	11.97
7	0.260	22.30	7.34	#NUM!	1.398	#NUM!	#NUM!	31.16	10.22
8	0.299	16.81	5.53	#NUM!	1.487	6.41	2.76	25.00	8.20
9	0.339	13.13	4.32	#NUM!	1.593	6.57	2.15	19.70	6.46
10	0.390	9.91	3.26	#NUM!	1.753	4.95	1.63	14.86	4.88
11	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Nozzle Diameter	Nozzle Diameter	Nozzle Area	Sample Rate					
Selected Nozzle	(inches)	(m)	(m ²)	(L/min)					
3	0.165	0.004	0.000014	13.2					

STACK ANALYSIS - FINAL CALCULATIONS

Fine Particulate (PM10)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 1.3479 m³ Average barometric pressure (P_{BARO}) 1020 hPa
 Average gas meter temp. (T_{M,2}): 25.6 °C
 298.8 K Average pressure at meter (P_{M,2}) 1020.00 hPa

Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.2406 m³

(B) PM10 concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: T509 PM10 Weight: 0.0046 g
 Final PM10 Weight (Mp1): 0.00460 g
 PM10 Concentration (C1): =M_{p1}/MV₄= 0.0037 g/m³ (0°C, dry gas, 1atm pressure)
 ;and C₂ = 3.7 mg/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 %
 Average CO₂ %: 0.2 %

Therefore, C_c: = C_a x 12/CO₂% = 0.22 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 220 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.6 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) = 0.12 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 120 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: M301
 V_v = 11 g (from laboratory report) V_w = 15 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0200
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0147

Therefore, B_{ws} =
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

B_{ws} = 2.72 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Fine Particulate (PM10)

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.29 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions = $(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
 = 1.109 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.67 m/s
 - (ii) Average of post-sampling velocities: 14.50 m/s
 - (iii) Average of while-sampling velocities: N/A m/s
 - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 14.58 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)
- (Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

$$Q_{stack} = V_s \times A = 31.18 \text{ m}^3/\text{s (stack conditions)}$$

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

$$Q_{std} = 26.1 \text{ m}^3/\text{s (0°C, dry gas, 1 atm pressure)}$$

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = 0.096 \text{ g/s (0°C, dry gas, 1 atm pressure)}$$

$$= 96 \text{ mg/s (0°C, dry gas, 1 atm pressure)}$$

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 1.6178 m³ Average barometric pressure (P_{BARO}) 1020 hPa
 Average gas meter temp. (T_{M,2}): 33.2 °C
 306.4 K Average pressure at meter (P_{M,2}) 1020.00 hPa

Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.4521 m³

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: T510 Total Particulate Weight 0.0126 g
 Final Total Particulate Weight (Mp1): 0.01260 g
 Total Particulate Concentration (C1): =M_{p1}/MV₄= 0.0087 g/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 % ;and C₂ = 8.7 mg/m³ (0°C, dry gas, 1atm pressure)
 Average CO₂%; 0.2 %

Therefore, C_c: = C_a x 12/CO₂% = 0.52 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 520 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂%; 20.6 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) 0.27 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 270 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: Z8
 V_v = 8.4 g (from laboratory report) V_w = 18 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0240
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0112

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 2.37 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.28 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =

$$(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$$

= 1.085 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.75 m/s
- (ii) Average of post-sampling velocities: 14.91 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 14.83 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q_{stack} = V_s x A = 31.71 m³/s (stack conditions)

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

Q_{std} = 26.2 m³/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R_m = C_{1a} x Q_{std} = 0.23 g/s (0°C, dry gas, 1 atm pressure)

= 230 mg/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Particulate Fluoride

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 1.1718 m³ Average barometric pressure (P_{BARO}) 1020 hPa
 Average gas meter temp. (T_{M,2}): 28.6 °C
 301.8 K Average pressure at meter (P_{M,2}) 1020.00 hPa
 Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.0678 m³

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: NA Particulate Fluoride Weight 0.000401 g
 Final Particulate Fluoride Weight (Mp1): 0.00040 g
 Particulate Fluoride Concentration (C1): =M_{p1}/MV₄= 0.00038 g/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 % ;and C₂ = 0.38 mg/m³ (0°C, dry gas, 1atm pressure)
 Average CO₂ %: 0.2 %

Therefore, C_c: = C_a x 12/CO₂% = 0.023 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 23 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.6 %

Therefore, C_b: =C_a x (21 - O_{2rel}%)/(21 - O_{2mea}%) 0.012 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 12 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G57
 V_v = 13.6 g (from laboratory report) V_w = 10 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0133
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0182

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 2.86 %

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Particulate Fluoride

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling:	1.28 kg/m ³ (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.29 kg/m ³ (0°C, wet, 1 atm pressure) 1.29 kg/m ³ (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.094 kg/m ³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	14.75 m/s
(ii) Average of post-sampling velocities:	14.91 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.83 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)
(Note: (Vs) is from all individual data, not from (i) and (ii) alone.)	

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

$$Q_{stack} = V_s \times A = 31.71 \text{ m}^3/\text{s (stack conditions)}$$

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

$$Q_{std} = 26.1 \text{ m}^3/\text{s (0°C, dry gas, 1 atm pressure)}$$

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = 0.0099 \text{ g/s (0°C, dry gas, 1 atm pressure)}$$

$$= 9.9 \text{ mg/s (0°C, dry gas, 1 atm pressure)}$$

STACK ANALYSIS - FINAL CALCULATIONS

Gaseous Fluoride

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	1.1718 m ³	Average barometric pressure (P _{BARO}):	1020 hPa
Average gas meter temp. (T _{M,2}):	28.6 °C	Average pressure at meter (P _{M,2}):	1020.00 hPa
	301.8 K		
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	1.0678 m ³		

(B) Gaseous Fluoride concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Gaseous Fluoride Weight:	0.00003 g
Final Gaseous Fluoride Weight (Mp1):	0.00003 g		
Gaseous Fluoride Concentration (C1):	=M _{p1} /MV ₄ =	0.000028 g/m ³ (0°C, dry gas, 1atm pressure)	

CO₂ Basis 12 % ;and C₂ = 0.028 mg/m³ (0°C, dry gas, 1atm pressure)

Average CO₂%: 0.2 %

Therefore, C_c: = C_a x 12/CO₂% = 0.0017 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 1.7 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %

Average O₂%: 20.6 %

Therefore, C_b: = C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) = 0.00087 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 0.87 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number:	G57		
V _v =	13.6 g (from laboratory report)	V _w =	10 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V _{wc(std)}) =	0.0133		
Volume of Water Vapour Condensed (V _{wsg(std)}) =	0.0182		

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 2.86 %

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Emission Measurement Calculations Spreadsheet

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STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Gaseous Fluoride

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.29 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =

$$(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$$

= 1.094 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.75 m/s
- (ii) Average of post-sampling velocities: 14.91 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 14.83 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

$$Q_{stack} = V_s \times A = 31.71 \text{ m}^3/\text{s (stack conditions)}$$

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

$$Q_{std} = 26.1 \text{ m}^3/\text{s (0°C, dry gas, 1 atm pressure)}$$

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = 0.00073 \text{ g/s (0°C, dry gas, 1 atm pressure)}$$

$$= 0.73 \text{ mg/s (0°C, dry gas, 1 atm pressure)}$$

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 8-Jun-17 FINE PARTICULATE (PM10) TOTAL PARTICULATE PARTICULATE FLUORIDE GASEOUS FLUORIDE		
Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	50.0 °C	323.2 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26 m ³ /s	
Fine Particulate (PM10) Testing		
Test Period	10:55	- 12:37
Fine Particulate (PM10) Mass	4.6 mg	
Gas Volume Sampled	1.24 m ³	
Fine Particulate (PM10) Emission*1	3.7 mg/m ³	
Fine Particulate (PM10) Mass Emission Rate*2	96 mg/s	
Regulatory Limit	NA mg/m ³	
Total Particulate Testing		
Test Period	10:55	- 12:37
Total Particulate Mass	12.6 mg	
Gas Volume Sampled	1.45 m ³	
Total Particulate Emission*1	8.7 mg/m ³	
Total Particulate Mass Emission Rate*2	230 mg/s	
Regulatory Limit	25 mg/m ³	
Particulate Fluoride Testing		
Test Period	10:55	- 12:37
Particulate Fluoride Mass	0.401 mg	
Gas Volume Sampled	1.07 m ³	
Particulate Fluoride Emission*1	0.38 mg/m ³	
Particulate Fluoride Mass Emission Rate*2	9.9 mg/s	
Regulatory Limit	NA mg/m ³	
Gaseous Fluoride Testing		
Test Period	10:55	- 12:37
Gaseous Fluoride Mass	0.03 mg	
Gas Volume Sampled	1.07 m ³	
Gaseous Fluoride Emission*1	0.028 mg/m ³	
Gaseous Fluoride Mass Emission Rate*2	0.73 mg/s	
Regulatory Limit	2 mg/m ³	
Moisture Content (%)	2.7	
Gas Density (dry at 1 atmosphere)	1.29 kg/m ³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Weston Aluminium

AECOM's Project Number: 60539866

Emission Source: Stack 1

Date Sampled: 8-Jun-17

ANALYTE(S)**METHOD**

Cyanide

USEPA OTM - 29

Hydrogen Chloride

NSW EPA TM - 7 & 8

Chlorine

NSW EPA TM - 7 & 8

Observations made during testing period:

Sampling Performed By:



James Lang



Dylan Turnbull

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Cyanide
 Test 2: Hydrogen Chloride
 Test 3: Chlorine

Sampling time start: 12:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	12:45	7	20.8	0.1
2	12:46	7	20.8	0.1
3	12:47	7	20.8	0.1
4	12:48	7	20.8	0.1
5	12:49	7	20.8	0.1
6	12:50	7	20.8	0.1
7	12:51	7	20.8	0.1
8	12:52	7	20.8	0.1
Averages:		7.0 ppm	20.8 %	0.1 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 2.00 %

Measurements

CO: 0.0007 %,(dry)	N ₂ : 79.1 %,(dry)
CO ₂ : 0.1 %,(dry)	O ₂ : 20.8 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0007 %,(wet)	N ₂ : 77.5 %,(wet)
CO ₂ : 0.1 %,(wet)	O ₂ : 20.4 %,(wet)
H ₂ O: 2.00 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Cyanide
 Test 2: Hydrogen Chloride
 Test 3: Chlorine

Sampling time start: 14:40		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	14:40	18	20.3	0.3
2	14:41	18	20.3	0.3
3	14:42	18	20.3	0.3
4	14:43	18	20.3	0.3
5	14:44	18	20.3	0.3
6	14:45	18	20.3	0.3
7	14:46	18	20.3	0.3
8	14:47	18	20.3	0.3
Averages:		18.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 2.43 %

Measurements

CO: 0.0018 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0018 %,(wet)	N ₂ : 77.5 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 19.8 %,(wet)
H ₂ O: 2.43 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Cyanide

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	1.9923 m ³	Average barometric pressure (P _{BARO}):	1020 hPa
Average gas meter temp. (T _{M,2}):	26.9 °C	Average pressure at meter (P _{M,2}):	1020.00 hPa
	300.1 K		
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	1.8258 m ³		

(B) Cyanide concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Cyanide Weight:	0.0007 g
Final Cyanide Weight (Mp1):	0.00070 g		
Cyanide Concentration (C1):	=M _{p1} /MV ₄ =	0.00038 g/m ³ (0°C, dry gas, 1atm pressure)	

		;and C ₂ =	0.38 mg/m ³ (0°C, dry gas, 1atm pressure)
CO ₂ Basis	12 %		
Average CO ₂ %:	0.2 %		

Therefore, C _c :	= C _a x 12/CO ₂ % =	0.023 g/m ³ (0°C, dry gas, 1atm pressure, 12% CO ₂)
	;and C _{c1} =	23 mg/m ³ (0°C, dry gas, 1atm pressure, 12% CO ₂)

O ₂ Basis	7 %
Average O ₂ %:	20.6 %

Therefore, C _b :	=C _a x (21 - O _{2ref} %)/(21 - O _{2mea} %)	0.012 g/m ³ (0°C, dry gas, 1atm pressure, 7% O ₂)
	;and C _{b1} =	12 mg/m ³ (0°C, dry gas, 1atm pressure, 7% O ₂)

(C) Moisture content

Silica Gel Number:	z7		
V _v =	6 g (from laboratory report)	V _w =	10 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V _{wc(std)}) =	0.0133		
Volume of Water Vapour Condensed (V _{wsg(std)}) =	0.0080		

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 1.16 %

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Cyanide

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling:	1.28 kg/m ³ (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.27 kg/m ³ (0°C, wet, 1 atm pressure) 1.29 kg/m ³ (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.070 kg/m ³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	14.90 m/s
(ii) Average of post-sampling velocities:	14.92 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.91 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack =	Vs x A =	31.88 m ³ /s (stack conditions)
Qstd =	Qstack x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Qstd =	26.5 m ³ /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

