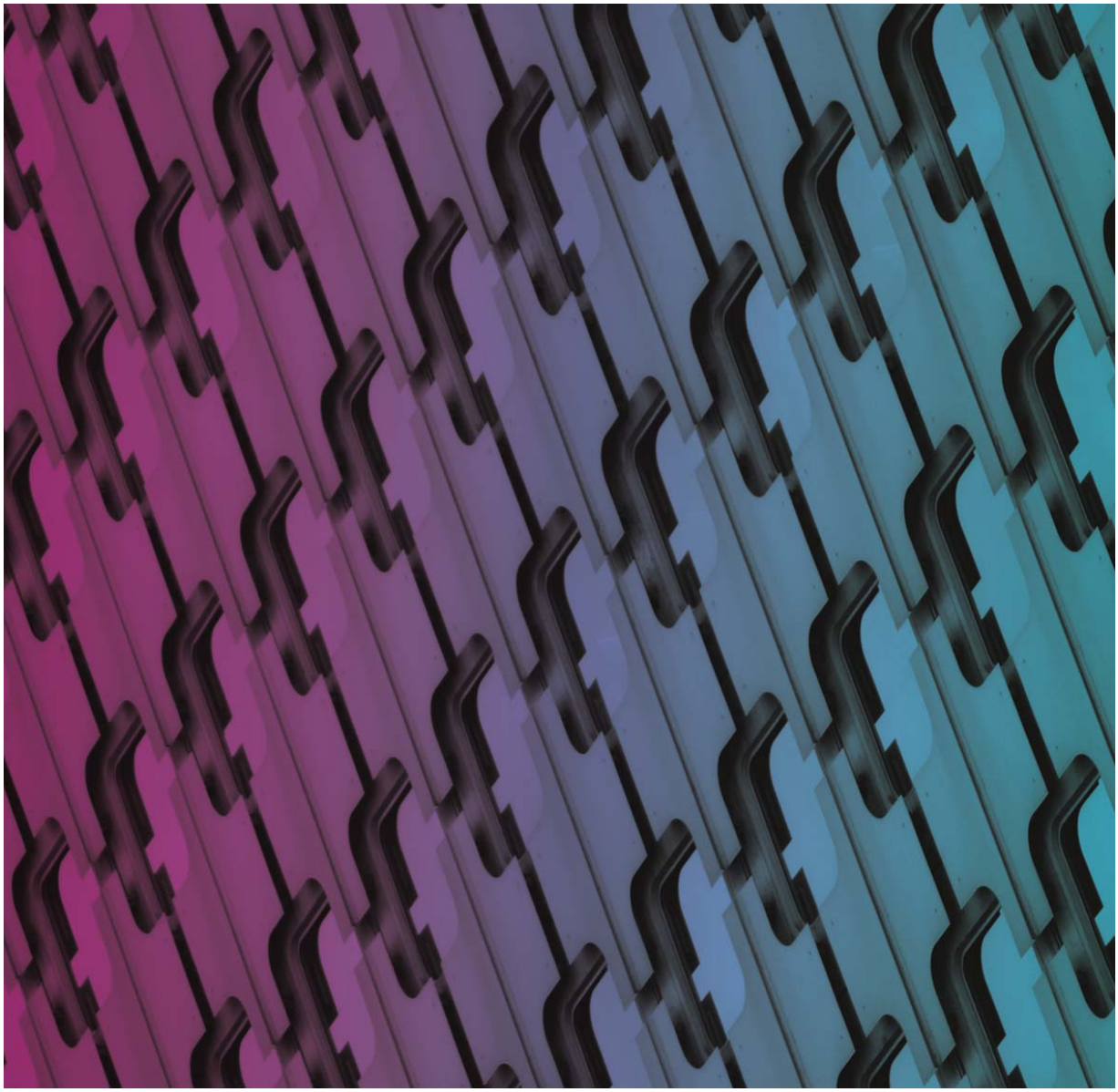
Stack 1 Emissions Testing Report June 2016

Pharmaceutical Waste Trial



Stack 1 Emissions Testing Report June 2016

Pharmaceutical Waste Trial

Client: Weston Aluminium

ABN: 91 075 245 108

Prepared by

AECOM Australia Pty Ltd
17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia
T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com
ABN 20 093 846 925

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Quality Information

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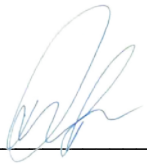
Prepared by James Lang Approved Signatory 

Reviewed by Paul Wenta

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	02-Sep-2016	Final Report	Chad Whitburn Compliance Services - Team Leader	

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Table of Contents

List of Tables

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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. Emission testing was a compliance requirement of Environmental Protection Licence (EPL) number 6423.

Testing was conducted on 30 June 2016 to determine emission concentrations for the following parameters:

Stack 1 (EPL Point 1)

- Total Particulate;
- Fine Particulate (PM_{10});
- Sulfuric Acid Mist (H_2SO_4 as SO_3);
- Sulfur Dioxide (SO_2 as SO_3);
- 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 11667-0-P, 11667-0-M and 11616-0-M:
    - Moisture;
    - Fine Particulate (PM_{10}); and
    - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1602522:
    - 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 ORG16_049 and DAU16-166:
    - Polycyclic Aromatic Hydrocarbons; and
    - Dioxins and Furans.
- SGS Leeder Consulting, NATA accreditation number 14429, performed the following analysis detailed in report number M161500:
    - 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^{o} 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_2SO_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 TM-15 (AS 4323.2-1995)	USEPA (2000) Method 5 under approved circumstances	Solid particles (Total)

NSW EPA Approved Methods	USEPA Methods	Parameter Measured
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 30 June 2016 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 2016 testing is presented in **Table 5**. Calculated Fine Particulate (PM_{10}) 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 30 June 2016

Parameter	Stack 1 EPL Point 1
Carbon Monoxide (CO) (ppm)	2 *(100)*
Chlorine (mg/m^3)	<1.8
Cyanide	0.33 *(0.5)*
Fine Particulate (PM_{10}) (mg/m^3)	0.83
Gaseous Fluoride (mg/m^3)	0.03 *(2)*
Hydrogen Chloride (mg/m^3)	<9.1 *(400)*
Oxides of Nitrogen (as Equivalent NO_2) (mg/m^3)	7 *(2500)*
Oxygen (%)	20.5
Carbon Dioxide (%)	<0.1
Particulate Fluoride (mg/m^3)	0.13
Sulfur Dioxide (SO_2 as SO_3) (mg/m^3)	<9.6
Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	<1.9 *(100)*
Total Particulate (mg/m^3)	2.6 *(25)*
Total Polycyclic Aromatic Hydrocarbons (mg/m^3)	0.053
Dioxins and Furans Lower Bound	0.0053
Dioxins and Furans Middle Bound	0.0053
Type 1 and 2 Substances in Aggregate (Metals) (mg/m^3)	0.0087 *(10)*
Volatile Organic Compounds (VOC) (mg/m^3)	0.4

Note – EPL Limits are in parenthesis

USEPA method 201A, section 6.3.5 (Determination of PM_{10} 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 (D_{50}) 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 D_{50}, 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 (PM_{10}) test particle sizes of 10µm and less are expected.

The cut size (D_{50}) 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 (D_{50}) 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 PM_{10} Cut Size

Sampling Location	PM_{10} Cut Size (D_{50})
Stack 1	9.6

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

Table 7 Calculated Gas Concentrations Data Summary, 30 June 2016

Parameter	Stack 1
Time Period	8:30-9:30
Nitrogen Oxide (NO) (mg/m^3)	4
Nitrogen Dioxide (NO_2) (mg/m^3)	0.1
Nitrogen Oxides (NO_x) (mg/m^3)	5
Oxides of Nitrogen as Equivalent NO_2 (mg/m^3)	*7 (2500)*
Carbon Monoxide (ppm)	*2 (100)*
Carbon Monoxide (mg/m^3)	3
Carbon Dioxide (%)	<0.1
Oxygen (%)	20.5

Note – EPL Limits are provided in parenthesis.

Table 8 Gas Mass Emission Rates Summary, 30 June 2016

Parameter	Stack 1
Time Period	8:30-9:30
Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure)	25
Nitrogen Oxide (NO) (mg/s)	100
Nitrogen Dioxide (NO_2) (mg/s)	0.25
Nitrogen Oxides (NO_x) (mg/s)	125
Oxides of Nitrogen as Equivalent NO_2 (mg/s)	175
Carbon Monoxide (mg/s)	75

Table 9 Stack 1 Fine Particulate (PM_{10}), Total Particulate, Particulate Fluoride and Gaseous Fluoride Results, 30 June 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	59.0	^{o}C	332.2	K
Stack pressure (average)	1021	hPa		
Stack gas velocity (average, stack conditions)	14	m/s		
Stack gas flowrate (stack conditions)	31	m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	25	m^3/s		
Fine Particulate (PM10) Testing				
Test Period	9:05	-	10:45	
Fine Particulate (PM10) Mass	1.1	mg		
Gas Volume Sampled	1.32	m^3		
Fine Particulate (PM10) Emission*1	0.83	mg/m^3		
Fine Particulate (PM10) Mass Emission Rate*2	21	mg/s		
Regulatory Limit	NA	mg/m^3		
Total Particulate Testing				
Test Period	9:05	-	10:45	
Total Particulate Mass	2.6	mg		
Gas Volume Sampled	0.989	m^3		
Total Particulate Emission*1	2.6	mg/m^3		
Total Particulate Mass Emission Rate*2	65	mg/s		
Regulatory Limit	25	mg/m^3		
Particulate Fluoride Testing				
Test Period	9:05	-	10:45	
Particulate Fluoride Mass	0.133	mg		
Gas Volume Sampled	0.995	m^3		
Particulate Fluoride Emission*1	0.13	mg/m^3		
Particulate Fluoride Mass Emission Rate*2	3.3	mg/s		
Regulatory Limit	NA	mg/m^3		
Gaseous Fluoride Testing				
Test Period	9:05	-	10:45	
Gaseous Fluoride Mass	0.03	mg		
Gas Volume Sampled	0.995	m^3		
Gaseous Fluoride Emission*1	0.03	mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	0.75	mg/s		
Regulatory Limit	2	mg/m^3		
Moisture Content (%)	**1.3**			
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 0^0C, 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 1 Hazardous Substances (Metals) and Cyanide Results, 30 June 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	54.0	^{o}C	327.2	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 (0^0C, dry gas, 1 atm pressure)	27	m^3/s		
Hazardous Substances (Metals) Testing				
Test Period	12:54	-	14:34	
Hazardous Substances (Metals) Mass	0.01	mg		
Gas Volume Sampled	1.17	m^3		
Hazardous Substances (Metals) Emission*1	0.0087	mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.23	mg/s		
Regulatory Limit	10	mg/m^3		
Cyanide Testing				
Test Period	12:54	-	14:34	
Cyanide Mass	0.30	mg		
Gas Volume Sampled	0.913	m^3		
Cyanide Emission*1	0.33	mg/m^3		
Cyanide Mass Emission Rate*2	8.9	mg/s		
Regulatory Limit	0.5	mg/m^3		
Moisture Content (%)	**1.0**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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 Hydrogen Chloride, Chlorine, Sulfuric Acid Mist (H_2SO_4 as SO_3) and Sulfur Dioxide (SO_2 as SO_3) Results, 30 June 2016

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	63.5 ^oC	336.7	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 (0^0C, dry gas, 1 atm pressure)	25 m^3/s		
Sulfuric Acid Mist (H2SO4 as SO3) Testing			
Test Period	11:04-	12:44	
Sulfuric Acid Mist (H2SO4 as SO3) Mass	<2 mg		
Gas Volume Sampled	1.04 m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Emission*1	<1.9 mg/m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2	<48 mg/s		
Regulatory Limit	100 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Testing			
Test Period	11:04-	12:44	
Sulfur Dioxide (SO2 as SO3) Mass	<10 mg		
Gas Volume Sampled	1.04 m^3		
Sulfur Dioxide (SO2 as SO3) Emission*1	<9.6 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2	<240 mg/s		
Regulatory Limit	NA mg/m^3		
Hydrogen Chloride Testing			
Test Period	11:04-	12:44	
Hydrogen Chloride Mass	<10 mg		
Gas Volume Sampled	1.09 m^3		
Hydrogen Chloride Emission*1	<9.1 mg/m^3		
Hydrogen Chloride Mass Emission Rate*2	<230 mg/s		
Regulatory Limit	400 mg/m^3		
Chlorine Testing			
Test Period	11:04-	12:44	
Chlorine Mass	<2 mg		
Gas Volume Sampled	1.09 m^3		
Chlorine Emission*1	<1.8 mg/m^3		
Chlorine Mass Emission Rate*2	<46 mg/s		
Regulatory Limit	NA mg/m^3		
Moisture Content (%)	**1.4**		
Gas Density (dry at 1 atmosphere)	**1.29 kg/m^3**		
Dry Molecular Weight	**28.8 g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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, 30 June 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	49.5	^{o}C	322.7	K
Stack pressure (average)	1021	hPa		
Stack gas velocity (average, stack conditions)	15	m/s		
Stack gas flowrate (stack conditions)	31	m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	26	m^3/s		
Dioxins and Furans Lower Bound Testing				
Test Period	8:21	-	14:21	
Dioxins and Furans Lower Bound Mass	0.018	mg		
Gas Volume Sampled	3.42	m^3		
Dioxins and Furans Lower Bound Emission*1	0.0053	mg/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.14	mg/s		
Regulatory Limit	NA	mg/m^3		
Dioxins and Furans Middle Bound Testing				
Test Period	8:21	-	14:21	
Dioxins and Furans Middle Bound Mass	0.018	mg		
Gas Volume Sampled	3.42	m^3		
Dioxins and Furans Middle Bound Emission*1	0.0053	mg/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.14	mg/s		
Regulatory Limit	NA	mg/m^3		
Polycyclic Aromatic Hydrocarbons Testing				
Test Period	8:21	-	14:21	
Polycyclic Aromatic Hydrocarbons Mass	0.18	mg		
Gas Volume Sampled	3.42	m^3		
Polycyclic Aromatic Hydrocarbons Emission*1	0.053	mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	1.4	mg/s		
Regulatory Limit	NA	mg/m^3		
Moisture Content (%)	**1.3**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.8**	**g/g-mole**		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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, 30 June 2016