Rm =	C _{1a} x Qstd =	0.01 g/s (0°C, dry gas, 1 atm pressure)
=	=	10 mg/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Hydrogen Chloride

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	1.4681 m ³	Average barometric pressure (P _{BARO}):	1020 hPa
Average gas meter temp. (T _{M,2}):	35.8 °C	Average pressure at meter (P _{M,2}):	1020.00 hPa
	309.0 K		
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	1.3067 m ³		

(B) Hydrogen Chloride concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Hydrogen Chloride Weight:	<0.01 g
Final Hydrogen Chloride Weight (Mp1):	<0.01 g		
Hydrogen Chloride Concentration (C1):	=M _{p1} /MV ₄ =		<0.0077 g/m ³ (0°C, dry gas, 1atm pressure)
		and C ₂ =	<7.7 mg/m ³ (0°C, dry gas, 1atm pressure)
CO ₂ Basis	12 %		
Average CO ₂ %:	0.2 %		

Therefore, C _c :	= C _a x 12/CO ₂ % =	<0.46 g/m ³ (0°C, dry gas, 1atm pressure, 12% CO ₂)
		and C _{c1} =
		<460 mg/m ³ (0°C, dry gas, 1atm pressure, 12% CO ₂)
O ₂ Basis	7 %	
Average O ₂ %:	20.6 %	
Therefore, C _b :	=C _a x (21 - O _{2ref} %)/(21 - O _{2mea} %)	<0.24 g/m ³ (0°C, dry gas, 1atm pressure, 7% O ₂)
		and C _{b1} =
		<240 mg/m ³ (0°C, dry gas, 1atm pressure, 7% O ₂)

(C) Moisture content

Silica Gel Number:	Z2	
V _v =	15.3 g (from laboratory report)	V _w =
Volume of Water Vapour Condensed (V _{wc(std)}) =	0.0213	16 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V _{wsg(std)}) =	0.0204	
Therefore, B _{ws} =	$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$	
B _{ws} =	3.10 %	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Hydrogen Chloride

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.29 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =

$$(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$$

= 1.086 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.90 m/s
- (ii) Average of post-sampling velocities: 14.92 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 14.91 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

$$Q_{stack} = V_s \times A = 31.88 \text{ m}^3/\text{s (stack conditions)}$$

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

$$Q_{std} = 26.0 \text{ m}^3/\text{s (0°C, dry gas, 1 atm pressure)}$$

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = <0.2 \text{ g/s (0°C, dry gas, 1 atm pressure) })$$

$$= <200 \text{ mg/s (0°C, dry gas, 1 atm pressure) })$$

STACK ANALYSIS - FINAL CALCULATIONS

Chlorine

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	1,4681 m ³	Average barometric pressure (P _{BARO})	1020 hPa
Average gas meter temp. (T _{M,2}):	28.6 °C	Average pressure at meter (P _{M,2})	1020.00 hPa
	301.8 K		
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	1.3378 m ³		

(B) Chlorine concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Chlorine Weight	0.0146 g
Final Chlorine Weight (Mp1):	0.01460 g		
Chlorine Concentration (C1):	=M _{p1} /MV ₄ =	0.011 g/m ³ (0°C, dry gas, 1atm pressure)	

;and C₂ = 11 mg/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 %
 Average CO₂%; 0.2 %

Therefore, C_c: = C_a x 12/CO₂% = 0.66 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 660 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂%; 20.6 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) = 0.34 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 340 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: Z2
 V_v = 15.3 g (from laboratory report) V_w = 16 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0213
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0204

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 3.03 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Chlorine

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.29 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =

$$(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$$

= 1.086 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.90 m/s
- (ii) Average of post-sampling velocities: 14.92 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 14.91 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q_{stack} = V_s x A = 31.88 m³/s (stack conditions)

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

Q_{std} = 26.0 m³/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = 0.29 \text{ g/s (0°C, dry gas, 1 atm pressure) } \\ = 290 \text{ mg/s (0°C, dry gas, 1 atm pressure) }$$

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 8-Jun-17 CYANIDE HYDROGEN CHLORIDE CHLORINE		
Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	53.6 °C	326.8 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26 m ³ /s	
Cyanide Testing		
Test Period	12:55	- 14:37
Cyanide Mass	0.7 mg	
Gas Volume Sampled	1.83 m ³	
Cyanide Emission*1	0.38 mg/m ³	
Cyanide Mass Emission Rate*2	10 mg/s	
Regulatory Limit	0.5 mg/m ³	
Hydrogen Chloride Testing		
Test Period	12:55	- 14:37
Hydrogen Chloride Mass	<10 mg	
Gas Volume Sampled	1.31 m ³	
Hydrogen Chloride Emission*1	<7.7 mg/m ³	
Hydrogen Chloride Mass Emission Rate*2	<200 mg/s	
Regulatory Limit	400 mg/m ³	
Chlorine Testing		
Test Period	12:55	- 14:37
Chlorine Mass	14.6 mg	
Gas Volume Sampled	1.34 m ³	
Chlorine Emission*1	11 mg/m ³	
Chlorine Mass Emission Rate*2	290 mg/s	
Regulatory Limit	NA mg/m ³	
Moisture Content (%)	2.4	
Gas Density (dry at 1 atmosphere)	1.29 kg/m ³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Emission Measurement Calculations Spreadsheet**Weston Aluminium**

AECOM's Project Number: 60539866



Emission Source: Stack 1

Date Sampled: 8-Jun-17

ANALYTE(S)	METHOD
Hazardous Substances (Metals)	NSW EPA TM - 12, 13 & 14
Sulfuric Acid Mist	NSW EPA TM - 3
Sulfur Dioxide	NSW EPA TM - 4

Observations made during testing period:

Sampling Performed By:


James Lang
Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Hazardous Substances (Metals)
 Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
 Test 3: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 8:20		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	8:20	58	20.3	0.3
2	8:21	58	20.3	0.3
3	8:22	58	20.3	0.3
4	8:23	58	20.3	0.3
5	8:24	58	20.3	0.3
6	8:25	58	20.3	0.3
7	8:26	58	20.3	0.3
8	8:27	58	20.3	0.3
Averages:		58.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 2.00 %

Measurements

CO: 0.0058 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0057 %,(wet)	N ₂ : 77.8 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 19.9 %,(wet)
H ₂ O: 2.00 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Hazardous Substances (Metals)
 Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
 Test 3: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 10:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	10:30	1	20.3	0.3
2	10:31	1	20.3	0.3
3	10:32	1	20.3	0.3
4	10:33	1	20.3	0.3
5	10:34	1	20.3	0.3
6	10:35	1	20.3	0.3
7	10:36	1	20.3	0.3
8	10:37	1	20.3	0.3
Averages:		1.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 1.60 %

Measurements

CO: 0.0001 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0001 %,(wet)	N ₂ : 78.1 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 20.0 %,(wet)
H ₂ O: 1.60 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

Metal	Particulate Metals Results	Gaseous Metals Results	Oxidisable Mercury Results		
	Front Half, Filter, Acetone Rinses and Acid Rinses (mg). Containers 1, 2 and 3	Back Half, Impingers + Acid Rinses (mg) Container 4	KO Impinger + Acid Rinses (mg) (5A)	KMnO ₄ /H ₂ SO ₄ + Rinses (mg) (5B)	Residue Rinse 8N HCl (mg) (If Required) (5C)
Antimony	<0.0002	<0.0001			
Arsenic	0.0001	<0.0001			
Beryllium	<0.0002	0.000047			
Cadmium	0.035	0.0013			
Chromium	0.027	0.0013			
Cobalt	<0.0002	<0.0001			
Copper	0.002	0.00025			
Lead	0.0011	0.00095			
Magnesium	<0.124	0.0033			
Manganese	0.0052	<0.0016			
Mercury	<0.0001	0.00049	<0.0001	<0.0001	<0.0001
Nickel	0.0083	0.00095			
Selenium	0.0047	0.00025			
Thallium	<0.0002	<0.0001			
Tin	0.0004	0.00015			
Vanadium	<0.0088	<0.0057			
Zinc	0.92	0.014			

Note: Where the blank has returned a less than value, half of this value was subtracted from the sample result as a blank correction ie for a blank value of <0.0005, 0.00025 was subtracted from the sample result.

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

Stack Analysis - Hazardous Substances Elemental Analysis Results Continued

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m ³)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m ³)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m ³)	Total (mg)	Total (mg/m ³)	Mass Emission Rate (mg/s)
Antimony	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Arsenic	0.0001	0.000077	<0.0001	<0.000077			0.0001	0.000077	0.0021
Beryllium	<0.0002	<0.00015	0.000047	0.000036			0.000047	0.000036	0.00097
Cadmium	0.035	0.027	0.0013	0.001			0.04	0.031	0.84
Chromium	0.027	0.021	0.0013	0.001			0.03	0.023	0.62
Cobalt	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Copper	0.002	0.0015	0.00025	0.00019			0.002	0.0015	0.04
Lead	0.0011	0.00085	0.00095	0.00073			0.002	0.0015	0.04
Magnesium	<0.124	<0.096	0.0033	0.0025			0.0033	0.0025	0.067
Manganese	0.0052	0.004	<0.0016	<0.0012			0.0052	0.004	0.11
Mercury	<0.0001	<0.000077	0.00049	0.00038	<0.0001	<0.000077	0.00049	0.00038	0.01
Nickel	0.0083	0.0064	0.00095	0.00073			0.009	0.0069	0.19
Selenium	0.0047	0.0036	0.00025	0.00019			0.005	0.0039	0.11
Thallium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.004
Tin	0.0004	0.00031	0.00015	0.00012			0.0006	0.00046	0.012
Vanadium	<0.0088	<0.0068	<0.0057	<0.0044			<0.0002	<0.00015	<0.004
Zinc	0.92	0.71	0.014	0.011			0.9	0.69	19
Total Hazardous Metals*	0.081	0.063	0.0053	0.0041	<0.0001	<0.000077	0.092	0.071	1.9
Total Metals	1	0.77	0.023	0.018			1	0.77	21

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

STACK ANALYSIS - FINAL CALCULATIONS

Hazardous Substances (Metals)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	1.3850 m ³	Average barometric pressure (P _{BARO}):	1020 hPa
Average gas meter temp. (T _{M,2}):	20.2 °C	Average pressure at meter (P _{M,2}):	1020.00 hPa
	293.4 K		

Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.2982 m³

(B) Metals concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Metals Weight:	0.000092 g
Final Metals Weight (Mp1):	0.00009 g		
Metals Concentration (C1):	=M _{p1} /MV ₄ =	0.000071 g/m ³ (0°C, dry gas, 1atm pressure)	
		and C ₂ =	0.071 mg/m ³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 %
 Average CO₂ %: 0.3 %

Therefore, C_c: = C_a x 12/CO₂% = 0.0028 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 2.8 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.3 %

Therefore, C_b: = C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) = 0.0014 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 1.4 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: Z14
 V_v = 15.5 g (from laboratory report) V_w = 10 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0133
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0207

Therefore, B_{ws} =
$$\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$$

B_{ws} = 2.55 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Hazardous Substances (Metals)

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling:	1.28 kg/m ³ (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.28 kg/m ³ (0°C, wet, 1 atm pressure) 1.29 kg/m ³ (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.106 kg/m ³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	15.28 m/s
(ii) Average of post-sampling velocities:	14.72 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	15.00 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q _{stack} =	V _s x A =	32.07 m ³ /s (stack conditions)
Q _{std} =	Q _{stack} x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Q _{std} =	27.0 m ³ /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

R _m =	C _{1a} x Q _{std} =	0.0019	g/s (0°C, dry gas, 1 atm pressure)
	=	1.9	mg/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Sulfuric Acid Mist (H2SO4 as SO3)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 1.3512 m³ Average barometric pressure (P_{BARO}) 1020 hPa
 Average gas meter temp. (T_{M,2}): 24.7 °C
 297.9 K Average pressure at meter (P_{M,2}) 1020.00 hPa
 Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.2474 m³

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: 0 H2SO4 as SO3 Weight <0.002 g
 Final H2SO4 as SO3 Weight (Mp1): <0.002 g
 H2SO4 as SO3 Concentration (C1): =M_{p1}/MV₄= <0.0016 g/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 % ;and C₂ = <1.6 mg/m³ (0°C, dry gas, 1atm pressure)
 Average CO₂ %: 0.3 %

Therefore, C_c: = C_a x 12/CO₂% = <0.064 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = <64 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.3 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) = <0.032 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = <32 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G030
 V_v = 44.6 g (from laboratory report) V_w = -34 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = -0.0453
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0595

Therefore, B_{ws} =
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

B_{ws} = 1.13 %

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Emission Measurement Calculations Spreadsheet

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STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Sulfuric Acid Mist (H₂SO₄ as SO₃)

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.27 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =

$$(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$$

= 1.097 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 15.28 m/s
- (ii) Average of post-sampling velocities: 14.72 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 15.00 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

$$Q_{stack} = V_s \times A = 32.07 \text{ m}^3/\text{s (stack conditions)}$$

$$Q_{std} = Q_{stack} \times \frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

$$Q_{std} = 27.4 \text{ m}^3/\text{s (0°C, dry gas, 1 atm pressure)}$$

(G) Mass Emission Rate

$$R_m = C_{1a} \times Q_{std} = <0.044 \text{ g/s (0°C, dry gas, 1 atm pressure))}$$

$$= <44 \text{ mg/s (0°C, dry gas, 1 atm pressure))}$$

STACK ANALYSIS - FINAL CALCULATIONS

Sulfur Dioxide (SO₂ as SO₃)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 1.3512 m³ Average barometric pressure (P_{BARO}) 1020 hPa
 Average gas meter temp. (T_{M,2}): 24.7 °C
 297.9 K Average pressure at meter (P_{M,2}) 1020.00 hPa
 Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 1.2474 m³

(B) SO₂ as SO₃ concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: 0 SO₂ as SO₃ Weight: <0.01 g
 Final SO₂ as SO₃ Weight (Mp₁): <0.01 g
 SO₂ as SO₃ Concentration (C₁): =M_{p1}/MV₄= <0.008 g/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 % ;and C₂ = <8 mg/m³ (0°C, dry gas, 1atm pressure)
 Average CO₂ %: 0.3 %

Therefore, C_c: = C_a x 12/CO₂% = <0.32 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = <320 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.3 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) <0.16 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = <160 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G030
 V_v = 44.6 g (from laboratory report) V_w = -34 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = -0.0453
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0595

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 1.13 %

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Sulfur Dioxide (SO₂ as SO₃)

(D) Gas Composition and Density (Re-calculation)

- (i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
 - 1.27 kg/m³ (0°C, wet, 1 atm pressure)
 - 1.29 kg/m³ (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions = $(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
 = 1.097 kg/m³ (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 15.28 m/s
 - (ii) Average of post-sampling velocities: 14.72 m/s
 - (iii) Average of while-sampling velocities: N/A m/s
 - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 - 15.00 m/s (stack conditions, wet)
 - N/A m/s (stack conditions, wet)
- (Note:** (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q_{stack} = V_s x A = 32.07 m³/s (stack conditions)

$$Q_{std} = Q_{stack} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$$

Q_{std} = 27.4 m³/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R_m = C_{1a} x Q_{std} = <0.22 g/s (0°C, dry gas, 1 atm pressure)
 = <220 mg/s (0°C, dry gas, 1 atm pressure)

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 8-Jun-17 HAZARDOUS SUBSTANCES (METALS) SULFURIC ACID MIST (H2SO4 AS SO3) SULFUR DIOXIDE (SO2 AS SO3)		
Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	45.5 °C	318.7 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	27 m ³ /s	
Hazardous Substances (Metals) Testing		
Test Period	8:50	- 10:33
Hazardous Substances (Metals) Mass	0.092 mg	
Gas Volume Sampled	1.3 m ³	
Hazardous Substances (Metals) Emission*1	0.071 mg/m ³	
Hazardous Substances (Metals) Mass Emission Rate*2	1.9 mg/s	
Regulatory Limit	10 mg/m ³	
Sulfuric Acid Mist (H2SO4 as SO3) Testing		
Test Period	8:50	- 10:33
Sulfuric Acid Mist (H2SO4 as SO3) Mass	<2 mg	
Gas Volume Sampled	1.25 m ³	
Sulfuric Acid Mist (H2SO4 as SO3) Emission*1	<1.6 mg/m ³	
Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2	<44 mg/s	
Regulatory Limit	100 mg/m ³	
Sulfur Dioxide (SO2 as SO3) Testing		
Test Period	8:50	- 10:33
Sulfur Dioxide (SO2 as SO3) Mass	<10 mg	
Gas Volume Sampled	1.25 m ³	
Sulfur Dioxide (SO2 as SO3) Emission*1	<8 mg/m ³	
Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2	<220 mg/s	
Regulatory Limit	NA mg/m ³	
Moisture Content (%)	2.6	
Gas Density (dry at 1 atmosphere)	1.29 kg/m ³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Emission Measurement Calculations Spreadsheet**Weston Aluminium**

AECOM's Project Number: 60539866

Emission Source: Stack 1

Date Sampled: 8-Jun-17

ANALYTE(S)	METHOD
Polycyclic Aromatic Hydrocarbons	NSW EPA OM - 6
Dioxins and Furans	NSW EPA TM - 18

Observations made during testing period:

Sampling Performed By:


James Lang
Dylan Turnbull

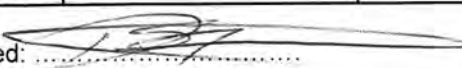
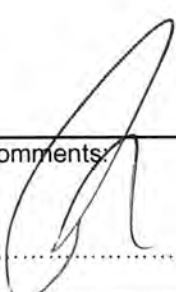
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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Polycyclic Aromatic Hydrocarbons
 Test 2: Dioxins and Furans Lower Bound
 Test 3: Dioxins and Furans Middle Bound

Measurement/Observations				
Stack Internal Dimensions:				
Diameter	1650 mm	Cross Sectional Area :		2.14 m ²
OR	Length Width			
Length/Width (mm)		Minimum No. of		
Equivalent Diameter	N/A mm	sampling points=		16
Distance from sampling plane to nearest disturbances:		Total No. of sampling points = 20		
		PM2.5/10= NA		
Upstream (m) =	4	No. of sampling traverses/ports		
No. Diameters =	2.4	sampled =		2
Type of Upstream Disturbance:	Fan	PM2.5/10=		NA
Downstream (m) =	6	No. of sampling points on each		
No. Diameters =	3.6	traverse/port =		10
Type of Down Stream Disturbance:	Stack Exit			PM2.5/10= NA
Position of each sampling point, for each traverse:		Exclusion of any sample point numbers - comments:		
		A	B	
		PM10/2.5 A	PM2.5/10 B	
No.	Distance from wall	S-type Pitot distances	Distance from wall	S-Type Pitot distances
1	111	81		
2	195	165		
3	292	262		
4	413	383		
5	584	554		
6	1066	1036		
7	1238	1208		
8	1358	1328		
9	1455	1425		
10	1539	1509		
11			Check of total points against minimum, (yes/no) - comments:	
12				
13				
14				
15				
16				
17				
18				
19				
20				
Signed: 		Checked: 		

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Polycyclic Aromatic Hydrocarbons
 Test 2: Dioxins and Furans Lower Bound
 Test 3: Dioxins and Furans Middle Bound

Sampling time start: 8:20		Sampling port No.: 1			
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)	
1	8:20	58	20.3	0.3	
2	8:21	58	20.3	0.3	
3	8:22	58	20.3	0.3	
4	8:23	58	20.3	0.3	
5	8:24	58	20.3	0.3	
6	8:25	58	20.3	0.3	
7	8:26	58	20.3	0.3	
8	8:27	58	20.3	0.3	
Averages:		58.0 ppm	20.3 %	0.3 %	

Moisture content (M3): 0.98
 Moisture percentage (M2): 2.00 %

Measurements

CO: 0.0058 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0057 %,(wet)	N ₂ : 77.8 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 19.9 %,(wet)
H ₂ O: 2.00 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1
 Test 1: Polycyclic Aromatic Hydrocarbons
 Test 2: Dioxins and Furans Lower Bound
 Test 3: Dioxins and Furans Middle Bound

Sampling time start: 14:40		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O ₂ (%), (dry)	CO ₂ (%), (dry)
1	14:40	18	20.3	0.3
2	14:41	18	20.3	0.3
3	14:42	18	20.3	0.3
4	14:43	18	20.3	0.3
5	14:44	18	20.3	0.3
6	14:45	18	20.3	0.3
7	14:46	18	20.3	0.3
8	14:47	18	20.3	0.3
Averages:		18.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
 Moisture percentage (M2): 1.57 %

Measurements

CO: 0.0018 %,(dry)	N ₂ : 79.4 %,(dry)
CO ₂ : 0.3 %,(dry)	O ₂ : 20.3 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0018 %,(wet)	N ₂ : 78.1 %,(wet)
CO ₂ : 0.3 %,(wet)	O ₂ : 20.0 %,(wet)
H ₂ O: 1.57 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m ³ (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m ³ (0°C, dry, 1 atm pressure)

Stack Analysis - Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results

Date: 8-Jun-17
 Client: Weston Aluminium
 AECOM's Project No: 60539866
 Stack/Duct Description: Stack 1

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m ³)	(mg/m ³)	(µg/s)	(mg/s)
Naphthalene	290000	290	0.29	78	0.078	2100	2.1
2 - Methylnaphthalene	20000	20	0.02	5.4	0.0054	140	0.14
Acenaphthylene	46000	46	0.046	12	0.012	330	0.33
Acenaphthene	3200	3.2	0.0032	0.86	0.00086	23	0.023
Fluorene	4700	4.7	0.0047	1.3	0.0013	34	0.034
Phenanthrene	34000	34	0.034	9.2	0.0092	250	0.25
Anthracene	260	0.26	0.00026	0.07	0.00007	1.9	0.0019
Fluoranthene	4500	4.5	0.0045	1.2	0.0012	33	0.033
Pyrene	1100	1.1	0.0011	0.3	0.0003	8	0.008
Benz(a)anthracene	38	0.038	0.000038	0.01	0.00001	0.28	0.00028
Chrysene	110	0.11	0.00011	0.03	0.00003	0.8	0.0008
Benzo(b)fluoranthene	55	0.055	0.000055	0.015	0.000015	0.4	0.0004
Benzo(k)fluoranthene	32	0.032	0.000032	0.0086	0.0000086	0.23	0.00023
Benzo(e)pyrene	49	0.049	0.000049	0.013	0.000013	0.36	0.00036
Benzo(a)pyrene	360	0.36	0.00036	0.097	0.000097	2.6	0.0026
Perylene	<20	<0.02	<0.00002	<0.0054	<0.0000054	<0.14	<0.00014
Indeno(123:cd)pyrene	32	0.032	0.000032	0.0086	0.0000086	0.23	0.00023
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0054	<0.0000054	<0.14	<0.00014
Benzo(ghi)perylene	28	0.028	0.000028	0.0076	0.0000076	0.2	0.0002
Sum of reported PAH's	400000	400	0.4	110	0.11	2900	2.9

60539866 Weston Aluminium Stack 1 Speciated Dioxins and Furans Results					
Analyte	Mass ng	Toxic Equivalency Factor (1 - TEFs)	Total Toxic Equivalence (1 - TEQs) ng	Concentration ng/m ³	Total Toxic Equivalence (1-TEQs) ng/m ³
2,3,7,8-TCDF	<0.002	0.1	0.0001	<0.00054	0.000027
Total TCDF isomers	0.015				
2,3,7,8-TCDD	<0.001	1	0.0005	<0.00027	0.00013
Total TCDD isomers	<0.0007				
1,2,3,7,8-PeCDF	<0.001	0.05	0.000025	<0.00027	0.0000067
2,3,4,7,8-PeCDF	<0.0002	0.5	0.00005	<0.000054	0.000013
Total PeCDF isomers	<0.004				
1,2,3,7,8-PeCDD	<0.0003	0.5	0.000075	<0.000081	0.00002
Total PeCDD isomers	<0.002				
1,2,3,4,7,8-HxCDF	<0.0003	0.1	0.000015	<0.000081	0.000004
1,2,3,6,7,8-HxCDF	<0.0003	0.1	0.000015	<0.000081	0.000004
2,3,4,6,7,8-HxCDF	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,7,8,9-HxCDF	<0.0002	0.1	0.00001	<0.000054	0.0000027
Total HxCDF isomers	<0.002				
1,2,3,4,7,8-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,6,7,8-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
1,2,3,7,8,9-HxCDD	<0.0002	0.1	0.00001	<0.000054	0.0000027
Total HxCDD isomers	<0.002				
1,2,3,4,6,7,8-HpCDF	<0.0007	0.01	0.0000035	<0.00019	0.00000094
1,2,3,4,7,8,9-HpCDF	<0.0004	0.01	0.000002	<0.00011	0.00000054
Total HpCDF isomers	<0.002				
1,2,3,4,6,7,8-HpCDD	<0.0009	0.01	0.0000045	<0.00024	0.0000012
Total HpCDD isomers	<0.002				
OCDF	0.0013	0.001	0.0000013	0.00035	0.00000035
OCDD	0.0061	0.001	0.0000061	0.0016	0.0000016

I-TEQ_{DF}

Lower Bound (excluding LOD Values)

0.0000074 ng

Middle Bound (including half LOD Values)

0.00085 ng

Date Tested

8-Jun-17

STACK ANALYSIS - FINAL CALCULATIONS

Polycyclic Aromatic Hydrocarbons

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV₃): 4.0576 m³ Average barometric pressure (P_{BARO}): 1020 hPa
 Average gas meter temp. (T_{M,2}): 28.0 °C 301.2 K Average pressure at meter (P_{M,2}): 1020.00 hPa
 Sample gas volume (MV₄); (0°C, dry gas, 1 atm pressure): 3.7049 m³