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m^3)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.9
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.9
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.9
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.9
Benzene	1.1	<1.0	0.6	0.11	3
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.9
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.9
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.9
MIBK	<1.0	<1.0	<1.0	<0.18	<4.9
Toluene	1.9	<1.0	1.4	0.25	6.8
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.9
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.9
m- & p-xylene	<2.0	<0.2	<2.0	<0.36	<9.7
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.9
Styrene	<1.0	<1.0	<1.0	<0.18	<4.9
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.9
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.9
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.9
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
n-decane	<1.0	<1.0	<1.0	<0.18	<4.9
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.18	<4.9
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.9
Total	**3.0**		**2.0**	**0.4**	**9.8**

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, 30 June 2016

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	0.0049	0.1	0.00049	0.0014	0.00014
Total TCDF isomers	0.057				
2,3,7,8-TCDD	0.0054	1	0.0054	0.0016	0.0016
Total TCDD isomers	0.038				
1,2,3,7,8-PeCDF	0.0041	0.05	0.000205	0.0012	0.00006
2,3,4,7,8-PeCDF	0.0035	0.5	0.00175	0.001	0.00051
Total PeCDF isomers	0.026				
1,2,3,7,8-PeCDD	0.0017	0.5	0.00085	0.0005	0.00025
Total PeCDD isomers	0.027				
1,2,3,4,7,8-HxCDF	0.0092	0.1	0.00092	0.0027	0.00027
1,2,3,6,7,8-HxCDF	0.003	0.1	0.0003	0.00088	0.000088
2,3,4,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00029	0.000015
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00029	0.000015
Total HxCDF isomers	0.019				
1,2,3,4,7,8-HxCDD	<0.002	0.1	0.0001	<0.00058	0.000029
1,2,3,6,7,8-HxCDD	0.0056	0.1	0.00056	0.0016	0.00016
1,2,3,7,8,9-HxCDD	0.0022	0.1	0.00022	0.00064	0.000064
Total HxCDD isomers	0.067				
1,2,3,4,6,7,8-HpCDF	0.0091	0.01	0.000091	0.0027	0.000027
1,2,3,4,7,8,9-Hp CDF	0.0018	0.01	0.000018	0.00053	0.0000053
Total HpCDF isomers	0.029				
1,2,3,4,6,7,8-HpCDD	0.12	0.01	0.0012	0.035	0.00035
Total HpCDD isomers	0.25				
OCDF	0.018	0.001	0.000018	0.0053	0.0000053
OCDD	6.23	0.001	0.00623	1.8	0.0018

I-TEQ$_{DF}$

Lower Bound (excluding LOD Values)	0.018	ng
Middle Bound (including half LOD Values)	0.018	ng
Date Tested	30-Jun-16	

Table 15 Stack 1 Elemental Metals Results, 30 June 2016

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	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Arsenic	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Beryllium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Cadmium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Chromium	0.0001	0.000085	0.0073	0.0062			0.007	0.006	0.16
Cobalt	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Copper	<0.0003	<0.00026	0.0008	0.00068			0.0008	0.00068	0.018
Lead	<0.0002	<0.00017	0.00065	0.00055			0.00065	0.00055	0.015
Magnesium	0.003	0.0026	<0.0012	<0.001			0.003	0.0026	0.069
Manganese	0.0012	0.001	0.0005	0.00043			0.002	0.0017	0.045
Mercury	<0.0002	<0.00017	<0.0001	<0.000085	<0.0005	<0.00043	<0.0002	<0.00017	<0.0045
Nickel	<0.0002	<0.00017	0.00025	0.00021			0.00025	0.00021	0.0056
Selenium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Thallium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Tin	<0.0002	<0.00017	0.00035	0.0003			0.00035	0.0003	0.008
Vanadium	<0.0005	<0.00043	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Zinc	0.011	0.0094	0.0005	0.00043			0.01	0.0085	0.23
Total Hazardous Metals*	**0.0013**	**0.0011**	**0.0087**	**0.0074**	**<0.0005**	**<0.00043**	**0.01**	**0.0087**	**0.23**
Total Metals	**0.015**	**0.013**	**0.01**	**0.0088**			**0.024**	**0.021**	**0.55**

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

Table 16 Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 30 June 2016

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m^3)	(mg/m^3)	(µg/s)	(mg/s)
Naphthalene	120000	120	0.12	35	0.035	920	0.92
2 - Methylnaphthalene	6400	6.4	0.0064	1.9	0.0019	49	0.049
Acenaphthylene	34000	34	0.034	9.9	0.0099	260	0.26
Acenaphthene	440	0.44	0.00044	0.13	0.00013	3.4	0.0034
Fluorene	3800	3.8	0.0038	1.1	0.0011	29	0.029
Phenanthrene	9800	9.8	0.0098	2.9	0.0029	75	0.075
Anthracene	330	0.33	0.00033	0.096	0.000096	2.5	0.0025
Fluoranthene	710	0.71	0.00071	0.21	0.00021	5.5	0.0055
Pyrene	550	0.55	0.00055	0.16	0.00016	4.2	0.0042
Benz(a)anthracene	190	0.19	0.00019	0.056	0.000056	1.5	0.0015
Chrysene	250	0.25	0.00025	0.073	0.000073	1.9	0.0019
Benzo(b)fluoranthene	170	0.17	0.00017	0.05	0.00005	1.3	0.0013
Benzo(k)fluoranthene	130	0.13	0.00013	0.038	0.000038	1	0.001
Benzo(e)pyrene	130	0.13	0.00013	0.038	0.000038	1	0.001
Benzo(a)pyrene	87	0.087	0.000087	0.025	0.000025	0.67	0.00067
Perylene	270	0.27	0.00027	0.079	0.000079	2.1	0.0021
Indeno(123:cd)pyrene	120	0.12	0.00012	0.035	0.000035	0.92	0.00092
Dibenzo(ah)anthracene	63	0.063	0.000063	0.018	0.000018	0.48	0.00048
Benzo(ghi)perylene	160	0.16	0.00016	0.047	0.000047	1.2	0.0012
Sum of reported PAH's	**180000**	**180**	**0.18**	**52**	**0.052**	**1400**	**1.4**

Appendix A

Field Sheets and Final Calculations (70 pages)

Appendix A Field Sheets and Final Calculations (70 pages)

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 30-Jun-16

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:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
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
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 2.14 m^2

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

Upstream (m) = 4
No. Diameters = 2.4
Type of Upstream Disturbance: Fan
Downstream (m) = 6
No. Diameters = 3.6
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 20
PM2.5/10= 12
No. of sampling traverses/ports sampled = 2
PM2.5/10= 2
No. of sampling points on each traverse/port = 10
PM2.5/10= 6

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

No.	A Distance from wall	A S-type Pitot distances	B PM10/2.5 A Distance from wall	B PM2.5/10 B 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		
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
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: 8:58		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	8:58	8	20.5	0.2
2	8:59	8	20.5	0.2
3	9:00	6	20.5	0.2
4	9:01	4	20.4	0.3
5	9:02	5	20.4	0.3
6	9:03	9	20.4	0.3
7	9:04	15	20.4	0.3
8	9:05	14	20.4	0.3
	Averages:	8.6 ppm	20.4 %	0.3 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.70 %

Measurements

CO:	0.0009 %,(dry)	N_2:	79.3 %,(dry)
CO_2:	0.3 %,(dry)	O_2:	20.4 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0008 %,(wet)	N_2:	78.0 %,(wet)
CO_2:	0.3 %,(wet)	O_2:	20.1 %,(wet)
H_2O:	1.70 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
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: 10:38		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:38	9	20.5	0.2
2	10:39	9	20.6	0.2
3	10:40	11	20.6	0.2
4	10:41	9	20.5	0.2
5	10:42	6	20.4	0.3
6	10:43	8	20.4	0.3
7	10:44	12	20.6	0.2
8	10:45	7	20.6	0.2
	Averages:	8.9 ppm	20.5 %	0.2 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.28 %

Measurements

CO:	0.0009 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.5 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0009 %,(wet)	N_2:	78.2 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.3 %,(wet)
H_2O:	1.28 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses
Fine Particulates

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

Time :	8:30	Barometric Pressure :		1022	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	0.155	59.0	332.2	14.4
1/2	211	0.115	59.0	332.2	12.4
1/3	458	0.108	59.0	332.2	12.0
1/4	1132	0.093	59.0	332.2	11.1
1/5	1379	0.157	59.0	332.2	14.4
1/6	1547	0.156	59.0	332.2	14.4
2/1	43	0.159	59.0	332.2	14.5
2/2	211	0.156	59.0	332.2	14.4
2/3	458	0.173	59.0	332.2	15.1
2/4	1132	0.180	59.0	332.2	15.4
2/5	1379	0.181	59.0	332.2	15.5
2/6	1547	0.171	59.0	332.2	15.1
Average			59.0	332.2	14.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -5 mm
Absolute pressure in stack (hPa) : 1021.51 hPa

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Particulate Fluoride
Test 4:Gaseous Fluoride

Time :	8:30	Barometric Pressure :	1022	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	81	0.145	59.0	332.2	13.9
1/2	165	0.181	59.0	332.2	15.5
1/3	262	0.155	59.0	332.2	14.4
1/4	383	0.115	59.0	332.2	12.4
1/5	554	0.108	59.0	332.2	12.0
1/6	1036	0.093	59.0	332.2	11.1
1/7	1208	0.157	59.0	332.2	14.4
1/8	1328	0.156	59.0	332.2	14.4
1/9	1425	0.164	59.0	332.2	14.8
1/10	1509	0.169	59.0	332.2	15.0
2/1	81	0.174	59.0	332.2	15.2
2/2	165	0.180	59.0	332.2	15.4
2/3	262	0.159	59.0	332.2	14.5
2/4	383	0.156	59.0	332.2	14.4
2/5	554	0.173	59.0	332.2	15.1
2/6	1036	0.180	59.0	332.2	15.4
2/7	1208	0.181	59.0	332.2	15.5
2/8	1328	0.171	59.0	332.2	15.1
2/9	1425	0.149	59.0	332.2	14.1
2/10	1509	0.142	59.0	332.2	13.7
Average			59.0	332.2	14.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -5 mm
Absolute pressure in stack (hPa) : 1021.51 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: fine5
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.92 x $10^{-5}m^2$
Thimble No: T406
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 191.3942 Meter finish: 191.3942
Time start: 8:57 Time finish: 8:58

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 192.7730 Meter finish: 192.7730
Time start: 10:46 Time finish: 10:47

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 191.3974 Time start: 9:05
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:08:30	73	13.5	11.0	7.0		Yes
1/2	0:07:15	241	13.5	14.0	7.0		Yes
1/3	0:07:00	488	13.5	16.0	7.0		Yes
1/4	0:06:45	1162	13.5	18.0	7.0		Yes
1/5	0:08:30	1409	13.5	19.0	8.0		Yes
1/6	0:08:30	1577	13.5	21.0	9.0		Yes
2/1	0:08:30	73	13.5	23.0	10.0		Yes
2/2	0:08:30	241	13.5	24.0	11.0		Yes
2/3	0:09:00	488	13.5	25.0	12.0		Yes
2/4	0:09:15	1162	13.5	27.0	15.0		Yes
2/5	0:09:15	1409	13.5	28.0	15.0		Yes
2/6	0:09:00	1577	13.5	28.0	16.0		Yes
Averages				21.2	10.3	no result	

Meter Finish: 192.7718 Time Finish: 10:45
Total Condensate collected: 0 ml Silica gel No(s) used: Z7

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: S2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x $10^{-5}m^2$
Thimble No: T454
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 99.4848 Meter finish: 99.4848
Time start: 8:59 Time finish: 9:00