(B) PAH concentration at standard conditions

Blank thimble No.: NA Blank weight: g
 Thimble No. used: AUT050617B PAH Weight: 0.0004 g
 Final PAH Weight (Mp1): 0.00040 g
 PAH Concentration (C1): =M_{p1}/MV₄= 0.00011 g/m³ (0°C, dry gas, 1atm pressure)

CO₂ Basis 12 % ;and C₂ = 0.11 mg/m³ (0°C, dry gas, 1atm pressure)
 Average CO₂%; 0.3 %

Therefore, C_c: = C_a x 12/CO₂% = 0.0044 g/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 4.4 mg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂%; 20.3 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) 0.0022 g/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 2.2 mg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G064
 V_v = 24.4 g (from laboratory report) V_w = 20 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0267
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0326

Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B_{ws} = 1.57 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Polycyclic Aromatic Hydrocarbons

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling:	1.28 kg/m ³ (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.28 kg/m ³ (0°C, wet, 1 atm pressure) 1.29 kg/m ³ (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.098 kg/m ³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	15.28 m/s
(ii) Average of post-sampling velocities:	14.47 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.87 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q _{stack} =	V _s x A =	31.80 m ³ /s (stack conditions)
Q _{std} =	Q _{stack} x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Q _{std} =	26.8 m ³ /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

R _m =	C _{1a} x Q _{std} =	0.003	g/s (0°C, dry gas, 1 atm pressure)
	=	3	mg/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Lower Bound

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	4.0576 m ³	Average barometric pressure	
Average gas meter temp. (T _{M,2}):	28.0 °C	(P _{BARO})	1020 hPa
	301.2 K		
		Average pressure at meter (P _{M,2})	1020.00 hPa
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	3.7049 m ³		

(B) Lower Bound concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	
Thimble No. used:	AUT050617B	Lower Bound Weight	7.4E-09 µg
Final Lower Bound Weight (Mp1):	0.00000 µg		
Lower Bound Concentration (C1):	=M _{p1} /MV ₄ =	0.000000002 µg/m ³ (0°C, dry gas, 1atm pressure)	

CO₂ Basis 12 % ;and C₂ = 0.000002 ng/m³ (0°C, dry gas, 1atm pressure)

Average CO₂ %: 0.3 %

Therefore, C_c: = C_a x 12/CO₂% = 0.00000008 µg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

;and C_{c1} = 0.00008 ng/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %

Average O₂ %: 20.3 %

Therefore, C_b: =C_a x (21 - O_{2ref}%)/(21 - O_{2mea}%) 0.00000004 µg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

;and C_{b1} = 0.00004 ng/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G064

V_v = 24.4 g (from laboratory report) V_w = 20 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0267

Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0326

Therefore, B_{ws} =
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{n(std)})}$$

B_{ws} = 1.57 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Dioxins and Furans Lower Bound

(D) Gas Composition and Density (Re-calculation)

Emission Measurement Calculations Spreadsheet

(i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.28 kg/m³ (0°C, wet, 1 atm pressure)
1.29 kg/m³ (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = $(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
= 1.098 kg/m³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.28 m/s

(ii) Average of post-sampling velocities: 14.47 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.87 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)

(Note: (Vs) is from all individual data, not from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q_{stack} = V_s x A = 31.80 m³/s (stack conditions)

Q_{std} = Q_{stack} x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$

Q_{std} = 26.8 m³/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R_m = C_{1a} x Q_{std} = 0.000000054 μg/s (0°C, dry gas, 1 atm pressure)
= 0.000054 ng/s (0°C, dry gas, 1 atm pressure)

μg/s (0°C, dry gas, 1 atm pressure)
ng/s (0°C, dry gas, 1 atm pressure)

μg/s (0°C, dry gas, 1 atm pressure)
ng/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Middle Bound

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Jun-17 Client: Weston Aluminium
 AECOM's Project No: 60539866 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV ₃):	4.0576 m ³	Average barometric pressure (P _{BARO}):	1020 hPa
Average gas meter temp. (T _{M,2}):	28.0 °C	Average pressure at meter (P _{M,2}):	1020.00 hPa
	301.2 K		
Sample gas volume (MV ₄); (0°C, dry gas, 1 atm pressure):	3.7049 m ³		

(B) Middle Bound concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	μg
Thimble No. used:	AUT050617B	Middle Bound Weight:	8.474E-07 μg
Final Middle Bound Weight (Mp1):	0.00000 μg		
Middle Bound Concentration (C1):	= Mp1/MV ₄ =	0.00000023 μg/m ³ (0°C, dry gas, 1atm pressure)	

CO₂ Basis 12 %
 Average CO₂ %: 0.3 %
 ;and C₂ = 0.00023 ng/m³ (0°C, dry gas, 1atm pressure)

Therefore, C_c: = C_a x 12/CO₂% = 0.0000092 μg/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)
 ;and C_{c1} = 0.0092 ng/m³ (0°C, dry gas, 1atm pressure, 12% CO₂)

O₂ Basis 7 %
 Average O₂ %: 20.3 %

Therefore, C_b: = C_a x (21 - O_{2ref}%) / (21 - O_{2mea}%) = 0.0000046 μg/m³ (0°C, dry gas, 1atm pressure, 7% O₂)
 ;and C_{b1} = 0.0046 ng/m³ (0°C, dry gas, 1atm pressure, 7% O₂)

(C) Moisture content

Silica Gel Number: G064
 V_v = 24.4 g (from laboratory report) V_w = 20 mL (=grams) (recorded on Laboratory Form 108)
 Volume of Water Vapour Condensed (V_{wc(std)}) = 0.0267
 Volume of Water Vapour Condensed (V_{wsg(std)}) = 0.0326
 Therefore, B_{ws} = $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$
 B_{ws} = 1.57 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Dioxins and Furans Middle Bound

(D) Gas Composition and Density (Re-calculation)

Emission Measurement Calculations Spreadsheet

(i) Initial gas density for sampling: 1.28 kg/m³ (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c):
 1.28 kg/m³ (0°C, wet, 1 atm pressure)
 1.29 kg/m³ (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+T_s)}$ x $\frac{(P_s)}{(1013.25)}$
 = 1.098 kg/m³ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.28 m/s
 (ii) Average of post-sampling velocities: 14.47 m/s
 (iii) Average of while-sampling velocities: N/A m/s
 (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
 14.87 m/s (stack conditions, wet)
 N/A m/s (stack conditions, wet)
 (Note: (Vs) is from all individual data, not from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Q_{stack} = V_s x A = 31.80 m³/s (stack conditions)

Q_{std} = Q_{stack} x $\frac{P_s}{(P_{std})}$ x $\frac{(T_{std})}{(T_s)}$ x $\frac{(100 - B_w)}{100}$

Q_{std} = 26.8 m³/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R_m = C_{1a} x Q_{std} = 0.0000062 μg/s (0°C, dry gas, 1 atm pressure)
 = 0.0062 ng/s (0°C, dry gas, 1 atm pressure)
 μg/s (0°C, dry gas, 1 atm pressure
 ng/s (0°C, dry gas, 1 atm pressure
 μg/s (0°C, dry gas, 1 atm pressure
 ng/s (0°C, dry gas, 1 atm pressure

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 8-Jun-17 POLYCYCLIC AROMATIC HYDROCARBONS DIOXINS AND FURANS		
Sampling Conditions:		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	47.7 °C	320.9 K
Stack pressure (average)	1021 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m ³ /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	27 m ³ /s	
Polycyclic Aromatic Hydrocarbons Testing		
Test Period	8:30	- 14:37
Polycyclic Aromatic Hydrocarbons Mass	0.4 mg	
Gas Volume Sampled	3.7 m ³	
Polycyclic Aromatic Hydrocarbons Emission*1	0.11 mg/m ³	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	3 mg/s	
Regulatory Limit	NA mg/m ³	
Dioxins and Furans Lower Bound Testing		
Test Period	8:30	- 14:37
Dioxins and Furans Lower Bound Mass	0.0000074 ng	
Gas Volume Sampled	3.7 m ³	
Dioxins and Furans Lower Bound Emission*1	0.000002 ng/m ³	
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.000054 ng/s	
Regulatory Limit	NA ng/m ³	
Dioxins and Furans Middle Bound Testing		
Test Period	8:30	- 14:37
Dioxins and Furans Middle Bound Mass	0.0008474 ng	
Gas Volume Sampled	3.7 m ³	
Dioxins and Furans Middle Bound Emission*1	0.00023 ng/m ³	
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.0062 ng/s	
Regulatory Limit	NA ng/m ³	
Moisture Content (%)	1.6	
Gas Density (dry at 1 atmosphere)	1.29 kg/m ³	
Dry Molecular Weight	28.9 g/g-mole	

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS


Client: Weston Aluminium
 Project Number: 60539866
 Stack Description: Stack 1
 Date: 08-Jun-17
 Rotameter Correction Factor: 1.02
 Time Start: 13:00
 Time Finish: 13:30
 Sample Flow Rate: 0.2 L/min
 Sample Time: 30 min
 Sampled Volume: 6.12 litres
 0.00612 m³

Ambient Temperature: 18 °C
 Barometric Pressure: 1021 hPa
 Stack Gas Moisture: 2.4 %

Corrected Volume: 0.00565 m³ (0°C, dry gas, 1 atmosphere pressure)
 Stack Flow Rate 26 m³/s (0°C, dry gas, 1 atmosphere pressure)

VOC AIR EMISSION TEST RESULTS					
Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m ³)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.7
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.7
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.7
Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.7
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.7
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.7
MIBK	<1.0	<1.0	<1.0	<0.18	<4.7
Toluene	<1.0	<1.0	<1.0	<0.18	<4.7
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
m- & p-xylene	<2.0	<0.2	<2.0	<0.35	<9.1
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.7
Styrene	<1.0	<1.0	<1.0	<0.18	<4.7
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-decane	<1.0	<1.0	<1.0	<0.18	<4.7
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,2-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.7
Total	<1	<1	<1	<0.35	<9.1

Note: Where the blank has returned a less than value, the analysed value has been corrected for half of that blank value. ie a blank value of <0.5 has had 0.25 subtracted from the analysed value.



Appendix B

Laboratory Analytical
Reports (27 pages)

Appendix B Laboratory Analytical Reports (27 pages)

Steel River Testing



5/11 McIntosh Drive, Mayfield West, NSW 2304

Phone: 02 49677880

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: 60539866

Report : 13761-0-P Page 1 of 1

Description : Stack Emission Samples
Received: 13-Jun-17

Date : 15-Jun-17

Report To : James Lang
17 Warabrook Blvd, Warabrook NSW 2304

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
T509	Filter	-	0.0046
T510	Filter	-	0.0126



NATA Accredited Laboratory 18079
Accredited for compliance with
ISO/IEC 17025 - Testing

Note : *Sampled by Client*

Reported By: J. Campbell

Jason Campbell

Determined in Accordance With:
Particulate matter - total in stack gases by
gravimetric using in-house M300;
Acetone/Water Rinse using AS4323.2

Steel River Testing

5/11 McIntosh Drive, Mayfield West, NSW 2304
Phone: 02 49677880

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle **Report :** 13761-0-M Page 1 of 1
Project: 60539866
Description : Stack Emission Samples **Date :** 15-Jun-17
Received: 13-Jun-17
Report To : James Lang **Copy to:** FILE
17 Warabrook Blvd, Warabrook NSW 2304

Jar ID	Moisture (g)
G030	44.6
G064	24.4
G57	13.6
M301	11.0
Z14	15.5
Z2	15.3
Z7	6.0
Z8	8.4



NATA Accredited Laboratory 18079
Accredited for compliance with
ISO/IEC 17025 - Testing

Reported By: J. Campbell

Jason Campbell

Determined in Accordance With:
Moisture content in stack gases by gravimetric
using in-house M301



Environmental

CERTIFICATE OF ANALYSIS

Work Order : EN1702503
 Client : AECOM Australia Pty Ltd
 Contact : MR JAMES LANG
 Address : 17 WARABROOK BOULEVARDE
 WARABROOK NSW, AUSTRALIA 2304
 Telephone : +61 02 4911 4900
 Project : 60539866 Task 1.1
 Order number : 60539866 Task 1.1
 C-O-C number : ----
 Sampler : DT. JL
 Site : ----
 Quote number : EN/004/16
 No. of samples received : 17
 No. of samples analysed : 17

Page : 1 of 13
 Laboratory : Environmental Division Newcastle
 Contact : Hayley Worthington
 Address : 5/585 Maitland Road Mayfield West NSW Australia 2304
 Telephone : +612 4014 2500
 Date Samples Received : 14-Jun-2017 00:40
 Date Analysis Commenced : 16-Jun-2017
 Issue Date : 26-Jun-2017 17:41