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 100.5348 Meter finish: 100.5348
Time start: 10:48 Time finish: 10:49

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 99.4868 Time start: 9:05
Meter correction factor (GMf) : 1.0050

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	10.6	13.0	7.0		Yes
1/2	0:10:00	195	11.8	15.0	7.0		Yes
1/3	0:15:00	292	11.0	17.0	8.0		Yes
1/4	0:20:00	413	9.4	20.0	8.0		Yes
1/5	0:25:00	584	9.1	22.0	9.0		Yes
1/6	0:30:00	1066	8.5	23.0	10.0		Yes
1/7	0:35:00	1238	11.0	24.0	11.0		Yes
1/8	0:40:00	1358	11.0	25.0	12.0		Yes
1/9	0:45:00	1455	11.3	26.0	13.0		Yes
1/10	0:50:00	1539	11.4	27.0	14.0		Yes
2/1	0:55:00	111	11.6	28.0	14.0		Yes
2/2	1:00:00	195	11.7	29.0	15.0		Yes
2/3	1:05:00	292	11.0	30.0	15.0		Yes
2/4	1:10:00	413	11.0	30.0	16.0		Yes
2/5	1:15:00	584	11.5	31.0	16.0		Yes
2/6	1:20:00	1066	11.7	31.0	17.0		Yes
2/7	1:25:00	1238	11.8	32.0	17.0		Yes
2/8	1:30:00	1358	11.5	32.0	17.0		Yes
2/9	1:35:00	1455	10.7	33.0	18.0		Yes
2/10	1:40:00	1539	10.4	33.0	19.0		Yes
Averages				26.1	13.2	no result	

Meter Finish: 100.5330 Time Finish: 10:45
Total Condensate collected: 0 ml Silica gel No(s) used: F25

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF PARTICULATE FLUORIDE AND GASEOUS FLUORIDE

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: S9
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.39 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 386.3408 Meter finish: 386.3408
Time start: 9:01 Time finish: 9:02

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 387.3962 Meter finish: 387.3962
Time start: 10:50 Time finish: 10:51

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 386.3436 Time start: 9:05
Meter correction factor (GMf) : 1.0000

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	10.3	12.0	7.0		Yes
1/2	0:10:00	195	11.5	15.0	7.0		Yes
1/3	0:15:00	292	10.7	17.0	8.0		Yes
1/4	0:20:00	413	9.2	19.0	8.0		Yes
1/5	0:25:00	584	8.9	21.0	8.0		Yes
1/6	0:30:00	1066	8.2	22.0	9.0		Yes
1/7	0:35:00	1238	10.7	23.0	9.0		Yes
1/8	0:40:00	1358	10.7	24.0	10.0		Yes
1/9	0:45:00	1455	11.0	25.0	10.0		Yes
1/10	0:50:00	1539	11.1	26.0	11.0		Yes
2/1	0:55:00	111	11.3	27.0	11.0		Yes
2/2	1:00:00	195	11.4	27.0	12.0		Yes
2/3	1:05:00	292	10.8	28.0	13.0		Yes
2/4	1:10:00	413	10.7	28.0	13.0		Yes
2/5	1:15:00	584	11.2	29.0	14.0		Yes
2/6	1:20:00	1066	11.4	29.0	14.0		Yes
2/7	1:25:00	1238	11.5	30.0	15.0		Yes
2/8	1:30:00	1358	11.2	30.0	15.0		Yes
2/9	1:35:00	1455	10.5	30.0	16.0		Yes
2/10	1:40:00	1539	10.2	31.0	16.0		Yes
Averages				24.7	11.3	no result	

Meter Finish: 387.3946 Time Finish: 10:45
Total Condensate collected: 0 ml Silica gel No(s) used: 192

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

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

Time :	10:53	Barometric Pressure :		1022	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	59.0	332.2	14.6
1/2	211	0.165	59.0	332.2	14.8
1/3	458	0.154	59.0	332.2	14.3
1/4	1132	0.142	59.0	332.2	13.7
1/5	1379	0.143	59.0	332.2	13.8
1/6	1547	0.160	59.0	332.2	14.6
2/1	43	0.151	59.0	332.2	14.2
2/2	211	0.143	59.0	332.2	13.8
2/3	458	0.150	59.0	332.2	14.1
2/4	1132	0.156	59.0	332.2	14.4
2/5	1379	0.159	59.0	332.2	14.5
2/6	1547	0.168	59.0	332.2	14.9
Average			59.0	332.2	14.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -10.3 mm
Absolute pressure in stack (hPa) : 1021.51 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Particulate Fluoride
Test 4:Gaseous Fluoride

Time :	10:53	Barometric Pressure :		1022	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	81	0.155	59.0	332.2	14.3
1/2	165	0.144	59.0	332.2	13.8
1/3	262	0.161	59.0	332.2	14.6
1/4	383	0.165	59.0	332.2	14.8
1/5	554	0.154	59.0	332.2	14.3
1/6	1036	0.142	59.0	332.2	13.7
1/7	1208	0.143	59.0	332.2	13.8
1/8	1328	0.160	59.0	332.2	14.6
1/9	1425	0.159	59.0	332.2	14.5
1/10	1509	0.158	59.0	332.2	14.5
2/1	81	0.164	59.0	332.2	14.7
2/2	165	0.166	59.0	332.2	14.8
2/3	262	0.151	59.0	332.2	14.2
2/4	383	0.143	59.0	332.2	13.8
2/5	554	0.150	59.0	332.2	14.1
2/6	1036	0.156	59.0	332.2	14.4
2/7	1208	0.159	59.0	332.2	14.5
2/8	1328	0.168	59.0	332.2	14.9
2/9	1425	0.162	59.0	332.2	14.7
2/10	1509	0.154	59.0	332.2	14.3
Average			59.0	332.2	14.4

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -10.3 mm
Absolute pressure in stack (hPa) : 1020.99 hPa

STACK ANALYSIS - PM10 CALCULATIONS

Date:	30-Jun-16	Client:	Weston Aluminium
AECOM's Project No:	60489919	Stack/Duct Description:	Stack 1

1. Gas Analysis

	%		
$\%CO_2$	0.2		
$\%O_2$	20.5		
$\%N_2+\%CO$	79.3		
Fraction Moisture Content, Bws	0.01	M_s=	0.99

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.86
Mol. Wt. of Stack Gas (wet)	28.67

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	102200	30.17
Stack Static Pressure (Pg)	102099	30.14
Absolute Stack Pressure		30.14

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	59.0	138.2
Average Meter Temperature:	15.8	
Stack Gas Viscosity		198.2

5. Cyclone Flow Rate

	ft^3/min	m^3/min	L/min	L/s
Cyclone Flow Rate	0.50	0.0178	17.82	0.30

6. Nozzle Velocity, Rmin and Rmax

Nozzle Number	Nozzle Diameter	Nozzle Velocity		Rmin	Rmax	Vmin	Vmin	Vmax	Vmax
	(inches)	ft/sec	m/s	[-]	[-]	ft/sec	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	0.132	88.64	29.18	0.759	1.229	67.26	22.07	108.91	35.73
2	0.154	65.07	21.42	0.733	1.245	47.69	15.65	81.01	26.58
3	0.160	60.35	19.87	0.724	1.250	43.71	14.34	75.45	24.75
4	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
5	0.195	40.60	13.36	0.653	1.289	26.49	8.69	52.32	17.17
6	0.219	32.06	10.55	0.570	1.324	18.28	6.00	42.44	13.93
7	0.235	27.91	9.19	0.488	1.350	13.96	4.58	37.68	12.36
8	0.261	22.63	7.45	#NUM!	1.399	11.32	3.71	31.67	10.39
9	0.296	17.64	5.81	#NUM!	1.477	8.82	2.89	26.05	8.55
10	0.341	13.26	4.37	#NUM!	1.598	6.63	2.18	19.90	6.53
11	0.389	10.19	3.35	#NUM!	1.748	5.10	1.67	15.29	5.02

Selected Nozzle	Nozzle Diameter (inches)	Nozzle Diameter (m)	Nozzle Area (m^2)	Sample Rate (L/min)
5	0.195	0.005	0.000019	13.3

STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 30-Jun-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

7.Sampling Time Total Run Time 100 Number of points 12

Velocity Head (pitot) Pa	Vel Head in H20	Sqr Root	Dwell time mins
160.88	0.65	0.80	8.5
164.81	0.66	0.81	8.6
154.02	0.62	0.79	8.3
142.25	0.57	0.76	8.0
143.23	0.57	0.76	8.0
159.90	0.64	0.80	8.5
151.07	0.61	0.78	8.2
143.23	0.57	0.76	8.0
150.09	0.60	0.78	8.2
155.98	0.63	0.79	8.4
158.92	0.64	0.80	8.5
167.75	0.67	0.82	8.7
	Average	0.79	100.00
	Square	0.62	

Total time min	Full hours	Full minutes	Seconds
8.5	0	8	30
15.8	0	15	45
22.8	0	22	45
29.5	0	29	30
38.0	0	38	0
46.5	0	46	30
55.0	0	55	0
63.5	1	3	30
72.5	1	12	30
81.8	1	21	45
91.0	1	31	0
100.0	1	40	0

Aerodynamic Cut Size (u_{cyc})
198.2

PM_{10} Flow rate at actual cyclone conditions (Q_a)
0.0151

Actual D_{50}
9.6

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Fine Particulate (PM10)

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.3881 m^3	Average barometric pressure (P_{BARO})	1022 hPa	
Average gas meter temp. ($T_{M,2}$):	15.8 °C			
	289.0 K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa	
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.3235 m^3			

(B) PM10 concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	T406	PM10 Weight	0.0011 g
Final PM10 Weight (Mp1):	0.00110 g		
PM10 Concentration (C1):	$=M_{p1}/MV_4=$	0.00083	g/m^3 (0°C, dry gas, 1atm pressure)
	;and C_2 =	0.83	mg/m^3 (0°C, dry gas, 1atm pressure)
CO_2 Basis	12 %		
Average CO_2%:	0.2 %		
Therefore, C_c:	$= C_a \times 12/CO_2\% =$	0.041	g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
	;and C_{c1} =	41	mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
O_2 Basis	7 %		
Average O_2%:	20.5 %		
Therefore, C_b:	$=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$	0.022	g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)
	;and C_{b1} =	22	mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z7

V_v = 13.2 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0176

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

B_{ws} = 1.31 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Fine Particulate (PM10)

(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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.061 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.06 m/s

(ii) Average of post-sampling velocities: 14.31 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.18 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 = 30.32 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 24.8 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.021	g/s (0°C, dry gas, 1 atm pressure)		
	=	21	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	1	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.56	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	560	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.0514 m^3	Average barometric pressure (P_{BARO})	1022	hPa
Average gas meter temp. ($T_{M,2}$):	19.6 °C			
	292.8 K	Average pressure at meter ($P_{M,2}$)	1022.00	hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.9895 m^3			

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: T454 Total Particulate Weight 0.0026 g

Final Total Particulate Weight (Mp1): 0.00260 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0026 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 2.6 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.13 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 130 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.07 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 70 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F25

V_v = 9.6 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0128

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

B_{ws} = 1.28 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(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^oC, wet, 1 atm pressure)
1.29 kg/m^3 (0^oC, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.061 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.32 m/s

(ii) Average of post-sampling velocities: 14.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.34 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 = 30.66 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.1 m^3/s (0^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.065	g/s (0^oC, dry gas, 1 atm pressure)		
	=	65	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	3.2	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	3200	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	1.8	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	1800	mg/s (0^oC, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Particulate Fluoride

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.0510 m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	18.0 °C		
	291.2 K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.9945 m^3		

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: 0 Particulate Fluoride Weight 0.000133 g

Final Particulate Fluoride Weight (Mp1): 0.00013 g

Particulate Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00013 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.13 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0064 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 6.4 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0035 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 3.5 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 192

V_v = 9.5 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0127

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

B_{ws} = 1.26 %

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): 1.28 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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.061 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.32 m/s

(ii) Average of post-sampling velocities: 14.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.34 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 = 30.66 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.1 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0033	g/s (0°C, dry gas, 1 atm pressure)		
	=	3.3	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.16	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	160	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.088	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	88	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Gaseous Fluoride

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.0510 m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	18.0 °C		
	291.2 K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.9945 m^3		

(B) Gaseous Fluoride concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: 0 Gaseous Fluoride Weight 0.00003 g

Final Gaseous Fluoride Weight (Mp1): 0.00003 g

Gaseous Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00003 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.03 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0015 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 1.5 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00081 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.81 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 192

V_v = 9.5 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0127

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

B_{ws} = 1.26 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Gaseous 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): 1.28 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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.061 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.32 m/s

(ii) Average of post-sampling velocities: 14.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.34 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 = 30.66 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.1 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00075	g/s (0°C, dry gas, 1 atm pressure)		
	=	0.75	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.037	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	37	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.02	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	20	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
30-Jun-16
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
PARTICULATE FLUORIDE
GASEOUS FLUORIDE