Accreditation No. 825
 Accredited for compliance with
 ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Justin Houghton	Senior Analyst - Organic	Newcastle - Organics, Mayfield West, NSW
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW



Page : 2 of 13
Work Order : EN1702503
Client : AECOM Australia Pty Ltd
Project : 60539866 Task 1.1

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When no sampling time is provided, the sampling time will default 00:00 on the date of sampling, if no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

∅ = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- ED009-X : Spike failed for Fluoride due to matrix interferences (confirmed by re-analysis).
- ED009X : LOR was raised for Fluoride, Bromide and Chloride on various samples due to sample matrix.
- Filters were supplied by the client. Filter preparation may not meet ALS method requirements.
- EP091: The LOR values for EP091 have been raised due to increased charcoal sample size (350/350/350 mg) over the standard charcoal sample size (100/50mg) requiring greater extraction volume of solvent.
- EK026-I: Cyanide was analysed as a preserved water sample by ALS Environmental. Sydney under NATA accreditation no. 825. site no 10911



Analytical Results

Compound	Client sample ID		LOR	Unit	ST1 HCl	ST1 Cl2	HCl Blank	Cl2 Blank
	Sub-Matrix: EXTRACT (Matrix: WATER)	(Matrix: WATER)						
	CAS Number	Client sampling date / time			08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00
ED009: Anions					EN1702503-007	EN1702503-008	EN1702503-014	EN1702503-015
Bromide	24959-67-9	0.01	mg/L	<1.00	Result	Result	Result	Result
Chloride	16887-00-6	0.1	mg/L	<10.0	<1.00	53.5	<10.0	<10.0
Fluoride	16984-48-8	0.01	mg/L	<1.00	5.19	<1.00	<1.00	<1.00



Page : 4 of 13
 Work Order : EN1702503
 Client : AECOM Australia Pty Ltd
 Project : 60539866 Task 1.1

Analytical Results

Compound	CAS Number	Client sample ID		Particulate Fluoride Blank	Particulate Fluoride	St 1 Particulate Fluoride	Result
		LOR	Unit				
EA144C: Gaseous and Particulate Fluorides	-----	1	µg/filter	-----	-----	401	-----
Fluoride (Particulate) as HF	-----	1	µg/filter	-----	-----	401	-----



Analytical Results

Compound	Client sample ID		St 1 SO2 as SO3	St 1 H2SO4 as SO3	St 1 Gaseous Fluoride	St 1 CN A	St 1 CN B
	CAS Number	Client sampling date / time					
	LOR	Unit	Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)							
Volume - Impinger	1	mL	270				
Sulfuric Acid as SO3	2	mg/sample	<2				
Volume - Impinger	1	mL	297				
Sulfur Dioxide as SO3	10	mg/sample	<10				
EA144C: Gaseous and Particulate Fluorides							
Fluoride (as HF)	0.01	mg/sample	0.03				
Volume - Impinger	1	mL	300				
EK026-l: Cyanide in Air Impinger Solutions							
Ø Cyanide	57-12-5	0.01	0.70				<0.01
Ø Volume - Impinger	1	mL	297				162



Analytical Results

Compound	Client sample ID		C12 Blank	HCl Blank	CN Blank	LOR	Unit	CAS Number	Client sampling date / time
	Sub-Matrix: IMPINGER SOLUTION (Matrix: AIR)	Matrix: AIR							
EA147: Acid Gases									
Hydrogen Bromide						0.01	mg		
Hydrogen Chloride						0.1	mg		
Hydrogen Fluoride						0.01	mg		
EA147: Halogens									
Bromine						0.01	mg		
Chlorine						0.1	mg		
Fluorine						0.01	mg		
EK026-I: Cyanide in Air Impinger Solutions									
Ø Cyanide						0.01	mg		
Ø Volume - Impinger						1	mL		
Sampling Method									
Ø Volume - Impinger						0.01	mL		



Analytical Results

Compound	CAS Number	LOR	Client sampling date / time		St 1_VOC	VOC_Blank	Result
			Client sample ID	Unit			
Sub-Matrix: SORBENT TUBE (Matrix: AIR)							
EP091A: Aliphatic Hydrocarbons - Total							
1-heptene	592-76-7	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Decane	124-18-5	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Heptane	142-82-5	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
EP091B: Monocyclic Aromatic Hydrocarbons - Total							
Benzene	71-43-2	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Toluene	108-88-3	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Ethylbenzene	100-41-4	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
meta- & para-Xylene	108-38-3	1	08-Jun-2017 00:00	µg/sample	<2	<2	*****
Styrene	100-42-5	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
ortho-Xylene	95-47-6	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
1,3,5-Trimethylbenzene	108-67-8	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
1,2,4-Trimethylbenzene	95-63-6	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
n-Butylbenzene	104-51-8	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Isopropylbenzene	98-82-8	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
EP091C: Oxygenated Compounds - Total							
2-Propanone (Acetone)	67-64-1	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
2-Butanone (MEK)	78-93-3	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
2-Hexanone (MBK)	591-78-6	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
EP091D: Halogenated Compounds - Total							
1,1-Dichloroethane	75-34-3	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Chloroform	67-66-3	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Trichloroethene	79-01-6	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Chlorobenzene	108-90-7	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
2-Chlorotoluene	95-49-8	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
4-Chlorotoluene	106-43-4	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
1,3-Dichlorobenzene	541-73-1	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
1,4-Dichlorobenzene	106-46-7	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
1,2-Dichlorobenzene	95-50-1	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
Hexachlorobutadiene	87-68-3	0.5	08-Jun-2017 00:00	µg/sample	<1.0	<1.0	*****
EP091A: Aliphatic Hydrocarbons (Section 1)							
1-heptene	592-76-7	0.5	08-Jun-2017 00:00	µg	<1.0	<1.0	*****
Heptane	142-82-5	0.5	08-Jun-2017 00:00	µg	<1.0	<1.0	*****
Decane	124-18-5	0.5	08-Jun-2017 00:00	µg	<1.0	<1.0	*****



Analytical Results

Compound	CAS Number	LOR	Client sampling date / time	Client sample ID	VOC	
					St 1_VOC	VOC_Blank
Sub-Matrix: SORBENT TUBE (Matrix: AIR)						
					08-Jun-2017 00:00	08-Jun-2017 00:00
					EN1702503-016	EN1702503-017
					Result	Result
EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued						
meta- & para-Xylene	108-38-3	106-42-3	1	µg	<2	<2
Styrene	100-42-5	0.5	µg	<1.0	<1.0	<1.0
ortho-Xylene	95-47-6	0.5	µg	<1.0	<1.0	<1.0
1,3,5-Trimethylbenzene	108-67-8	0.5	µg	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene	95-63-6	0.5	µg	<1.0	<1.0	<1.0
n-Butylbenzene	104-51-8	0.5	µg	<1.0	<1.0	<1.0
Isopropylbenzene	98-82-8	0.5	µg	<1.0	<1.0	<1.0
EP091C: Oxygenated Compounds (Section 2)						
2-Propanone (Acetone)	67-64-1	0.5	µg	<1.0	<1.0	<1.0
2-Butanone (MEK)	78-93-3	0.5	µg	<1.0	<1.0	<1.0
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	µg	<1.0	<1.0	<1.0
2-Hexanone (MBK)	591-78-6	0.5	µg	<1.0	<1.0	<1.0
EP091D: Halogenated Compounds (Section 2)						
1,1-Dichloroethane	75-34-3	0.5	µg	<1.0	<1.0	<1.0
Chloroform	67-66-3	0.5	µg	<1.0	<1.0	<1.0
Trichloroethene	79-01-6	0.5	µg	<1.0	<1.0	<1.0
Chlorobenzene	108-90-7	0.5	µg	<1.0	<1.0	<1.0
2-Chlorotoluene	95-49-8	0.5	µg	<1.0	<1.0	<1.0
4-Chlorotoluene	106-43-4	0.5	µg	<1.0	<1.0	<1.0
1,3-Dichlorobenzene	541-73-1	0.5	µg	<1.0	<1.0	<1.0
1,4-Dichlorobenzene	106-46-7	0.5	µg	<1.0	<1.0	<1.0
1,2-Dichlorobenzene	95-50-1	0.5	µg	<1.0	<1.0	<1.0
Hexachlorobutadiene	87-68-3	0.5	µg	<1.0	<1.0	<1.0
EP091A: Aliphatic Hydrocarbons (Section 3)						
1-heptene	592-76-7	0.5	µg	<1.0	<1.0	<1.0
Heptane	142-82-5	0.5	µg	<1.0	<1.0	<1.0
Decane	124-18-5	0.5	µg	<1.0	<1.0	<1.0
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)						
Benzene	71-43-2	0.5	µg	<1.0	<1.0	<1.0
Toluene	108-88-3	0.5	µg	<1.0	<1.0	<1.0
Ethylbenzene	100-41-4	0.5	µg	<1.0	<1.0	<1.0
meta- & para-Xylene	108-38-3	106-42-3	1	µg	<2	<2
Styrene	100-42-5	0.5	µg	<1.0	<1.0	<1.0
ortho-Xylene	95-47-6	0.5	µg	<1.0	<1.0	<1.0



Analytical Results

Compound	CAS Number	LOR	Unit	Client sample ID (Matrix: AIR)	Client sampling date / time	St 1_VOC	VOC_Blank	Result	Result
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued									
1,3,5-Trimethylbenzene	108-67-8	0.5	µg			<1.0	<1.0	08-Jun-2017 00:00	EN1702503-017
1,2,4-Trimethylbenzene	95-63-6	0.5	µg			<1.0	<1.0		
n-Butylbenzene	104-51-8	0.5	µg			<1.0	<1.0		
Isopropylbenzene	98-82-8	0.5	µg			<1.0	<1.0		
EP091C: Oxygenated Compounds (Section 3)									
2-Propanone (Acetone)	67-64-1	0.5	µg			<1.0	<1.0		
2-Butanone (MEK)	78-93-3	0.5	µg			<1.0	<1.0		
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	µg			<1.0	<1.0		
2-Hexanone (MBK)	591-78-6	0.5	µg			<1.0	<1.0		
EP091D: Halogenated Compounds (Section 3)									
1,1-Dichloroethane	75-34-3	0.5	µg			<1.0	<1.0		
Chloroform	67-66-3	0.5	µg			<1.0	<1.0		
Trichloroethene	79-01-6	0.5	µg			<1.0	<1.0		
Chlorobenzene	108-90-7	0.5	µg			<1.0	<1.0		
2-Chlorotoluene	95-49-8	0.5	µg			<1.0	<1.0		
4-Chlorotoluene	106-43-4	0.5	µg			<1.0	<1.0		
1,3-Dichlorobenzene	541-73-1	0.5	µg			<1.0	<1.0		
1,4-Dichlorobenzene	106-46-7	0.5	µg			<1.0	<1.0		
1,2-Dichlorobenzene	95-50-1	0.5	µg			<1.0	<1.0		
Hexachlorobutadiene	87-68-3	0.5	µg			<1.0	<1.0		
EP091: Chlorinated Organic Surrogates (Section 1)									
1,2-Dichloroethane-D4	17060-07-0	0.5	%			96.8	95.4		
4-Bromofluorobenzene	460-00-4	0.5	%			90.2	81.2		
EP091: Chlorinated Organic Surrogates (Section 2)									
1,2-Dichloroethane-D4	17060-07-0	0.5	%			99.5	97.4		
4-Bromofluorobenzene	460-00-4	0.5	%			89.2	80.2		
EP091: Chlorinated Organic Surrogates (Section 3)									
1,2-Dichloroethane-D4	17060-07-0	0.5	%			99.6	97.5		
4-Bromofluorobenzene	460-00-4	0.5	%			91.2	79.3		
EP091: MAH Surrogates (Section 1)									
Toluene-D8	2037-26-5	0.5	%			96.6	90.4		
EP091: MAH Surrogates (Section 2)									
Toluene-D8	2037-26-5	0.5	%			102	89.8		
EP091: MAH Surrogates (Section 3)									



Page : 12 of 13
 Work Order : EN1702503
 Client : AECOM Australia Pty Ltd
 Project : 60539866 Task 1.1

Analytical Results

Sub-Matrix: SORBENT TUBE (Matrix: AIR)	Client sample ID		St 1_VOC	VOC_Blank	St 1_VOC	VOC_Blank	St 1_VOC	VOC_Blank
	CAS Number	LOR						
EP091: MAH Surrogates (Section 3) - Continued Toluene-D8	2037-26-5	0.5	08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00	08-Jun-2017 00:00
			EN1702503-016	EN1702503-017	Result	Result	Result	Result
					101	89.6		



Surrogate Control Limits

Sub-Matrix: SORBENT TUBE		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP091 : Chlorinated Organic Surrogates (Section 1)			
1,2-Dichloroethane-D4	17060-07-0	70	130
4-Bromofluorobenzene	460-00-4	60	130
EP091 : Chlorinated Organic Surrogates (Section 2)			
1,2-Dichloroethane-D4	17060-07-0	60	140
4-Bromofluorobenzene	460-00-4	60	140
EP091 : Chlorinated Organic Surrogates (Section 3)			
1,2-Dichloroethane-D4	17060-07-0	60	140
4-Bromofluorobenzene	460-00-4	60	140
EP091 : MAH Surrogates (Section 1)			
Toluene-D8	2037-26-5	70	130
EP091 : MAH Surrogates (Section 2)			
Toluene-D8	2037-26-5	60	140
EP091 : MAH Surrogates (Section 3)			
Toluene-D8	2037-26-5	60	140

CLIENT DETAILS

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 Project **60539866/3**
 Order Number **60539866/3**
 Samples **12**

LABORATORY DETAILS

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 Laboratory **SGS Melbourne EH&S**
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 Email **Au.SampleReceipt.Melbourne@sgs.com**
 SGS Reference **ME303133 R0**
 Date Received **15 Jun 2017**
 Date Reported **22 Jun 2017**

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(14420).