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	59.0 °C		332.2 K
Stack pressure (average)	1021 hPa		
Stack gas velocity (average, stack conditions)	14 m/s		
Stack gas flowrate (stack conditions)	31 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	25 m^3/s		
Fine Particulate (PM10) Testing			
Test Period	9:05	-	10:45
Fine Particulate (PM10) Mass	1.1 mg		
Gas Volume Sampled	1.32 m^3		
Fine Particulate (PM10) Emission*1	0.83 mg/m^3		
Fine Particulate (PM10) Mass Emission Rate*2	21 mg/s		
Regulatory Limit	NA mg/m^3		
Total Particulate Testing			
Test Period	9:05	-	10:45
Total Particulate Mass	2.6 mg		
Gas Volume Sampled	0.989 m^3		
Total Particulate Emission*1	2.6 mg/m^3		
Total Particulate Mass Emission Rate*2	65 mg/s		
Regulatory Limit	25 mg/m^3		
Particulate Fluoride Testing			
Test Period	9:05	-	10:45
Particulate Fluoride Mass	0.133 mg		
Gas Volume Sampled	0.995 m^3		
Particulate Fluoride Emission*1	0.13 mg/m^3		
Particulate Fluoride Mass Emission Rate*2	3.3 mg/s		
Regulatory Limit	NA mg/m^3		
Gaseous Fluoride Testing			
Test Period	9:05	-	10:45
Gaseous Fluoride Mass	0.03 mg		
Gas Volume Sampled	0.995 m^3		
Gaseous Fluoride Emission*1	0.03 mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	0.75 mg/s		
Regulatory Limit	2 mg/m^3		
Moisture Content (%)	1.3		
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 0^0C, 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: 60489919

Emission Source: Stack 1

Date Sampled: 30-Jun-16

ANALYTE(S)	METHOD
Hazardous Substances (Metals)	NSW EPA TM - 12, 13 & 14
Cyanide	USEPA OTM - 29

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Cyanide

Measurement/Observations

Stack Internal Dimensions:

Diameter 1650 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 2.14 m^2

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

Upstream (m) = 4
No. Diameters = 2.4
Type of Upstream Disturbance: Fan
Downstream (m) = 6
No. Diameters = 3.6
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 20
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 10
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				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Cyanide

Sampling time start: 12:47		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:47	45	20.6	0.2
2	12:48	43	20.7	0.1
3	12:49	41	20.6	0.2
4	12:50	38	20.7	0.1
5	12:51	32	20.7	0.1
6	12:52	30	20.7	0.1
7	12:53	28	20.8	0.1
8	12:54	27	20.3	0.3
	Averages:	35.5 ppm	20.6 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.70 %

Measurements

CO:	0.0036 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0035 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.1 %,(wet)	O_2:	20.3 %,(wet)
H_2O:	1.70 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Cyanide

Sampling time start: 14:27		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	14:27	1	20.9	0.0
2	14:28	2	20.9	0.0
3	14:29	2	20.9	0.0
4	14:30	2	20.9	0.0
5	14:31	1	20.9	0.0
6	14:32	1	20.9	0.0
7	14:33	0	20.9	0.0
8	14:34	1	20.9	0.0
	Averages:	1.3 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 0.97 %

Measurements

CO:	0.0001 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0001 %,(wet)	N_2:	78.3 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.7 %,(wet)
H_2O:	0.97 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)
Test 2:Cyanide

Time :	12:50	Barometric Pressure :		1022	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	81	0.178	68.0	341.2	15.6
1/2	165	0.153	68.0	341.2	14.5
1/3	262	0.172	68.0	341.2	15.3
1/4	383	0.150	68.0	341.2	14.3
1/5	554	0.130	68.0	341.2	13.4
1/6	1036	0.184	68.0	341.2	15.9
1/7	1208	0.197	68.0	341.2	16.4
1/8	1328	0.160	68.0	341.2	14.8
1/9	1425	0.172	68.0	341.2	15.3
1/10	1509	0.177	68.0	341.2	15.5
2/1	81	0.177	68.0	341.2	15.5
2/2	165	0.171	68.0	341.2	15.3
2/3	262	0.166	68.0	341.2	15.1
2/4	383	0.181	68.0	341.2	15.7
2/5	554	0.151	68.0	341.2	14.4
2/6	1036	0.164	68.0	341.2	15.0
2/7	1208	0.159	68.0	341.2	14.7
2/8	1328	0.166	68.0	341.2	15.1
2/9	1425	0.172	68.0	341.2	15.3
2/10	1509	0.178	68.0	341.2	15.6
Average			68.0	341.2	15.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -12.8 mm
Absolute pressure in stack (hPa) : 1020.74 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: G65
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.54 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 193.8850 Meter finish: 193.8850
Time start: 12:50 Time finish: 12:51
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 195.1532 Meter finish: 195.1532
Time start: 14:34 Time finish: 14:35
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 193.8888 Time start: 12:54
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:09	111	12.6	28.0	20.0		Yes
1/2	0:10:18	195	11.7	29.0	20.0		Yes
1/3	0:15:27	292	12.4	30.0	20.0		Yes
1/4	0:20:36	413	11.5	30.0	20.0		Yes
1/5	0:25:45	584	10.8	30.0	20.0		Yes
1/6	0:30:54	1066	12.8	30.0	20.0		Yes
1/7	0:36:03	1238	13.2	31.0	20.0		Yes
1/8	0:41:12	1358	12.0	31.0	21.0		Yes
1/9	0:46:21	1455	12.4	31.0	21.0		Yes
1/10	0:51:30	1539	12.5	31.0	21.0		Yes
2/1	0:56:39	111	12.5	32.0	21.0		Yes
2/2	1:01:48	195	12.4	32.0	22.0		Yes
2/3	1:06:57	292	12.2	32.0	22.0		Yes
2/4	1:12:06	413	12.7	33.0	22.0		Yes
2/5	1:17:15	584	11.6	32.0	22.0		Yes
2/6	1:22:24	1066	12.1	32.0	22.0		Yes
2/7	1:27:33	1238	11.9	32.0	22.0		Yes
2/8	1:32:42	1358	12.2	32.0	22.0		Yes
2/9	1:37:51	1455	12.4	32.0	22.0		Yes
2/10	1:43:00	1539	12.6	32.0	22.0		Yes
Averages				31.1	21.1	no result	

Meter Finish: 195.1500 Time Finish: 14:34
Total Condensate collected: 1 ml Silica gel No(s) used: F26

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS
SAMPLING OF CYANIDE

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: XX
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.26 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 101.7376 Meter finish: 101.7376
Time start: 12:52 Time finish: 12:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 102.7489 Meter finish: 102.7489
Time start: 14:36 Time finish: 14:37

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 101.7416 Time start: 12:54
Meter correction factor (GMf) : 1.0050

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:09	111	10.3	36.0	25.0		Yes
1/2	0:10:18	195	9.5	37.0	25.0		Yes
1/3	0:15:27	292	10.1	38.0	25.0		Yes
1/4	0:20:36	413	9.4	38.0	25.0		Yes
1/5	0:25:45	584	8.8	38.0	25.0		Yes
1/6	0:30:54	1066	10.5	38.0	25.0		Yes
1/7	0:36:03	1238	10.8	38.0	25.0		Yes
1/8	0:41:12	1358	9.7	38.0	25.0		Yes
1/9	0:46:21	1455	10.1	38.0	25.0		Yes
1/10	0:51:30	1539	10.2	38.0	26.0		Yes
2/1	0:56:39	111	10.2	38.0	26.0		Yes
2/2	1:01:48	195	10.1	39.0	26.0		Yes
2/3	1:06:57	292	9.9	39.0	26.0		Yes
2/4	1:12:06	413	10.3	39.0	27.0		Yes
2/5	1:17:15	584	9.5	39.0	27.0		Yes
2/6	1:22:24	1066	9.9	39.0	27.0		Yes
2/7	1:27:33	1238	9.7	38.0	27.0		Yes
2/8	1:32:42	1358	9.9	38.0	27.0		Yes
2/9	1:37:51	1455	10.1	38.0	27.0		Yes
2/10	1:43:00	1539	10.3	39.0	27.0		Yes
Averages				38.2	25.9	no result	

Meter Finish: 102.7478 Time Finish: 14:34
Total Condensate collected: 0 ml Silica gel No(s) used: F21

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)
Test 2:Cyanide

Time :	14:40	Barometric Pressure :		1022	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	81	0.181	40.0	313.2	15.0
1/2	165	0.192	40.0	313.2	15.5
1/3	262	0.181	40.0	313.2	15.0
1/4	383	0.185	40.0	313.2	15.2
1/5	554	0.187	40.0	313.2	15.3
1/6	1036	0.166	40.0	313.2	14.4
1/7	1208	0.179	40.0	313.2	14.9
1/8	1328	0.171	40.0	313.2	14.6
1/9	1425	0.180	40.0	313.2	15.0
1/10	1509	0.177	40.0	313.2	14.9
2/1	81	0.183	40.0	313.2	15.1
2/2	165	0.181	40.0	313.2	15.1
2/3	262	0.188	40.0	313.2	15.4
2/4	383	0.173	40.0	313.2	14.7
2/5	554	0.163	40.0	313.2	14.3
2/6	1036	0.166	40.0	313.2	14.4
2/7	1208	0.169	40.0	313.2	14.5
2/8	1328	0.180	40.0	313.2	15.0
2/9	1425	0.181	40.0	313.2	15.1
2/10	1509	0.170	40.0	313.2	14.6
Average			40.0	313.2	14.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.8 mm
Absolute pressure in stack (hPa) : 1021.04 hPa

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 30-Jun-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

	Particulate Metals Results	Gaseous Metals Results	Oixdisable Mercury Results		
Metal	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_2SO_4 + Rinses (mg) **(5B)**	Residue Rinse 8N HCl (mg) (If Required) **(5C)**
Antimony	<0.0002	<0.0001			
Arsenic	<0.0002	<0.0001			
Beryllium	<0.0002	<0.0001			
Cadmium	<0.0002	<0.0001			
Chromium	0.0001	0.0073			
Cobalt	<0.0002	<0.0001			
Copper	<0.0003	0.0008			
Lead	<0.0002	0.00065			
Magnesium	0.003	<0.0012			
Manganese	0.0012	0.0005			
Mercury	<0.0002	<0.0001	<0.0001	<0.0005	<0.0001
Nickel	<0.0002	0.00025			
Selenium	<0.0002	<0.0001			
Thallium	<0.0002	<0.0001			
Tin	<0.0002	0.00035			
Vanadium	<0.0005	<0.0001			
Zinc	0.011	0.0005			

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: 30-Jun-16 Client: Weston Aluminium
AECOM's Project No: 60489919 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	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Arsenic	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Beryllium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Cadmium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Chromium	0.0001	0.000085	0.0073	0.0062			0.007	0.006	0.16
Cobalt	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Copper	<0.0003	<0.00026	0.0008	0.00068			0.0008	0.00068	0.018
Lead	<0.0002	<0.00017	0.00065	0.00055			0.00065	0.00055	0.015
Magnesium	0.003	0.0026	<0.0012	<0.001			0.003	0.0026	0.069
Manganese	0.0012	0.001	0.0005	0.00043			0.002	0.0017	0.045
Mercury	<0.0002	<0.00017	<0.0001	<0.000085	<0.0005	<0.00043	<0.0002	<0.00017	<0.0045
Nickel	<0.0002	<0.00017	0.00025	0.00021			0.00025	0.00021	0.0056
Selenium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Thallium	<0.0002	<0.00017	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Tin	<0.0002	<0.00017	0.00035	0.0003			0.00035	0.0003	0.008
Vanadium	<0.0005	<0.00043	<0.0001	<0.000085			<0.0002	<0.00017	<0.0045
Zinc	0.011	0.0094	0.0005	0.00043			0.01	0.0085	0.23
Total Hazardous Metals*	0.0013	0.0011	0.0087	0.0074	<0.0005	<0.00043	0.01	0.0087	0.23
Total Metals	0.015	0.013	0.01	0.0088			0.024	0.021	0.55

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

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Cyanide

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.0112	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	32.0	°C		
	305.2	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	0.9130	m^3		

(B) Cyanide concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: NA Cyanide Weight 0.0003 g

Final Cyanide Weight (Mp1): 0.00030 g

Cyanide Concentration (C1): $=M_{p1}/MV_4=$ 0.00033 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.33 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.1 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.053 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 53 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.8 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.02 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 20 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F21

V_v = 5.1 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0068

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

B_{ws} = 0.74 %

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 $\frac{(273.2)}{(273.2+Ts)} \times \frac{(Ps)}{(1013.25)}$

= 1.068 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.14 m/s

(ii) Average of post-sampling velocities: 14.90 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.02 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 = 32.12 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 26.8 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0089	g/s (0°C, dry gas, 1 atm pressure)		
	=	8.9	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	1.4	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1400	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.54	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	540	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Hazardous Substances (Metals)

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.2738 m^3	Average barometric pressure (P_{BARO})	1022 hPa	
Average gas meter temp. ($T_{M,2}$):	26.1 °C			
	299.3 K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa	

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1728 m^3

(B) Metals concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Metals Weight	0.00001 g

Final Metals Weight (Mp1): 0.00001 g

Metals Concentration (C1): $=M_{p1}/MV_4=$ 8.7E-06 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.0087 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.1 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0014 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 1.4 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.8 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00053 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.53 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F26

V_v = 9.6 g (from laboratory report) V_w = 1 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0013

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0128

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

B_{ws} = 1.19 %

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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.077 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.14 m/s

(ii) Average of post-sampling velocities: 14.90 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.02 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 = 32.12 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 26.7 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00023	g/s (0°C, dry gas, 1 atm pressure)		
	=	0.23	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.037	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	37	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.014	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	14	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
30-Jun-16
HAZARDOUS SUBSTANCES (METALS)
CYANIDE

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	54.0 °C		327.2 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 (0^0C, dry gas, 1 atm pressure)	27 m^3/s		
Hazardous Substances (Metals) Testing			
Test Period	12:54	-	14:34
Hazardous Substances (Metals) Mass	0.01 mg		
Gas Volume Sampled	1.17 m^3		
Hazardous Substances (Metals) Emission*1	0.0087 mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.23 mg/s		
Regulatory Limit	10 mg/m^3		
Cyanide Testing			
Test Period	12:54	-	14:34
Cyanide Mass	0.3 mg		
Gas Volume Sampled	0.913 m^3		
Cyanide Emission*1	0.33 mg/m^3		
Cyanide Mass Emission Rate*2	8.9 mg/s		
Regulatory Limit	0.5 mg/m^3		
Moisture Content (%)	1.0		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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: 60489919

Emission Source: Stack 1

Date Sampled: 30-Jun-16

ANALYTE(S)	METHOD
Sulfuric Acid Mist	NSW EPA TM - 3
Sulfur Dioxide	NSW EPA TM - 4
Hydrogen Chloride	NSW EPA TM - 7 & 8
Chlorine	NSW EPA TM - 7 & 8

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

Measurement/Observations

Stack Internal Dimensions:

Diameter 1650 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 2.14 m^2

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

Upstream (m) = 4
No. Diameters = 2.4
Type of Upstream Disturbance: Fan
Downstream (m) = 6
No. Diameters = 3.6
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 20
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 10
PM2.5/10= NA

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

No.	A Distance from wall	A S-type Pitot distances	PM10/2.5 A Distance from wall	PM2.5/10 B 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				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

Sampling time start: 10:57		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:57	6	20.6	0.2
2	10:58	5	20.5	0.2
3	10:59	7	20.5	0.2
4	11:00	9	20.5	0.2
5	11:01	12	20.5	0.2
6	11:02	11	20.5	0.2
7	11:03	6	20.5	0.2
8	11:04	7	20.5	0.2
	Averages:	7.9 ppm	20.5 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.70 %

Measurements

CO:	0.0008 %,(dry)	N_2:	79.3 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.5 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0008 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.2 %,(wet)
H_2O:	1.70 %(=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 - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

Sampling time start: 12:37		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:37	8	20.5	0.2
2	12:38	1	20.5	0.2
3	12:39	1	20.6	0.2
4	12:40	7	20.8	0.1
5	12:41	9	20.8	0.1
6	12:42	10	20.9	0.0
7	12:43	11	20.9	0.0
8	12:44	12	20.9	0.0
	Averages:	7.4 ppm	20.7 %	0.1 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.35 %

Measurements

CO:	0.0007 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0007 %,(wet)	N_2:	78.1 %,(wet)
CO_2:	0.1 %,(wet)	O_2:	20.5 %,(wet)
H_2O:	1.35 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Sulfuric Acid Mist (H2SO4 as SO3)
Test 2:Sulfur Dioxide (SO2 as SO3)
Test 3:Hydrogen Chloride
Test 4:Chlorine

Time :	10:53	Barometric Pressure :		1022	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	81	0.155	59.0	332.2	14.4
1/2	165	0.144	59.0	332.2	13.8
1/3	262	0.161	59.0	332.2	14.6
1/4	383	0.165	59.0	332.2	14.8
1/5	554	0.154	59.0	332.2	14.3
1/6	1036	0.142	59.0	332.2	13.8
1/7	1208	0.143	59.0	332.2	13.8
1/8	1328	0.160	59.0	332.2	14.6
1/9	1425	0.159	59.0	332.2	14.5
1/10	1509	0.158	59.0	332.2	14.5
2/1	81	0.164	59.0	332.2	14.8
2/2	165	0.166	59.0	332.2	14.8
2/3	262	0.151	59.0	332.2	14.2
2/4	383	0.143	59.0	332.2	13.8
2/5	554	0.150	59.0	332.2	14.1
2/6	1036	0.156	59.0	332.2	14.4
2/7	1208	0.159	59.0	332.2	14.5
2/8	1328	0.168	59.0	332.2	14.9
2/9	1425	0.162	59.0	332.2	14.7
2/10	1509	0.154	59.0	332.2	14.3
Average			59.0	332.2	14.4

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -10.3 mm
Absolute pressure in stack (hPa) : 1020.99 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: S9
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.39 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 192.7738 Meter finish: 192.7738
Time start: 10:58 Time finish: 10:59

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 193.8837 Meter finish: 193.8837
Time start: 12:45 Time finish: 12:46

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 192.7764 Time start: 11:04
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	10.8	23.0	16.0		Yes
1/2	0:10:00	195	10.3	24.0	16.0		Yes
1/3	0:15:00	292	10.9	25.0	16.0		Yes
1/4	0:20:00	413	11.1	26.0	17.0		Yes
1/5	0:25:00	584	10.7	26.0	17.0		Yes
1/6	0:30:00	1066	10.3	27.0	17.0		Yes
1/7	0:35:00	1238	10.3	27.0	17.0		Yes
1/8	0:40:00	1358	10.9	27.0	18.0		Yes
1/9	0:45:00	1455	10.9	28.0	18.0		Yes
1/10	0:50:00	1539	10.9	28.0	18.0		Yes
2/1	0:55:00	111	11.1	28.0	19.0		Yes
2/2	1:00:00	195	11.1	29.0	19.0		Yes
2/3	1:05:00	292	10.6	29.0	19.0		Yes
2/4	1:10:00	413	10.3	29.0	20.0		Yes
2/5	1:15:00	584	10.6	30.0	20.0		Yes
2/6	1:20:00	1066	10.8	30.0	20.0		Yes
2/7	1:25:00	1238	10.9	30.0	20.0		Yes
2/8	1:30:00	1358	11.2	30.0	20.0		Yes
2/9	1:35:00	1455	11.0	30.0	20.0		Yes
2/10	1:40:00	1539	10.7	30.0	20.0		Yes
Averages				27.8	18.4	no result	

Meter Finish: 193.8818 Time Finish: 12:44
Total Condensate collected: 0 ml Silica gel No(s) used: P38

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFUR DIOXIDE (SO2 AS SO3)

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: S9
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.39 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 192.7738 Meter finish: 192.7738
Time start: 10:58 Time finish: 10:59
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 193.8837 Meter finish: 193.8837
Time start: 12:45 Time finish: 12:46
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 192.7764 Time start: 11:04
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	10.8	23.0	16.0		Yes
1/2	0:10:00	195	10.3	24.0	16.0		Yes
1/3	0:15:00	292	10.9	25.0	16.0		Yes
1/4	0:20:00	413	11.1	26.0	17.0		Yes
1/5	0:25:00	584	10.7	26.0	17.0		Yes
1/6	0:30:00	1066	10.3	27.0	17.0		Yes
1/7	0:35:00	1238	10.3	27.0	17.0		Yes
1/8	0:40:00	1358	10.9	27.0	18.0		Yes
1/9	0:45:00	1455	10.9	28.0	18.0		Yes
1/10	0:50:00	1539	10.9	28.0	18.0		Yes
2/1	0:55:00	111	11.1	28.0	19.0		Yes
2/2	1:00:00	195	11.1	29.0	19.0		Yes
2/3	1:05:00	292	10.6	29.0	19.0		Yes
2/4	1:10:00	413	10.3	29.0	20.0		Yes
2/5	1:15:00	584	10.6	30.0	20.0		Yes
2/6	1:20:00	1066	10.8	30.0	20.0		Yes
2/7	1:25:00	1238	10.9	30.0	20.0		Yes
2/8	1:30:00	1358	11.2	30.0	20.0		Yes
2/9	1:35:00	1455	11.0	30.0	20.0		Yes
2/10	1:40:00	1539	10.7	30.0	20.0		Yes
Averages				27.8	18.4	no result	

Meter Finish: 193.8818 Time Finish: 12:44
Total Condensate collected: 0 ml Silica gel No(s) used: P38

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HYDROGEN CHLORIDE AND CHLORINE

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: G65
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.54 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 100.5346 Meter finish: 100.5346
Time start: 11:00 Time finish: 11:01

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 101.7379 Meter finish: 101.7379
Time start: 12:47 Time finish: 12:48

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 100.5368 Time start: 11:04
Meter correction factor (GMf) : 1.0050

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	11.9	31.0	20.0		Yes
1/2	0:10:00	195	11.4	33.0	20.0		Yes
1/3	0:15:00	292	12.1	34.0	20.0		Yes
1/4	0:20:00	413	12.2	34.0	21.0		Yes
1/5	0:25:00	584	11.8	35.0	21.0		Yes
1/6	0:30:00	1066	11.4	36.0	22.0		Yes
1/7	0:35:00	1238	11.4	37.0	22.0		Yes
1/8	0:40:00	1358	12.1	37.0	23.0		Yes
1/9	0:45:00	1455	12.0	38.0	23.0		Yes
1/10	0:50:00	1539	12.0	38.0	23.0		Yes
2/1	0:55:00	111	12.2	38.0	23.0		Yes
2/2	1:00:00	195	12.2	39.0	24.0		Yes
2/3	1:05:00	292	11.7	39.0	24.0		Yes
2/4	1:10:00	413	11.4	39.0	24.0		Yes
2/5	1:15:00	584	11.6	40.0	24.0		Yes
2/6	1:20:00	1066	11.9	40.0	25.0		Yes
2/7	1:25:00	1238	12.0	40.0	25.0		Yes
2/8	1:30:00	1358	12.3	40.0	25.0		Yes
2/9	1:35:00	1455	12.1	40.0	25.0		Yes
2/10	1:40:00	1539	11.8	40.0	25.0		Yes
Averages				37.4	23.0	no result	

Meter Finish: 101.7356 Time Finish: 12:44
Total Condensate collected: 2 ml Silica gel No(s) used: P33

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Sulfuric Acid Mist (H2SO4 as SO3)
Test 2:Sulfur Dioxide (SO2 as SO3)
Test 3:Hydrogen Chloride
Test 4:Chlorine

Time :	12:50	Barometric Pressure :		1022	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	81	0.178	68.0	341.2	15.6
1/2	165	0.153	68.0	341.2	14.5
1/3	262	0.172	68.0	341.2	15.3
1/4	383	0.150	68.0	341.2	14.3
1/5	554	0.130	68.0	341.2	13.3
1/6	1036	0.184	68.0	341.2	15.9
1/7	1208	0.197	68.0	341.2	16.4
1/8	1328	0.160	68.0	341.2	14.8
1/9	1425	0.172	68.0	341.2	15.3
1/10	1509	0.177	68.0	341.2	15.5
2/1	81	0.177	68.0	341.2	15.5
2/2	165	0.171	68.0	341.2	15.3
2/3	262	0.166	68.0	341.2	15.0
2/4	383	0.181	68.0	341.2	15.7
2/5	554	0.151	68.0	341.2	14.4
2/6	1036	0.164	68.0	341.2	15.0
2/7	1208	0.159	68.0	341.2	14.7
2/8	1328	0.166	68.0	341.2	15.0
2/9	1425	0.172	68.0	341.2	15.3
2/10	1509	0.178	68.0	341.2	15.6
Average			68.0	341.2	15.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -12.8 mm
Absolute pressure in stack (hPa) : 1020.74 hPa

STACK ANALYSIS - FINAL CALCULATIONS

Sulfuric Acid Mist (H2SO4 as SO3)

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.1165	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	23.1	°C		
	296.3	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0383	m^3		

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: NA H2SO4 as SO3 Weight <0.002 g

Final H2SO4 as SO3 Weight (Mp1): <0.002 g

H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0019 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <1.9 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.15 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <150 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.071 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <71 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P38

V_v = 10.6 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0142

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

B_{ws} = 1.34 %

Emission Measurement Calculations Spreadsheet

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/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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.046 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.38 m/s

(ii) Average of post-sampling velocities: 15.12 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.75 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 = 31.54 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.4 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.048	g/s (0°C, dry gas, 1 atm pressure)		
	=	<48	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<3.9	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<3900	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<1.8	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<1800	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Sulfur Dioxide (SO2 as SO3)