SIGNATORIES

MING

Weiming Dai
 Inorganic Supervisor

Sample Number	ME303133.001	ME303133.002	ME303133.003	ME303133.004
Sample Matrix	Filter	Filter	Impinger	Impinger
Sample Date	08 Jun 2017	08 Jun 2017	Solution	Solution
Sample Name	St 1_Metals 1	Metals 12	08 Jun 2017 St 1_Metals 3	08 Jun 2017 St 1_Metals 4

Parameter	Units	LOR				
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 22/6/2017						
Sb	µg total	0.2	<0.2	<0.2	-	-
As	µg total	0.2	0.4	0.3	-	-
Be	µg total	0.2	<0.2	<0.2	-	-
Cd	µg total	0.2	35	<0.2	-	-
Cr	µg total	0.2	28	0.9	-	-
Co	µg total	0.2	<0.2	<0.2	-	-
Cu	µg total	0.2	2.1	<0.2	-	-
Pb	µg total	0.2	2.0	3.7	-	-
Mg	µg total	2	99	110	-	-
Mn	µg total	0.2	6.1	1.2	-	-
Hg	µg total	0.2	<0.2	<0.2	-	-
Ni	µg total	0.2	8.7	0.6	-	-
Se	µg total	0.2	0.8	<0.2	-	-
Tl	µg total	0.2	<0.2	<0.2	-	-
Sn	µg total	0.2	0.5	<0.2	-	-
V	µg total	0.2	5.6	5.3	-	-
Zn	µg total	0.2	2000	1100	-	-

Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 22/6/2017						
Sb	µg total	0.1	-	-	<0.1	<0.1
As	µg total	0.1	-	-	<0.1	<0.1
Be	µg total	0.1	-	-	<0.1	0.1
Cd	µg total	0.1	-	-	<0.1	1.4
Cr	µg total	0.1	-	-	0.1	1.4
Co	µg total	0.1	-	-	<0.1	<0.1
Cu	µg total	0.1	-	-	<0.1	0.3
Pb	µg total	0.1	-	-	2.8	1.0
Mg	µg total	0.1	-	-	14	27
Mn	µg total	0.1	-	-	0.8	1.6
Hg	µg total	0.1	-	-	<0.1	0.6
Ni	µg total	0.1	-	-	0.2	1.0
Se	µg total	0.1	-	-	4.0	0.3
Tl	µg total	0.1	-	-	<0.1	<0.1
Sn	µg total	0.1	-	-	<0.1	0.2
V	µg total	0.1	-	-	1.4	3.3
Zn	µg total	0.1	-	-	16	14
Sample Volume*	mL	-	-	-	100	320

Parameter	Units	LOR	ME303133.005	ME303133.006	ME303133.007	ME303133.008
Sample Number			ME303133.005	ME303133.006	ME303133.007	ME303133.008
Sample Matrix			Impinger	Impinger	Impinger	Impinger
Sample Date			Solution	Solution	Solution	Solution
Sample Name			08 Jun 2017	08 Jun 2017	08 Jun 2017	08 Jun 2017
			Metals 8A	Metals 9	St 1_Metals 5A	St 1_Metals 5C

Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 22/6/2017

Parameter	Units	LOR	ME303133.005	ME303133.006	ME303133.007	ME303133.008
Sb	µg total	0.2	-	-	-	-
As	µg total	0.2	-	-	-	-
Be	µg total	0.2	-	-	-	-
Cd	µg total	0.2	-	-	-	-
Cr	µg total	0.2	-	-	-	-
Co	µg total	0.2	-	-	-	-
Cu	µg total	0.2	-	-	-	-
Pb	µg total	0.2	-	-	-	-
Mg	µg total	2	-	-	-	-
Mn	µg total	0.2	-	-	-	-
Hg	µg total	0.2	-	-	-	-
Ni	µg total	0.2	-	-	-	-
Se	µg total	0.2	-	-	-	-
Tl	µg total	0.2	-	-	-	-
Sn	µg total	0.2	-	-	-	-
V	µg total	0.2	-	-	-	-
Zn	µg total	0.2	-	-	-	-

Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 20/6/2017

Parameter	Units	LOR	ME303133.005	ME303133.006	ME303133.007	ME303133.008
Sb	µg total	0.1	<0.1	<0.1	-	-
As	µg total	0.1	<0.1	<0.1	-	-
Be	µg total	0.1	<0.1	<0.1	-	-
Cd	µg total	0.1	<0.1	<0.1	-	-
Cr	µg total	0.1	<0.1	<0.1	-	-
Co	µg total	0.1	<0.1	<0.1	-	-
Cu	µg total	0.1	<0.1	<0.1	-	-
Pb	µg total	0.1	<0.1	<0.1	-	-
Mg	µg total	0.1	14	8.2	-	-
Mn	µg total	0.1	0.5	1.1	-	-
Hg	µg total	0.1	0.1	<0.1	<0.1	<0.1
Ni	µg total	0.1	<0.1	<0.1	-	-
Se	µg total	0.1	<0.1	<0.1	-	-
Tl	µg total	0.1	<0.1	<0.1	-	-
Sn	µg total	0.1	<0.1	<0.1	-	-
V	µg total	0.1	3.5	2.2	-	-
Zn	µg total	0.1	<0.1	0.2	-	-
Sample Volume*	mL	-	310	200	100	250

Sample Number	ME303133.009	ME303133.010	ME303133.011	ME303133.012
Sample Matrix	Impinger	Impinger	KMnO4	KMnO4
Sample Date	Solution	Solution	08 Jun 2017	08 Jun 2017
Sample Name	08 Jun 2017 Metals 8B	08 Jun 2017 Metals 11	St 1_Metals 5B	Metals 10

Parameter	Units	LOR	ME303133.009	ME303133.010	ME303133.011	ME303133.012
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 22/6/2017						
Sb	µg total	0.2	-	-	-	-
As	µg total	0.2	-	-	-	-
Be	µg total	0.2	-	-	-	-
Cd	µg total	0.2	-	-	-	-
Cr	µg total	0.2	-	-	-	-
Co	µg total	0.2	-	-	-	-
Cu	µg total	0.2	-	-	-	-
Pb	µg total	0.2	-	-	-	-
Mg	µg total	2	-	-	-	-
Mn	µg total	0.2	-	-	-	-
Hg	µg total	0.2	-	-	-	-
Ni	µg total	0.2	-	-	-	-
Se	µg total	0.2	-	-	-	-
Tl	µg total	0.2	-	-	-	-
Sn	µg total	0.2	-	-	-	-
V	µg total	0.2	-	-	-	-
Zn	µg total	0.2	-	-	-	-

Parameter	Units	LOR	ME303133.009	ME303133.010	ME303133.011	ME303133.012
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 20/6/2017						
Sb	µg total	0.1	-	-	-	-
As	µg total	0.1	-	-	-	-
Be	µg total	0.1	-	-	-	-
Cd	µg total	0.1	-	-	-	-
Cr	µg total	0.1	-	-	-	-
Co	µg total	0.1	-	-	-	-
Cu	µg total	0.1	-	-	-	-
Pb	µg total	0.1	-	-	-	-
Mg	µg total	0.1	-	-	-	-
Mn	µg total	0.1	-	-	-	-
Hg	µg total	0.1	<0.1	<0.1	<0.1	<0.1
Ni	µg total	0.1	-	-	-	-
Se	µg total	0.1	-	-	-	-
Tl	µg total	0.1	-	-	-	-
Sn	µg total	0.1	-	-	-	-
V	µg total	0.1	-	-	-	-
Zn	µg total	0.1	-	-	-	-
Sample Volume*	mL	-	100	260	400	100

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared to the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula: *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Metals in Fillers M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB013901	µg total	0.2	<0.2	NA
As	LB013901	µg total	0.2	<0.2	NA
Be	LB013901	µg total	0.2	<0.2	NA
Cd	LB013901	µg total	0.2	<0.2	NA
Cr	LB013901	µg total	0.2	<0.2	NA
Co	LB013901	µg total	0.2	<0.2	NA
Cu	LB013901	µg total	0.2	<0.2	NA
Pb	LB013901	µg total	0.2	<0.2	NA
Mg	LB013901	µg total	2	<2	NA
Mn	LB013901	µg total	0.2	<0.2	NA
Hg	LB013901	µg total	0.2	<0.2	NA
Ni	LB013901	µg total	0.2	<0.2	NA
Se	LB013901	µg total	0.2	<0.2	NA
Tl	LB013901	µg total	0.2	<0.2	NA
Sn	LB013901	µg total	0.2	<0.2	NA
V	LB013901	µg total	0.2	<0.2	NA
Zn	LB013901	µg total	0.2	<0.2	NA

Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (µg total) Method: EPA29_METIMP

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB013924	µg total	0.1	<0.1	105%
As	LB013924	µg total	0.1	<0.1	107%
Be	LB013924	µg total	0.1	<0.1	92%
Cd	LB013924	µg total	0.1	<0.1	105%
Cr	LB013924	µg total	0.1	<0.1	100%
Co	LB013924	µg total	0.1	<0.1	96%
Cu	LB013924	µg total	0.1	<0.1	96%
Pb	LB013924	µg total	0.1	<0.1	100%
Mg	LB013924	µg total	0.1	<0.1	92%
Mn	LB013924	µg total	0.1	<0.1	102%
Hg	LB013924	µg total	0.1	<0.1	11%
Ni	LB013924	µg total	0.1	<0.1	96%
Se	LB013924	µg total	0.1	<0.1	107%
Tl	LB013924	µg total	0.1	<0.1	109%
Sn	LB013924	µg total	0.1	<0.1	102%
V	LB013924	µg total	0.1	<0.1	103%
Zn	LB013924	µg total	0.1	<0.1	103%
Sample Volume*	LB013924	mL	-	1.0	NA

METHOD

METHODOLOGY SUMMARY

EPA 29

Analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA 3051A, USEPA M29, and USEPA 6020A.
 . Filters are digested using the appropriate sample preparation methods.
 A representative sample is extracted in concentrated acid using microwave heating by the CEM -MarsXPress (with Built-in USEPA method) Microwave Digestion system. The sample and acid are placed in a microwave vessel (TFM), which is then capped and heated in the microwave unit. After cooling, the vessel contents are diluted with DI water, then filtered/settled/centrifuged and analysed by ICP MS.

EPA29

This method covers the analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA M29, USEPA 3015A and USEPA 6020A.
 Prior to analysis, samples are be solubilised or digested using the appropriate sample preparation methods.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
 Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/-/media/Local/Australia/Documents/Technical%20Documents/IMP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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ANALYSIS REPORT # ORG17_026

Client	AECOM 17 Warabrook Boulevard Warabrook NSW 2304	Job No.	AECO01/170614/1
Contact	James Lang	Sampled by	Client
		Date Sampled	Not specified
		Date Received	14-Jun-2017

The results relate only to the sample(s) tested.

Method | NGCMS 11.27 | **AECOM Job Reference** | 60539866/3

Details | The samples are spiked with a range of isotopically labelled PAHs then extracted with organic solvent. The extracts were purified by chemical treatment and column chromatography. Analysis was performed using high resolution gas chromatography with low resolution mass spectrometry. Results have been corrected for recoveries of the internal standard.

Instrument: Agilent 5975 GCMS run in SIM mode. Column is a DB5-ms (30m×0.25mm×0.25µm). Method based on CARB429, July 1997 Revision.

Authorisation

Danny Slee
Senior Chemist- Environment
July 14, 2017

Accreditation | NATA Accreditation Number : 198



Accredited for compliance with ISO/IEC 17025 - Testing.