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

Date: 30-Jun-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3): 1.1165 m^3
Average gas meter temp. ($T_{M,2}$): 23.1 °C
296.3 K
Average barometric pressure (P_{BARO}) 1022 hPa
Average pressure at meter ($P_{M,2}$) 1022.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.0383 m^3

(B) SO2 as SO3 concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
SO2 as SO3 Weight <0.01 g
Final SO2 as SO3 Weight (Mp1): <0.01 g
SO2 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0096 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <9.6 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %
Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.77 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <770 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %
Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.36 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <360 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P38
V_v = 10.6 g (from laboratory report) V_w = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0142

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

B_{ws} = 1.34 %

ANZ

Emission Measurement Calculations Spreadsheet

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/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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.046 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.38 m/s

(ii) Average of post-sampling velocities: 15.12 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.75 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 = 31.54 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.4 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.24	g/s (0°C, dry gas, 1 atm pressure	)		
	=	<240	mg/s (0°C, dry gas, 1 atm pressure	)		
	C_{1a} x Qstd =	<20	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	=	<20000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	C_{1a} x Qstd =	<9.1	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)	
	=	<9100	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Hydrogen Chloride

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.2048	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	30.2	°C		
	303.4	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0942	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): $=M_{p1}/MV_4=$ <0.0091 g/m^3 (0°C, dry gas, 1atm pressure)

;and $C_2 =$ <9.1 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.73 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and $C_{c1} =$ <730 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.34 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and $C_{b1} =$ <340 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P33

$V_v =$ 9.4 g (from laboratory report) $V_w =$ 2 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0027

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0125

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

$B_{ws} =$ 1.37 %

ANZ

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/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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.046 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.38 m/s

(ii) Average of post-sampling velocities: 15.12 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.75 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 = 31.54 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.4 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.23	g/s (0°C, dry gas, 1 atm pressure)		
	=	<230	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<19	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<19000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<8.6	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<8600	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Chlorine

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.2048	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	30.2	°C		
	303.4	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0942	m^3		

(B) Chlorine concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Chlorine Weight	<0.002 g
Final Chlorine Weight (Mp1):	<0.002	g		
Chlorine Concentration (C1):		$=M_{p1}/MV_4=$	<0.0018	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	<1.8	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.14 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <140 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.067 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <67 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P33

V_v = 9.4 g (from laboratory report) V_w = 2 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0027

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0125

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

B_{ws} = 1.37 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Chlorine

(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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.046 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.38 m/s

(ii) Average of post-sampling velocities: 15.12 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 14.75 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 = 31.54 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 25.4 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.046	g/s (0°C, dry gas, 1 atm pressure)			
	=	<46	mg/s (0°C, dry gas, 1 atm pressure)			
	C_{1a} x Qstd =	<3.7	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	=	<3700	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	C_{1a} x Qstd =	<1.7	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)	
	=	<1700	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)	

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
30-Jun-16
SULFURIC ACID MIST (H2SO4 AS SO3)
SULFUR DIOXIDE (SO2 AS SO3)
HYDROGEN CHLORIDE
CHLORINE

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	63.5 °C		336.7 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 (0^0C, dry gas, 1 atm pressure)	25 m^3/s		
Sulfuric Acid Mist (H2SO4 as SO3) Testing			
Test Period	11:04	-	12:44
Sulfuric Acid Mist (H2SO4 as SO3) Mass	<2 mg		
Gas Volume Sampled	1.04 m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Emission*1	<1.9 mg/m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2	<48 mg/s		
Regulatory Limit	100 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Testing			
Test Period	11:04	-	12:44
Sulfur Dioxide (SO2 as SO3) Mass	<10 mg		
Gas Volume Sampled	1.04 m^3		
Sulfur Dioxide (SO2 as SO3) Emission*1	<9.6 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2	<240 mg/s		
Regulatory Limit	NA mg/m^3		
Hydrogen Chloride Testing			
Test Period	11:04	-	12:44
Hydrogen Chloride Mass	<10 mg		
Gas Volume Sampled	1.09 m^3		
Hydrogen Chloride Emission*1	<9.1 mg/m^3		
Hydrogen Chloride Mass Emission Rate*2	<230 mg/s		
Regulatory Limit	400 mg/m^3		
Chlorine Testing			
Test Period	11:04	-	12:44
Chlorine Mass	<2 mg		
Gas Volume Sampled	1.09 m^3		
Chlorine Emission*1	<1.8 mg/m^3		
Chlorine Mass Emission Rate*2	<46 mg/s		
Regulatory Limit	NA mg/m^3		
Moisture Content (%)	1.4		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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: 60489919

Emission Source: Stack 1

Date Sampled: 30-Jun-16

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

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Dioxins and Furans Lower Bound
Test 2: Dioxins and Furans Middle Bound
Test 3: Polycyclic Aromatic Hydrocarbons

Measurement/Observations				
Stack Internal Dimensions: Diameter 1650 mm OR Length Width Length/Width (mm) Equivalent Diameter N/A mm			Cross Sectional Area : 2.14 m^2 Minimum No. of sampling points= 16	
Distance from sampling plane to nearest disturbances: Upstream (m) = 4 No. Diameters = 2.4 Type of Upstream Disturbance: Fan Downstream (m) = 6 No. Diameters = 3.6 Type of Down Stream Disturbance: Stack Exit			Total No. of sampling points = 20 PM2.5/10= NA No. of sampling traverses/ports sampled = 2 PM2.5/10= NA No. of sampling points on each traverse/port = 10 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	Check of total points against minimum, (yes/no) - comments:	
11				
12				
13				
14				
15				
16				
17				
18				
19			General Comments:	
20				
Signed:			Checked:	

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Dioxins and Furans Lower Bound
Test 2: Dioxins and Furans Middle Bound
Test 3: Polycyclic Aromatic Hydrocarbons

Sampling time start: 8:14		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	8:14	30	20.4	0.3
2	8:15	25	20.2	0.4
3	8:16	18	20.5	0.2
4	8:17	19	20.3	0.3
5	8:18	16	20.2	0.4
6	8:19	11	20.4	0.3
7	8:20	15	20.4	0.3
8	8:21	9	20.3	0.3
	Averages:	17.9 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.70 %

Measurements

CO:	0.0018 %,(dry)	N_2:	79.3 %,(dry)
CO_2:	0.3 %,(dry)	O_2:	20.3 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0018 %,(wet)	N_2:	78.0 %,(wet)
CO_2:	0.3 %,(wet)	O_2:	20.0 %,(wet)
H_2O:	1.70 %(=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

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Dioxins and Furans Lower Bound
Test 2: Dioxins and Furans Middle Bound
Test 3: Polycyclic Aromatic Hydrocarbons

Sampling time start: 14:14		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	14:14	2	20.9	0.0
2	14:15	3	20.9	0.0
3	14:16	5	20.9	0.0
4	14:17	3	20.9	0.0
5	14:18	2	20.9	0.0
6	14:19	5	20.9	0.0
7	14:20	6	20.9	0.0
8	14:21	5	20.9	0.0
	Averages:	3.9 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.30 %

Measurements

CO:	0.0004 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0004 %,(wet)	N_2:	78.1 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.6 %,(wet)
H_2O:	1.30 %(=M2)		

Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Dioxins and Furans Lower Bound
Test 2:Dioxins and Furans Middle Bound
Test 3:Polycyclic Aromatic Hydrocarbons

Time :	0:00	Barometric Pressure :		1022	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	81	0.145	59.0	332.2	13.9
1/2	165	0.181	59.0	332.2	15.5
1/3	262	0.155	59.0	332.2	14.4
1/4	383	0.115	59.0	332.2	12.3
1/5	554	0.108	59.0	332.2	12.0
1/6	1036	0.093	59.0	332.2	11.1
1/7	1208	0.157	59.0	332.2	14.4
1/8	1328	0.156	59.0	332.2	14.4
1/9	1425	0.164	59.0	332.2	14.8
1/10	1509	0.169	59.0	332.2	15.0
2/1	81	0.174	59.0	332.2	15.2
2/2	165	0.180	59.0	332.2	15.4
2/3	262	0.159	59.0	332.2	14.5
2/4	383	0.156	59.0	332.2	14.4
2/5	554	0.173	59.0	332.2	15.1
2/6	1036	0.180	59.0	332.2	15.4
2/7	1208	0.181	59.0	332.2	15.5
2/8	1328	0.171	59.0	332.2	15.1
2/9	1425	0.149	59.0	332.2	14.1
2/10	1509	0.142	59.0	332.2	13.7
Average			59.0	332.2	14.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -5 mm
Absolute pressure in stack (hPa) : 1021.51 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF DIOXINS AND FURANS

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: G4
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.27 x $10^{-5}m^2$
Thimble No: DAU150616B
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 450.2576 Meter finish: 450.2576
Time start: 8:17 Time finish: 8:18

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 453.9162 Meter finish: 453.9162
Time start: 14:21 Time finish: 14:22

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 450.2597 Time start: 8:21
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:18:00	111	9.5	16.0	8.0		Yes
1/2	0:36:00	195	10.6	22.0	10.0		Yes
1/3	0:54:00	292	9.9	24.0	11.0		Yes
1/4	1:12:00	413	8.4	25.0	12.0		Yes
1/5	1:30:00	584	8.2	26.0	13.0		Yes
1/6	1:48:00	1066	7.6	27.0	14.0		Yes
1/7	2:06:00	1238	9.9	28.0	15.0		Yes
1/8	2:24:00	1358	9.9	30.0	17.0		Yes
1/9	2:42:00	1455	10.1	32.0	19.0		Yes
1/10	3:00:00	1539	10.3	33.0	20.0		Yes
2/1	3:18:00	111	10.4	33.0	21.0		Yes
2/2	3:36:00	195	10.5	33.0	21.0		Yes
2/3	3:54:00	292	9.9	33.0	22.0		Yes
2/4	4:12:00	413	9.9	33.0	22.0		Yes
2/5	4:30:00	584	10.3	34.0	23.0		Yes
2/6	4:48:00	1066	10.5	34.0	23.0		Yes
2/7	5:06:00	1238	10.6	34.0	23.0		Yes
2/8	5:24:00	1358	10.3	34.0	24.0		Yes
2/9	5:42:00	1455	9.7	35.0	24.0		Yes
2/10	6:00:00	1539	9.4	31.0	24.0		Yes
Averages				29.9	18.3	no result	

Meter Finish: 453.9130 Time Finish: 14:21
Total Condensate collected: 10 ml Silica gel No(s) used: P39

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: G4
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.27 x $10^{-5}m^2$
Thimble No: DAU150616B
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 450.2576 Meter finish: 450.2576
Time start: 8:17 Time finish: 8:18
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 453.9162 Meter finish: 453.9162
Time start: 14:21 Time finish: 14:22
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1022 hPa (start); 1022 hPa (finish)
Meter start: 450.2597 Time start: 8:21
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:18:00	111	9.5	16.0	8.0		Yes
1/2	0:36:00	195	10.6	22.0	10.0		Yes
1/3	0:54:00	292	9.9	24.0	11.0		Yes
1/4	1:12:00	413	8.4	25.0	12.0		Yes
1/5	1:30:00	584	8.2	26.0	13.0		Yes
1/6	1:48:00	1066	7.6	27.0	14.0		Yes
1/7	2:06:00	1238	9.9	28.0	15.0		Yes
1/8	2:24:00	1358	9.9	30.0	17.0		Yes
1/9	2:42:00	1455	10.1	32.0	19.0		Yes
1/10	3:00:00	1539	10.3	33.0	20.0		Yes
2/1	3:18:00	111	10.4	33.0	21.0		Yes
2/2	3:36:00	195	10.5	33.0	21.0		Yes
2/3	3:54:00	292	9.9	33.0	22.0		Yes
2/4	4:12:00	413	9.9	33.0	22.0		Yes
2/5	4:30:00	584	10.3	34.0	23.0		Yes
2/6	4:48:00	1066	10.5	34.0	23.0		Yes
2/7	5:06:00	1238	10.6	34.0	23.0		Yes
2/8	5:24:00	1358	10.3	34.0	24.0		Yes
2/9	5:42:00	1455	9.7	35.0	24.0		Yes
2/10	6:00:00	1539	9.4	31.0	24.0		Yes
Averages				29.9	18.3	no result	

Meter Finish: 453.9130 Time Finish: 14:21
Total Condensate collected: 10 ml Silica gel No(s) used: P39

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Dioxins and Furans Lower Bound
Test 2:Dioxins and Furans Middle Bound
Test 3:Polycyclic Aromatic Hydrocarbons

Time :	14:40	Barometric Pressure :		1022	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	81	0.181	40.0	313.2	15.0
1/2	165	0.192	40.0	313.2	15.5
1/3	262	0.181	40.0	313.2	15.0
1/4	383	0.185	40.0	313.2	15.2
1/5	554	0.187	40.0	313.2	15.3
1/6	1036	0.166	40.0	313.2	14.4
1/7	1208	0.179	40.0	313.2	15.0
1/8	1328	0.171	40.0	313.2	14.6
1/9	1425	0.180	40.0	313.2	15.0
1/10	1509	0.177	40.0	313.2	14.9
2/1	81	0.183	40.0	313.2	15.2
2/2	165	0.181	40.0	313.2	15.1
2/3	262	0.188	40.0	313.2	15.4
2/4	383	0.173	40.0	313.2	14.7
2/5	554	0.163	40.0	313.2	14.3
2/6	1036	0.166	40.0	313.2	14.4
2/7	1208	0.169	40.0	313.2	14.5
2/8	1328	0.180	40.0	313.2	15.0
2/9	1425	0.181	40.0	313.2	15.1
2/10	1509	0.170	40.0	313.2	14.6
Average			40.0	313.2	14.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.8 mm
Absolute pressure in stack (hPa) : 1021.04 hPa

Stack Analysis - Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results

Date: 30-Jun-16
Client: Weston Aluminium
AECOM's Project No: 60489919
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	120000	120	0.12	35	0.035	920	0.92
2 - Methylnapthalene	6400	6.4	0.0064	1.9	0.0019	49	0.049
Acenaphthylene	34000	34	0.034	9.9	0.0099	260	0.26
Acenaphthene	440	0.44	0.00044	0.13	0.00013	3.4	0.0034
Fluorene	3800	3.8	0.0038	1.1	0.0011	29	0.029
Phenanthrene	9800	9.8	0.0098	2.9	0.0029	75	0.075
Anthracene	330	0.33	0.00033	0.096	0.000096	2.5	0.0025
Fluoranthene	710	0.71	0.00071	0.21	0.00021	5.5	0.0055
Pyrene	550	0.55	0.00055	0.16	0.00016	4.2	0.0042
Benz(a)anthracene	190	0.19	0.00019	0.056	0.000056	1.5	0.0015
Chrysene	250	0.25	0.00025	0.073	0.000073	1.9	0.0019
Benzo(b)fluoranthene	170	0.17	0.00017	0.05	0.00005	1.3	0.0013
Benzo(k)fluoranthene	130	0.13	0.00013	0.038	0.000038	1	0.001
Benzo(e)pyrene	130	0.13	0.00013	0.038	0.000038	1	0.001
Benzo(a)pyrene	87	0.087	0.000087	0.025	0.000025	0.67	0.00067
Perylene	270	0.27	0.00027	0.079	0.000079	2.1	0.0021
Indeno(123:cd)pyrene	120	0.12	0.00012	0.035	0.000035	0.92	0.00092
Dibenzo(ah)anthracene	63	0.063	0.000063	0.018	0.000018	0.48	0.00048
Benzo(ghi)perylene	160	0.16	0.00016	0.047	0.000047	1.2	0.0012
Sum of reported PAH's	180000	180	0.18	52	0.052	1400	1.4

60489919 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	0.0049	0.1	0.00049	0.0014	0.00014
Total TCDF isomers	0.057				
2,3,7,8-TCDD	0.0054	1	0.0054	0.0016	0.0016
Total TCDD isomers	0.038				
1,2,3,7,8-PeCDF	0.0041	0.05	0.000205	0.0012	0.00006
2,3,4,7,8-PeCDF	0.0035	0.5	0.00175	0.001	0.00051
Total PeCDF isomers	0.026				
1,2,3,7,8-PeCDD	0.0017	0.5	0.00085	0.0005	0.00025
Total PeCDD isomers	0.027				
1,2,3,4,7,8-HxCDF	0.0092	0.1	0.00092	0.0027	0.00027
1,2,3,6,7,8-HxCDF	0.003	0.1	0.0003	0.00088	0.000088
2,3,4,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00029	0.000015
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00029	0.000015
Total HxCDF isomers	0.019				
1,2,3,4,7,8-HxCDD	<0.002	0.1	0.0001	<0.00058	0.000029
1,2,3,6,7,8-HxCDD	0.0056	0.1	0.00056	0.0016	0.00016
1,2,3,7,8,9-HxCDD	0.0022	0.1	0.00022	0.00064	0.000064
Total HxCDD isomers	0.067				
1,2,3,4,6,7,8-HpCDF	0.0091	0.01	0.000091	0.0027	0.000027
1,2,3,4,7,8,9-Hp CDF	0.0018	0.01	0.000018	0.00053	0.0000053
Total HpCDF isomers	0.029				
1,2,3,4,6,7,8-HpCDD	0.12	0.01	0.0012	0.035	0.00035
Total HpCDD isomers	0.25				
OCDF	0.018	0.001	0.000018	0.0053	0.0000053
OCDD	6.23	0.001	0.00623	1.8	0.0018

I-TEQ$_{DF}$

Lower Bound (excluding LOD Values)	0.018 ng
Middle Bound (including half LOD Values)	0.018 ng
Date Tested	**30-Jun-16**

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Lower Bound

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	3.6898	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	24.1	°C		
	297.3	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	3.4200	m^3		

(B) Lower Bound concentration at standard conditions

Blank thimble No.: NA Blank weight: µg

Thimble No. used: DAU150616B Lower Bound Weight 0.000018 µg

Final Lower Bound Weight (Mp1): 0.00002 µg

Lower Bound Concentration (C1): $=M_{p1}/MV_4=$ 5.3E-06 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.0053 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.00041 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.41 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00019 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.19 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P39

V_v = 23.8 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 ($V_{wsg(std)}$) = 0.0318

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

B_{ws} = 1.30 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

ANZ

Emission Measurement Calculations Spreadsheet

Dioxins and Furans Lower Bound

(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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.092 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.31 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): 14.61 m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) N/A m/s (stack conditions, wet)

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

Qstack = Vs x A = 31.24 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 26.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00014	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.14	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.011	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	11	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.0051	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	5.1	ng/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Middle Bound

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

Date: 30-Jun-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	3.6898	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	24.1	°C		
	297.3	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	3.4200	m^3		

(B) Middle Bound concentration at standard conditions

Blank thimble No.: NA Blank weight: µg
Thimble No. used: DAU150616B Middle Bound Weight 0.000018 µg
Final Middle Bound Weight (Mp1): 0.00002 µg
Middle Bound Concentration (C1): $=M_{p1}/MV_4=$ 5.3E-06 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.0053 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %
Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.00041 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.41 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %
Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00019 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.19 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P39
V_v = 23.8 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 ($V_{wsg(std)}$) = 0.0318
Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.30 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Dioxins and Furans Middle Bound

ANZ

Emission Measurement Calculations Spreadsheet

(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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.092 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.31 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): 14.61 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 = 31.24 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 26.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00014	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.14	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.011	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	11	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.0051	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	5.1	ng/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Polycyclic Aromatic Hydrocarbons

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

Date: 30-Jun-16 Client: Weston Aluminium

AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	3.6898	m^3	Average barometric pressure (P_{BARO})	1022 hPa
Average gas meter temp. ($T_{M,2}$):	24.1	°C		
	297.3	K	Average pressure at meter ($P_{M,2}$)	1022.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	3.4200	m^3		

(B) PAH concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	DAU150616B		PAH Weight	0.00018 g
Final PAH Weight (Mp1):	0.00018	g		
PAH Concentration (C1):		$=M_{p1}/MV_4=$	0.000053	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.053	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0041 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 4.1 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0019 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 1.9 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P39

V_v = 23.8 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 ($V_{wsg(std)}$) = 0.0318

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

B_{ws} = 1.30 %

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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.092 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.31 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): 14.61 m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) N/A m/s (stack conditions, wet)

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

Qstack = Vs x A = 31.24 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 26.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0014	g/s (0°C, dry gas, 1 atm pressure)			
	=	1.4	mg/s (0°C, dry gas, 1 atm pressure)			
	C_{1a} x Qstd =	0.11	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	=	110	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)	
	C_{1a} x Qstd =	0.051	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)	
	=	51	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)	

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
30-Jun-16
DIOXINS AND FURANS

POLYCYCLIC AROMATIC HYDROCARBONS

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	49.5 °C		322.7 K
Stack pressure (average)	1021 hPa		
Stack gas velocity (average, stack conditions)	15 m/s		
Stack gas flowrate (stack conditions)	31 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	26 m^3/s		
Dioxins and Furans Lower Bound Testing			
Test Period	8:21	-	14:21
Dioxins and Furans Lower Bound Mass	0.018 mg		
Gas Volume Sampled	3.42 m^3		
Dioxins and Furans Lower Bound Emission*1	0.0053 mg/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.14 mg/s		
Regulatory Limit	NA mg/m^3		
Dioxins and Furans Middle Bound Testing			
Test Period	8:21	-	14:21
Dioxins and Furans Middle Bound Mass	0.018 mg		
Gas Volume Sampled	3.42 m^3		
Dioxins and Furans Middle Bound Emission*1	0.0053 mg/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.14 mg/s		
Regulatory Limit	NA mg/m^3		
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	8:21	-	14:21
Polycyclic Aromatic Hydrocarbons Mass	0.18 mg		
Gas Volume Sampled	3.42 m^3		
Polycyclic Aromatic Hydrocarbons Emission*1	0.053 mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	1.4 mg/s		
Regulatory Limit	NA mg/m^3		
Moisture Content (%)	1.3		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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

AECOM

Client:	Weston Aluminium	
Project Number:	60489919	
Stack Description:	Stack 1	
Date:	30-Jun-16	
Rotameter Correction Factor:	1.01	
Time Start:	12:55	
Time Finish:	13:25	
Sample Flow Rate:	0.2	L/min
Sample Time:	30	min
Sampled Volume:	6.06	litres
	0.00606	m^3
Ambient Temperature:	21	°C
Barometric Pressure:	1021	hPa
Stack Gas Moisture:	1.0	%
Corrected Volume:	0.00561	m^3 (0°C, dry gas, 1 atmosphere pressure)
Stack Flow Rate	27	m^3/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	<4.9
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.9
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.9
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.9
Benzene	1.1	<1.0	0.6	0.11	3
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.9
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.9
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.9
MIBK	<1.0	<1.0	<1.0	<0.18	<4.9
Toluene	1.9	<1.0	1.4	0.25	6.8
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.9
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.9
m- & p-xylene	<2.0	<0.2	<2.0	<0.36	<9.7
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.9
Styrene	<1.0	<1.0	<1.0	<0.18	<4.9
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.9
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.9
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.9
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
n-decane	<1.0	<1.0	<1.0	<0.18	<4.9
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.9
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.18	<4.9
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.9
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.9
Total	3.0		2.0	0.4	9.8

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 (33 pages)

Appendix B Laboratory Analytical Reports (33 pages)

Steel River Testing

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

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle
Project: **60489919 / 1.2**

Report : 11616-0-M

Description : Stack Emission Samples
Received: 06-Jul-16

Date : 15-Jul-16

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

Copy to: FILE

Jar ID	Moisture (g)
135	5.4
192	9.5
CC12	5.2
F21	5.1
F23	9.3
F25	9.6
F26	9.6
F28	4.7
F99	4.4
FA8	8.8
FA9	32.3
I34	5.5
iA	11.9
JL308	5.9
L16	5.9
M300	9.2

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

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: M. Campbell
Michael Campbell

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

Steel River Testing

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

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle
Project: **60489919 / 1.2**

Report : 11616-0-M

Description : Stack Emission Samples
Received: 06-Jul-16

Date : 15-Jul-16

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

Copy to: FILE

Jar ID	Moisture (g)
M301	12.8
M302	8.1
M99	9.5
P1	10.8
P3	6.3
P32	4.0
P33	9.4
P35	2.7
P38	10.6
P5	11.1
P8	15.8
VK1	14.7
VK2	4.3
Z12	6.0
Z18	12.7
Z6	12.6

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

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: M Campbell
Michael Campbell

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

Steel River Testing

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

STACK EMISSION - MOISTURE REPORT

Origin:	AECOM - Newcastle	**Report :**	11616-0-M
Project:	**60489919 / 1.2**		
Description :	Stack Emission Samples Received: 06-Jul-16	**Date :**	15-Jul-16
Report To :	James Lang 17 Warabrook Blvd, Warabrook NSW 2304	**Copy to:**	FILE

Jar ID	Moisture (g)
Z7	13.2

Reported By: M. Campbell

Michael Campbell

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

Steel River Testing

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

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: **60489919**

Report : 11667-0-P

Description : Stack Emission Samples
Received: 14-Jul-16

Date : 15-Jul-16

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

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
T406	Filter	-	0.0011
T454	Filter	-	0.0026

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

Note : Sampled by Client

Reported By: M. Campbell
Michael 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 :**	11667-0-M	Page 1 of 1
Project:	**60489919**			
Description :	Stack Emission Samples Received: 14-Jul-16	**Date :**	15-Jul-16	
Report To :	James Lang 17 Warabrook Blvd, Warabrook NSW 2304	**Copy to:**	FILE	