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Sample Details : Job No. AECO01/170614/1			
Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N17/017470	AUT050617B	Emission	Resin, Filter, Solvent Rinse

Project Details

Project Name St 1
Project Number 60539866 /3

Key

Analytes	Labelled internal std.	Analytes	Labelled internal std.
Naphthalene	d8-Naphthalene	Chrysene	d12-Chrysene
2-Methylnaphthalene		Benzo(b)fluoranthene	d12-Benzo(b)fluoranthene
Acenaphthylene	d8-Acenaphthylene	Benzo(k)fluoranthene	d12-Benzo(k)fluoranthene
Acenaphthene	d10-Acenaphthene	Benzo(e)pyrene	
Fluorene	d10-Fluorene	Benzo(a)pyrene	d12-Benzo(a)pyrene
Phenanthrene	d10-Phenanthrene	Perylene	
Anthracene		Indeno(1,2,3-cd)pyrene	d12-Indeno(1,2,3-c,d)pyrene
Fluoranthene	d10-Fluoranthene	Dibenz(ah)anthracene	d14-Dibenz(ah)anthracene
Pyrene		Benzo(ghi)perylene	d12-Benzo(ghi)perylene
Benz(a)anthracene	d12-Benz(a)anthracene		

Abbreviations & Definitions

ng nanograms per sample train
< level less than limit of reporting (LOR)
BaP-PEF[†] Benzo(a)pyrene Potency Equivalent Factor
BaP-TEQ_{PAH} Benzo(a)pyrene Toxic Equivalents

[†] as defined in "Benzo(a)pyrene as a Toxic Air Contaminant", CARB/OEHHA Executive Summary, July 1994

TEQs are calculated by multiplying the quantified level for each toxic PAH by corresponding PEF and summing the result:

$$\text{BaP-TEQ}_{\text{PAH}} = \sum_{i=1}^n [\text{PAH}_i \times \text{BaP-PEF}_i] \quad i = \text{toxic PAH analyte index (1 to } n=7\text{)}$$

CARB California Air Resources Board
OEHHA Office of Environmental Health Hazard Assessment (US)

Surrogate Standard Known amount of deuterated standard added to the XAD resin prior to sampling. Surrogates are 'field spikes'. The surrogate recovery indicates how effectively the sample train retains PAHs collected on the resin. It is also a guide to matrix effects caused by time of storage and transportation.

Internal Standard Known amount of deuterated PAHs added to field samples, blanks and QC samples prior to laboratory analysis. The internal standard is used to measure the concentration of native PAHs and surrogates. The internal standard recovery will determine the performance of the laboratory method. Usual recoveries are 50 to 150%. Lower recoveries can be accepted as long as the signal/noise ratio of the internal standard is >10.

Results : Job No. AECO01/170614/1

Laboratory Reg. No. N17/017470 Date Reported 14-Jul-2017
 Client Sample Ref. AUT050617B Date Extracted 21-Jun-2017
 Matrix Emission
 Description Resin, Filter, Solvent Rinse

PAH	Conc. ng	Reporting Level (LOR, ng)	BaP-PEF Value	BaP-TEQ Contribution	Labelled Internal recovery (%)	Flags
Naphthalene	290000	400	-	-	64	
2-Methylnaphthalene	20000	400	-	-		
Acenaphthylene	46000	400	-	-	60	
Acenaphthene	3200	20	-	-	62	
Fluorene	4700	20	-	-	82	
Phenanthrene	34000	400	-	-	83	
Anthracene	260	20	-	-		
Fluoranthene	4500	20	-	-	78	
Pyrene	1100	20	-	-		
Benz(a)anthracene	38	20	0.1	3.8	84	
Chrysene	110	20	0.01	1.1	75	
Benzo(b)fluoranthene	55	20	0.1	5.5	80	
Benzo(k)fluoranthene	32	20	0.1	3.2	71	
Benzo(e)pyrene	49	20	-	-		
Benzo(a)pyrene	360	20	1.0	360	75	
Perylene	<20	20	-	-		
Indeno(1,2,3-cd)pyrene	32	20	0.1	3.2	77	
Dibenz(ah)anthracene	<20	20	0.4	4.0	80	
Benzo(ghi)perylene	28	20	-	-	76	

Flags

" * " : indicates the recovery is outside range but signal to noise is >10.

Acceptable recovery range set at 50 to 150%.

Sample diluted prior to analysis for selected analytes.

Surrogate Recovery	%
d14-Terphenyl	78

Summary Results**BaP-TEQ_{PAH}**

Lower Bound [excluding LOD values]	380	ng
Middle Bound [including half LOD values]	380	ng
Upper Bound [including LOD values]	380	ng



CERTIFICATE OF ANALYSIS # DAU17_122

Client	AECOM 17 Warabrook Boulevard Warabrook NSW 2304	Job No.	AECO01/170614/1
Contact	James Lang	Sampled by Date Sampled Date Received	Client Not specified 14-Jun-17

The results relate only to the sample(s) tested.

Method | AUTL_02 **Date Reported** 12-Jul-17
AECOM Job Reference 60539866/3

Details | The method is for determination of tetra- through octa-chlorinated dibenzo-p-dioxins (PCDDs) & dibenzofurans (PCDFs) in emission samples by high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS). This method provides data on all toxic 2,3,7,8-PCDD (seven) and PCDF (ten) isomers. PCDD and PCDF totals for each homologue group (tetra to octa) are also reported. The dioxin toxicity equivalent (I-TEQ) in each sample is calculated using International toxic equivalency factors (I-TEFs). All results are corrected for labelled surrogate recoveries.

After sampling the filter & resin are spiked with a range of isotopically labelled surrogate standards and exhaustively extracted. Clean up is effected by partitioning with sulphuric acid then distilled water. Further purification is performed using column chromatography on acid and base modified silica gels, basic alumina and carbon dispersed on celite.

Immediately prior to injection, internal standards are added to each extract, and an aliquot of the extract is injected into the GC. The analytes are separated by the GC and detected by a high-resolution (>10,000) mass spectrometer.

Authorisation

Nino Piro
Senior Chemist
Australian Ultra Trace Laboratory

Dr Alan Yates
Senior Analyst
Australian Ultra Trace Laboratory

Accreditation



NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025 - Testing.

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Sample Details : Job No. AECO01/170614/1

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N17/017470X	AUT050617B	Emission	Resin, Filter, Solvent Rinse

Project Details

Project Name	<i>Not specified</i>
Project Number	60539866 /3

Key**Analytes**

TCDD	Tetrachlorodibenzo-p-dioxin	TCDF	Tetrachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin	PeCDF	Pentachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin	HxCDF	Hexachlorodibenzofuran
HpCDD	Heptachlorodibenzo-p-dioxin	HpCDF	Heptachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin	OCDF	Octachlorodibenzofuran

Units & Abbreviations

pg	picograms
<	level less than limit of detection (LOD)
I-TEF [‡]	International toxic equivalency factor
I-TEQ [‡]	International toxic equivalents - dioxins & furans

TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:

$$I-TEQ = \sum_{i=1}^7 [PCDD_i \times TEF_i] + \sum_{j=1}^{10} [PCDF_j \times TEF_j]$$

i = PCDD congener index (1 - 7)
j = PCDF congener index (1 - 10)

Lower Bound TEQ	defines all congener values reported below the LOD as equal to zero.
Middle Bound TEQ	defines all congener values reported below the LOD as equal to half the LOD.
Upper Bound TEQ	defines all congener values reported below the LOD as equal to the LOD.

Surrogate Recovery	percentage recovery for ¹³ C ₁₂ labelled surrogate standard
\square	Laboratory surrogate recovery outside normal acceptance criteria: 40-130% for Tetra/Penta/Hexa congeners - 25-130% for Hepta/Octa congeners
\square	Field surrogate recovery outside normal acceptance criteria (70-130%)

[‡] as defined in USEPA publication **EPA/625/3-89/016** (1989)

USEPA US Environmental Protection Agency

Results : Job No. AECO01/170614/1

Laboratory Reg. No. N17/017470X

Date Extracted 21-Jun-17

Client Sample Ref. AUT050617B

DB5 Analysis 30-Jun-17

Matrix Emission

DB-Dioxin Analysis 11-Jul-17

Description Resin, Filter, Solvent Rinse

PCDD/F Congeners	Level pg	I-TEF	I-TEQ middle bound contribution	Labelled Surrogate recovery
2,3,7,8-TCDF	<2	0.1	0.1	49
2,3,7,8-TCDD	<1	1	0.5	47
1,2,3,7,8-PeCDF	<1	0.05	0.025	53
2,3,4,7,8-PeCDF	<0.2	0.5	0.05	110
1,2,3,7,8-PeCDD	<0.3	0.5	0.075	62
1,2,3,4,7,8-HxCDF	<0.3	0.1	0.015	102
1,2,3,6,7,8-HxCDF	<0.3	0.1	0.015	55
2,3,4,6,7,8-HxCDF	<0.2	0.1	0.01	
1,2,3,7,8,9-HxCDF	<0.2	0.1	0.01	
1,2,3,4,7,8-HxCDD	<0.2	0.1	0.01	100
1,2,3,6,7,8-HxCDD	<0.2	0.1	0.01	59
1,2,3,7,8,9-HxCDD	<0.2	0.1	0.01	
1,2,3,4,6,7,8-HpCDF	<0.7	0.01	0.0035	62
1,2,3,4,7,8,9-HpCDF	<0.4	0.01	0.002	97
1,2,3,4,6,7,8-HpCDD	<0.9	0.01	0.0045	73
OCDF	1.3	0.001	0.0013	
OCDD	6.1	0.001	0.0061	69

PCDD/F Homologue Groups	Level pg
Total TCDF isomers	15
Total TCDD isomers	<7
Total PeCDF isomers	<4
Total PeCDD isomers	<2
Total HxCDF isomers	<2
Total HxCDD isomers	<2
Total HpCDF isomers	<2
Total HpCDD isomers	<2

Summary Results**Sum of PCDD and PCDF congeners**

Excluding LOD values 22 pg

I-TEQ

Lower Bound [excluding LOD values] **0.0074** pg
Middle Bound [including half LOD values] **0.85** pg
Upper Bound [including LOD values] **1.7** pg

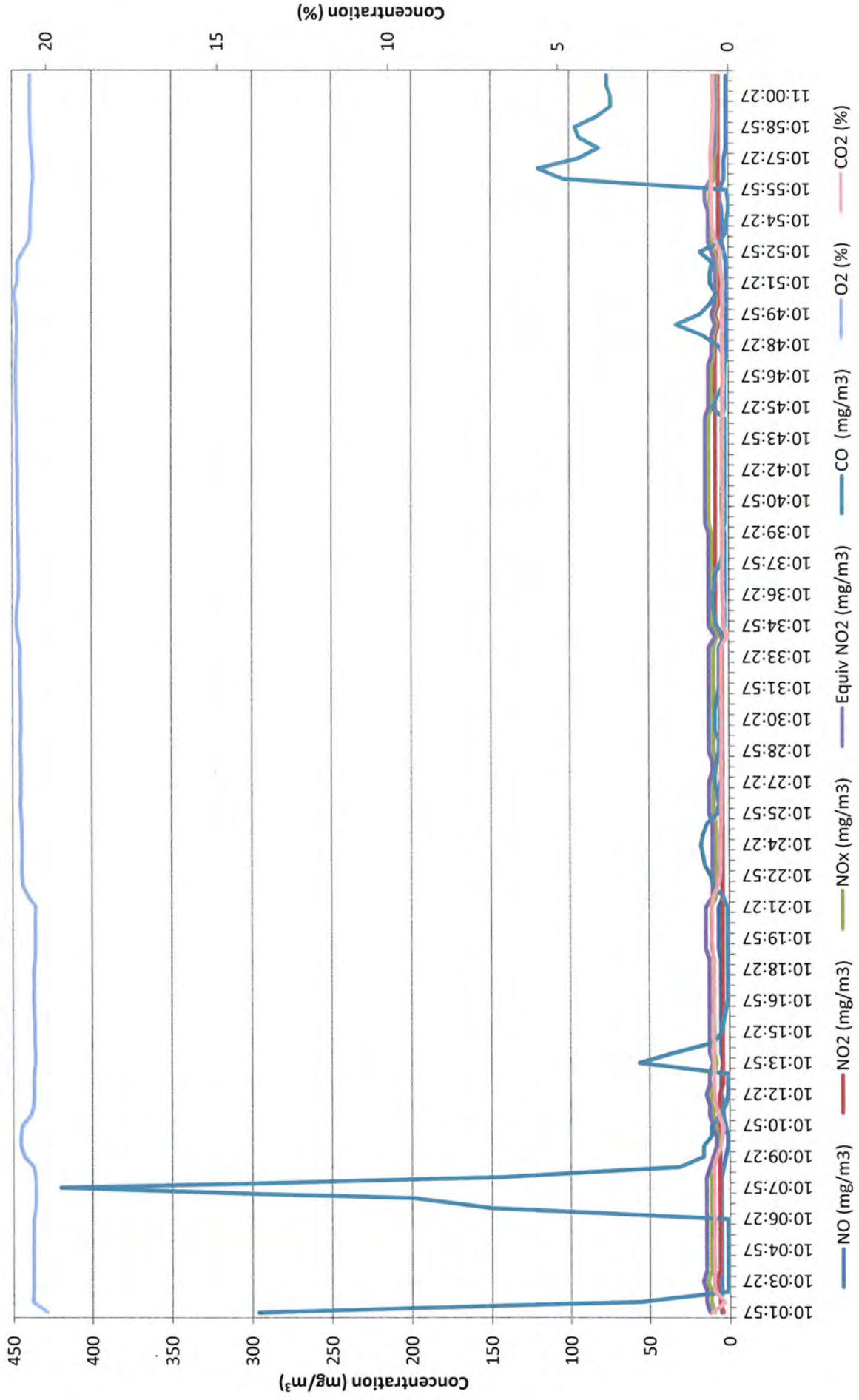


Appendix C

Raw & Calculated Gas
Data (3 pages)

Appendix C Raw & Calculated Gas Data (3 pages)

60539866 - Stack 1 Calculated Gas Data, 8 June 2017



60539866
Stack 1 Calculated Gas Data
8 June 2017

Date	Time	NO (ppm)	NO ₂ (ppm)	NOx (ppm)	Equiv NO ₂ (ppm)	CO (ppm)	NO (mg/m ³)	NO ₂ (mg/m ³)	NOx (mg/m ³)	Equiv NO ₂ (mg/m ³)	CO (mg/m ³)	O ₂ %	CO ₂ %
08-Jun-17	10:01:57	4	2	6	8	237	5	4	9	12	296	20.0	0.5
08-Jun-17	10:02:27	4	3	7	9	45	5	6	12	14	56	20.4	0.1
08-Jun-17	10:02:57	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:03:27	4	4	8	10	1	5	8	14	16	1	20.4	0.5
08-Jun-17	10:03:57	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:04:27	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:04:57	4	3	7	9	1	5	6	12	14	1	20.4	0.5
08-Jun-17	10:05:27	4	3	7	9	1	5	6	12	14	1	20.4	0.5
08-Jun-17	10:05:57	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:06:27	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:06:57	4	3	7	9	120	5	6	12	14	150	20.3	0.5
08-Jun-17	10:07:27	4	3	7	9	159	5	6	12	14	199	20.3	0.5
08-Jun-17	10:07:57	4	3	7	9	336	5	6	12	14	420	20.3	0.5
08-Jun-17	10:08:27	4	3	7	9	114	5	6	12	14	143	20.3	0.5
08-Jun-17	10:08:57	3	3	6	8	25	4	6	10	12	31	20.4	0.5
08-Jun-17	10:09:27	2	3	5	6	13	3	6	9	10	16	20.7	0.4
08-Jun-17	10:09:57	1	3	4	5	13	1	6	8	8	16	20.8	0.3
08-Jun-17	10:10:27	1	3	4	5	9	1	6	8	8	11	20.8	0.2
08-Jun-17	10:10:57	2	3	5	6	9	3	6	9	10	11	20.7	0.2
08-Jun-17	10:11:27	3	3	6	8	5	4	6	10	12	6	20.5	0.3
08-Jun-17	10:11:57	3	3	6	8	2	4	6	10	12	3	20.4	0.4
08-Jun-17	10:12:27	4	3	7	9	1	5	6	12	14	1	20.4	0.4
08-Jun-17	10:12:57	4	2	6	8	1	5	4	9	12	1	20.4	0.4
08-Jun-17	10:13:27	4	2	6	8	1	5	4	9	12	1	20.4	0.5
08-Jun-17	10:13:57	3	2	5	7	45	4	4	8	10	56	20.3	0.5
08-Jun-17	10:14:27	4	2	6	8	27	5	4	9	12	34	20.3	0.5
08-Jun-17	10:14:57	4	2	6	8	8	5	4	9	12	10	20.4	0.5
08-Jun-17	10:15:27	4	2	6	8	4	5	4	9	12	5	20.4	0.5
08-Jun-17	10:15:57	4	2	6	8	3	5	4	9	12	4	20.4	0.5
08-Jun-17	10:16:27	4	2	6	8	2	5	4	9	12	3	20.4	0.5
08-Jun-17	10:16:57	4	2	6	8	1	5	4	9	12	1	20.4	0.5
08-Jun-17	10:17:27	4	2	6	8	1	5	4	9	12	1	20.4	0.5
08-Jun-17	10:17:57	4	2	6	8	1	5	4	9	12	1	20.4	0.5
08-Jun-17	10:18:27	4	2	6	8	1	5	4	9	12	1	20.4	0.5
08-Jun-17	10:18:57	4	2	6	8	1	5	4	9	12	1	20.3	0.5
08-Jun-17	10:19:27	5	2	7	10	1	7	4	11	14	1	20.3	0.5
08-Jun-17	10:19:57	5	2	7	10	1	7	4	11	14	1	20.3	0.5
08-Jun-17	10:20:27	5	2	7	10	1	7	4	11	14	1	20.3	0.5
08-Jun-17	10:20:57	5	2	7	10	1	7	4	11	14	1	20.3	0.5
08-Jun-17	10:21:27	5	2	7	10	1	7	4	11	14	1	20.3	0.5
08-Jun-17	10:21:57	3	2	5	7	3	4	4	8	10	4	20.5	0.5
08-Jun-17	10:22:27	3	2	5	7	8	4	4	8	10	10	20.7	0.3
08-Jun-17	10:22:57	3	2	5	7	9	4	4	8	10	11	20.7	0.3
08-Jun-17	10:23:27	3	2	5	7	12	4	4	8	10	15	20.7	0.3
08-Jun-17	10:23:57	3	2	5	7	13	4	4	8	10	16	20.7	0.3
08-Jun-17	10:24:27	3	2	5	7	14	4	4	8	10	18	20.7	0.3
08-Jun-17	10:24:57	3	2	5	7	13	4	4	8	10	16	20.7	0.3
08-Jun-17	10:25:27	3	2	5	7	11	4	4	8	10	14	20.7	0.2
08-Jun-17	10:25:57	4	2	6	8	6	5	4	9	12	8	20.8	0.2
08-Jun-17	10:26:27	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:26:57	4	2	6	8	6	5	4	9	12	8	20.8	0.2
08-Jun-17	10:27:27	4	2	6	8	7	5	4	9	12	9	20.8	0.2
08-Jun-17	10:27:57	3	2	5	7	7	4	4	8	10	9	20.8	0.2
08-Jun-17	10:28:27	3	2	5	7	6	4	4	8	10	8	20.8	0.2
08-Jun-17	10:28:57	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:29:27	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:29:57	4	2	6	8	7	5	4	9	12	9	20.8	0.2
08-Jun-17	10:30:27	4	2	6	8	7	5	4	9	12	9	20.8	0.2
08-Jun-17	10:30:57	4	2	6	8	7	5	4	9	12	9	20.8	0.2
08-Jun-17	10:31:27	4	2	6	8	6	5	4	9	12	8	20.8	0.2
08-Jun-17	10:31:57	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:32:27	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:32:57	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:33:27	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:33:57	4	2	6	8	5	5	4	9	12	6	20.8	0.2
08-Jun-17	10:34:27	2	2	4	5	2	3	4	7	8	3	20.8	0.1
08-Jun-17	10:34:57	2	4	6	7	6	3	8	11	12	8	20.9	0.2
08-Jun-17	10:35:27	2	4	6	7	7	3	8	11	12	9	20.9	0.2
08-Jun-17	10:35:57	2	4	6	7	8	3	8	11	12	10	20.9	0.2
08-Jun-17	10:36:27	2	4	6	7	8	3	8	11	12	10	20.8	0.2
08-Jun-17	10:36:57	2	4	6	7	7	3	8	11	12	9	20.8	0.2
08-Jun-17	10:37:27	2	4	6	7	7	3	8	11	12	9	20.8	0.2
08-Jun-17	10:37:57	2	4	6	7	4	3	8	11	12	5	20.8	0.2
08-Jun-17	10:38:27	2	4	6	7	3	3	8	11	12	4	20.8	0.2
08-Jun-17	10:38:57	2	4	6	7	2	3	8	11	12	3	20.8	0.2
08-Jun-17	10:39:27	2	4	6	7	3	3	8	11	12	4	20.8	0.2
08-Jun-17	10:39:57	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:40:27	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:40:57	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:41:27	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:41:57	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:42:27	3	4	7	9	2	4	8	12	14	3	20.8	0.2
08-Jun-17	10:42:57	3	4	7	9	2	4	8	12	14	3	20.9	0.2
08-Jun-17	10:43:27	3	4	7	9	2	4	8	12	14	3	20.9	0.2
08-Jun-17	10:43:57	3	4	7	9	2	4	8	12	14	3	20.9	0.2
08-Jun-17	10:44:27	3	4	7	9	2	4	8	12	14	3	20.9	0.2
08-Jun-17	10:44:57	3	4	7	9	2	4	8	12	14	3	20.9	0.2
08-Jun-17	10:45:27	2	4	6	7	8	3	8	11	12	10	20.9	0.2

60539866
Stack 1 Calculated Gas Data
8 June 2017

Date	Time	NO (ppm)	NO ₂ (ppm)	NO _x (ppm)	Equiv NO ₂ (ppm)	CO (ppm)	NO (mg/m ³)	NO ₂ (mg/m ³)	NO _x (mg/m ³)	Equiv NO ₂ (mg/m ³)	CO (mg/m ³)	O ₂ %	CO ₂ %
08-Jun-17	10:45:57	2	4	6	7	6	3	8	11	12	8	20.9	0.2
08-Jun-17	10:46:27	2	4	6	7	3	3	8	11	12	4	20.9	0.2
08-Jun-17	10:46:57	2	4	6	7	2	3	8	11	12	3	20.9	0.2
08-Jun-17	10:47:27	2	4	6	7	2	3	8	11	12	3	20.9	0.2
08-Jun-17	10:47:57	1	4	5	6	2	1	8	10	10	3	20.9	0.2
08-Jun-17	10:48:27	1	4	5	6	5	1	8	10	10	6	20.9	0.2
08-Jun-17	10:48:57	1	4	5	6	13	1	8	10	10	16	20.9	0.2
08-Jun-17	10:49:27	1	3	4	5	26	1	6	8	8	33	20.9	0.2
08-Jun-17	10:49:57	1	4	5	6	14	1	8	10	10	18	20.9	0.2
08-Jun-17	10:50:27	1	3	4	5	9	1	6	8	8	11	20.9	0.2
08-Jun-17	10:50:57	1	3	4	5	6	1	6	8	8	8	21.0	0.2
08-Jun-17	10:51:27	1	3	4	5	9	1	6	8	8	11	20.8	0.2
08-Jun-17	10:51:57	1	3	4	5	9	1	6	8	8	11	20.8	0.2
08-Jun-17	10:52:27	1	3	4	5	8	1	6	8	8	10	20.8	0.2
08-Jun-17	10:52:57	2	3	5	6	14	3	6	9	10	18	20.7	0.2
08-Jun-17	10:53:27	3	3	6	8	4	4	6	10	12	5	20.5	0.4
08-Jun-17	10:53:57	3	3	6	8	1	4	6	10	12	1	20.5	0.4
08-Jun-17	10:54:27	3	3	6	8	1	4	6	10	12	1	20.5	0.5
08-Jun-17	10:54:57	3	3	6	8	0	4	6	10	12	0	20.4	0.5
08-Jun-17	10:55:27	4	3	7	9	0	5	6	12	14	0	20.4	0.5
08-Jun-17	10:55:57	4	3	7	9	1	5	6	12	14	1	20.4	0.5
08-Jun-17	10:56:27	2	3	5	6	83	3	6	9	10	104	20.4	0.5
08-Jun-17	10:56:57	2	3	5	6	96	3	6	9	10	120	20.4	0.5
08-Jun-17	10:57:27	2	3	5	6	75	3	6	9	10	94	20.4	0.5
08-Jun-17	10:57:57	1	3	4	5	65	1	6	8	8	81	20.4	0.5
08-Jun-17	10:58:27	1	3	4	5	75	1	6	8	8	94	20.5	0.5
08-Jun-17	10:58:57	1	3	4	5	77	1	6	8	8	96	20.5	0.5
08-Jun-17	10:59:27	1	3	4	5	66	1	6	8	8	83	20.5	0.5
08-Jun-17	10:59:57	1	3	4	5	59	1	6	8	8	74	20.5	0.4
08-Jun-17	11:00:27	1	3	4	5	59	1	6	8	8	74	20.5	0.4
08-Jun-17	11:00:57	1	3	4	5	61	1	6	8	8	76	20.5	0.5
08-Jun-17	11:01:27	1	3	4	5	61	1	6	8	8	76	20.5	0.5
MIN		1	2	4	5	0	1	4	7	8	0	20.0	0.1
MAX		5	4	8	10	336	7	8	14	16	420	21.0	0.5
AVERAGE		3	3	6	7	20	4	6	10	12	25	20.6	0.3
MASS EMISSION RATES (mg/s)							104	156	260	312	650		

End of Report

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