Jar ID	Moisture (g)
P39	23.8

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

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: M Campbell

Michael Campbell

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

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EN1602522**	Page	: 1 of 14
Client	: **AECOM Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR JAMES LANG	Contact	: Kim Smith
Address	: 17 WARABROOK BOULEVARDE WARABROOK NSW 2304	Address	: 5/585 Maitland Road Mayfield West NSW Australia 2304
Telephone	: +61 02 4911 4900	Telephone	: +61 2 4014 2500
Project	: 60489919 Task 1.8	Date Samples Received	: 14-Jul-2016 13:30
Order number	: 60489919 Task 1.8	Date Analysis Commenced	: 14-Jul-2016
C-O-C number	: ----	Issue Date	: 21-Jul-2016 19:10
Sampler	: D TURNBULL, VILAI KELEMETE-MANUA		
Site	: ----		
Quote number	: ----		
No. of samples received	: 17		
No. of samples analysed	: 17		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA
WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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*
Ashesh Patel	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

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 sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **Filters were supplied by the client. Filter preparation may not meet ALS method requirements.**
- **EA144C-F: Gaseous and Particulate Fluoride conducted in accordance with AS3580.13.2 - 2013.**
- **EK026SF: LOR raised for Total Cyanide on samples 8 and 16 due to sample matrix.**
- **ED009x: LOR has been raised for Chloride, Bromide and Fluoride due to sample matrix interference.**
- **EP091: Surrogate recovery bias low due to sample matrix interferences, confirmed by re-analysis.**
- **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

Sub-Matrix: **FILTER** (Matrix: **AIR**)			Client sample ID	**Pharm_Particulate Fluoride**	**Particulate Fluoride_Blank**	----	----	----
			Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1602522-001**	**EN1602522-010**	--------	--------	--------
				Result	Result	----	----	----
EA144C: Gaseous and Particulate Fluorides								
Fluoride (Particulate) as HF	----	1	µg/filter	**133**	<1	----	----	----

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)				Client sample ID	Pharm_Gaseous Fluoride	Pharm_HCl	Pharm_Cl2	Pharm_H2SO4 as SO3	Pharm_SO2 as SO3
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]
Compound	CAS Number	LOR	Unit		EN1602522-002	EN1602522-003	EN1602522-004	EN1602522-005	EN1602522-006
					Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)									
Volume - Impinger	----	1	mL		----	----	----	217	----
Sulfuric Acid as SO3	----	2	mg/sample		----	----	----	<2	----
Volume - Impinger	----	1	mL		----	----	----	----	240
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		245	----	----	----	----
EA147: Acid Gases									
Hydrogen Bromide	----	0.01	mg		----	<1.00	----	----	----
Hydrogen Chloride	7647-01-0	0.1	mg		----	<10.0	----	----	----
Hydrogen Fluoride	73602-61-6	0.01	mg		----	<1.00	----	----	----
EA147: Halogens									
Bromine	7726-95-6	0.01	mg		----	----	<0.200	----	----
Chlorine	7782-50-5	0.1	mg		----	----	<2.00	----	----
Fluorine	7782-41-4	0.01	mg		----	----	<0.200	----	----
EK026-I: Cyanide in Air Impinger Solutions									
ø Cyanide	57-12-5	0.01	mg		----	----	----	----	----
ø Volume - Impinger	----	1	mL		----	----	----	----	----
Sampling Method									
ø Volume - Impinger	----	0.01	mL		----	255	246	----	----

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)				Client sample ID	Pharm_CNA	Pharm_CNB	Gaseous Fluoride_Blank	HCl(H2SO4)_Blank	Cl2(NaOH)_Blank
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]
Compound	CAS Number	LOR	Unit		EN1602522-007	EN1602522-008	EN1602522-011	EN1602522-012	EN1602522-013
					Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)									
Volume - Impinger	----	1	mL		----	----	----	----	----
Sulfuric Acid as SO3	----	2	mg/sample		----	----	----	----	----
Volume - Impinger	----	1	mL		----	----	----	----	----
Sulfur Dioxide as SO3	----	10	mg/sample		----	----	----	----	----
EA144C: Gaseous and Particulate Fluorides									
Fluoride (as HF)	----	0.01	mg/sample		----	----	<0.01	----	----
Volume - Impinger	----	1	mL		----	----	**215**	----	----
EA147: Acid Gases									
Hydrogen Bromide	----	0.01	mg		----	----	----	<1.00	----
Hydrogen Chloride	7647-01-0	0.1	mg		----	----	----	<10.0	----
Hydrogen Fluoride	73602-61-6	0.01	mg		----	----	----	<1.00	----
EA147: Halogens									
Bromine	7726-95-6	0.01	mg		----	----	----	----	<0.200
Chlorine	7782-50-5	0.1	mg		----	----	----	----	<2.00
Fluorine	7782-41-4	0.01	mg		----	----	----	----	<0.200
EK026-I: Cyanide in Air Impinger Solutions									
ø Cyanide	57-12-5	0.01	mg		**0.30**	<0.01	----	----	----
ø Volume - Impinger	----	1	mL		**298**	**137**	----	----	----
Sampling Method									
ø Volume - Impinger	----	0.01	mL		----	----	----	**72.6**	**146**

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)			Client sample ID	**Sox_IPA_Blank**	**SOX_H2O2_Blank**	**Cyanide_Blank**	----	----
			Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1602522-014**	**EN1602522-015**	**EN1602522-016**	--------	--------
				Result	Result	Result	----	----
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)								
Volume - Impinger	----	1	mL	**172**	----	----	----	----
Sulfuric Acid as SO3	----	2	mg/sample	<2	----	----	----	----
Volume - Impinger	----	1	mL	----	**210**	----	----	----
Sulfur Dioxide as SO3	----	10	mg/sample	----	<10	----	----	----
EA144C: Gaseous and Particulate Fluorides								
Fluoride (as HF)	----	0.01	mg/sample	----	----	----	----	----
Volume - Impinger	----	1	mL	----	----	----	----	----
EA147: Acid Gases								
Hydrogen Bromide	----	0.01	mg	----	----	----	----	----
Hydrogen Chloride	7647-01-0	0.1	mg	----	----	----	----	----
Hydrogen Fluoride	73602-61-6	0.01	mg	----	----	----	----	----
EA147: Halogens								
Bromine	7726-95-6	0.01	mg	----	----	----	----	----
Chlorine	7782-50-5	0.1	mg	----	----	----	----	----
Fluorine	7782-41-4	0.01	mg	----	----	----	----	----
EK026-I: Cyanide in Air Impinger Solutions								
ø Cyanide	57-12-5	0.01	mg	----	----	<0.01	----	----
ø Volume - Impinger	----	1	mL	----	----	**127**	----	----
Sampling Method								
ø Volume - Impinger	----	0.01	mL	----	----	----	----	----

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)			Client sample ID	**Pharm_VOC**	**VOC_Blank**	----	----	----
			Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1602522-009**	**EN1602522-017**	--------	--------	--------
				Result	Result	---	---	---
EP091A: Aliphatic Hydrocarbons - Total								
1-heptene	592-76-7	0.5	µg/sample	<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg/sample	<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg/sample	<1.0	<1.0	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons - Total								
Benzene	71-43-2	0.5	µg/sample	**1.1**	<1.0	----	----	----
Toluene	108-88-3	0.5	µg/sample	**1.9**	<1.0	----	----	----
Ethylbenzene	100-41-4	0.5	µg/sample	<1.0	<1.0	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	1	µg/sample	<2	<2	----	----	----
Styrene	100-42-5	0.5	µg/sample	<1.0	<1.0	----	----	----
ortho-Xylene	95-47-6	0.5	µg/sample	<1.0	<1.0	----	----	----
1.3.5-Trimethylbenzene	108-67-8	0.5	µg/sample	<1.0	<1.0	----	----	----
1.2.4-Trimethylbenzene	95-63-6	0.5	µg/sample	<1.0	<1.0	----	----	----
n-Butylbenzene	104-51-8	0.5	µg/sample	<1.0	<1.0	----	----	----
Isopropylbenzene	98-82-8	0.5	µg/sample	<1.0	<1.0	----	----	----
EP091C: Oxygenated Compounds - Total								
2-Propanone (Acetone)	67-64-1	0.5	µg/sample	<1.0	<1.0	----	----	----
2-Butanone (MEK)	78-93-3	0.5	µg/sample	<1.0	<1.0	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	µg/sample	<1.0	<1.0	----	----	----
2-Hexanone (MBK)	591-78-6	0.5	µg/sample	<1.0	<1.0	----	----	----
EP091D: Halogenated Compounds - Total								
1.1-Dichloroethane	75-34-3	0.5	µg/sample	<1.0	<1.0	----	----	----
Chloroform	67-66-3	0.5	µg/sample	<1.0	<1.0	----	----	----
Trichloroethene	79-01-6	0.5	µg/sample	<1.0	<1.0	----	----	----
Chlorobenzene	108-90-7	0.5	µg/sample	<1.0	<1.0	----	----	----
2-Chlorotoluene	95-49-8	0.5	µg/sample	<1.0	<1.0	----	----	----
4-Chlorotoluene	106-43-4	0.5	µg/sample	<1.0	<1.0	----	----	----
1.3-Dichlorobenzene	541-73-1	0.5	µg/sample	<1.0	<1.0	----	----	----
1.4-Dichlorobenzene	106-46-7	0.5	µg/sample	<1.0	<1.0	----	----	----
1.2-Dichlorobenzene	95-50-1	0.5	µg/sample	<1.0	<1.0	----	----	----
Hexachlorobutadiene	87-68-3	0.5	µg/sample	<1.0	<1.0	----	----	----
EP091A: Aliphatic Hydrocarbons (Section 1)								
1-heptene	592-76-7	0.5	µg	<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg	<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg	<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	Pharm_VOC	VOC_Blank	----	----	----
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1602522-009	EN1602522-017	--------	--------	--------
					Result	Result	---	---	---
EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)									
Benzene	71-43-2	0.5	µg		1.1	<1.0	----	----	----
Toluene	108-88-3	0.5	µg		1.9	<1.0	----	----	----
Ethylbenzene	100-41-4	0.5	µg		<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	----	----	----
ortho-Xylene	95-47-6	0.5	µg		<1.0	<1.0	----	----	----
1.3.5-Trimethylbenzene	108-67-8	0.5	µg		<1.0	<1.0	----	----	----
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 1)									
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 1)									
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	----	----	----
EP091A: Aliphatic Hydrocarbons (Section 2)									
1-heptene	592-76-7	0.5	µg		<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg		<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg		<1.0	<1.0	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 2)									
Benzene	71-43-2	0.5	µg		<1.0	<1.0	----	----	----
Toluene	108-88-3	0.5	µg		<1.0	<1.0	----	----	----
Ethylbenzene	100-41-4	0.5	µg		<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	**Pharm_VOC**	**VOC_Blank**	----	----	----
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EN1602522-009**	**EN1602522-017**	--------	--------	--------
					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	----	----	----
ortho-Xylene	95-47-6	0.5	µg		<1.0	<1.0	----	----	----
1.3.5-Trimethylbenzene	108-67-8	0.5	µg		<1.0	<1.0	----	----	----
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 2)									
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 2)									
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	----	----	----
EP091A: Aliphatic Hydrocarbons (Section 3)									
1-heptene	592-76-7	0.5	µg		<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg		<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg		<1.0	<1.0	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)									
Benzene	71-43-2	0.5	µg		<1.0	<1.0	----	----	----
Toluene	108-88-3	0.5	µg		<1.0	<1.0	----	----	----
Ethylbenzene	100-41-4	0.5	µg		<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	----	----	----
ortho-Xylene	95-47-6	0.5	µg		<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	Pharm_VOC	VOC_Blank	----	----	----
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1602522-009	EN1602522-017	--------	--------	--------
					Result	Result	---	---	---
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued									
1.3.5-Trimethylbenzene	108-67-8	0.5	µg		<1.0	<1.0	----	----	----
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	%		75.5	64.8	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		55.6	44.5	----	----	----
EP091: Chlorinated Organic Surrogates (Section 2)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		73.7	81.7	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		50.8	57.1	----	----	----
EP091: Chlorinated Organic Surrogates (Section 3)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		86.6	77.7	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		61.4	46.8	----	----	----
EP091: MAH Surrogates (Section 1)									
Toluene-D8	2037-26-5	0.5	%		66.4	50.2	----	----	----
EP091: MAH Surrogates (Section 2)									
Toluene-D8	2037-26-5	0.5	%		60.7	71.8	----	----	----
EP091: MAH Surrogates (Section 3)									

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	**Pharm_VOC**	**VOC_Blank**	----	----	----
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EN1602522-009**	**EN1602522-017**	--------	--------	--------
					Result	Result	----	----	----
EP091: MAH Surrogates (Section 3) - Continued									
Toluene-D8	2037-26-5	0.5	%		**74.3**	**66.2**	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	Pharm_HCl	Pharm_Cl2	Pharm_CNA	Pharm_CNB	HCl(H2SO4)_Blank
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]	[30-Jun-2016]
Compound	CAS Number	LOR	Unit		EN1602522-003	EN1602522-004	EN1602522-007	EN1602522-008	EN1602522-012
					Result	Result	Result	Result	Result
ED009: Anions									
Bromide	24959-67-9	0.01	mg/L		<1.00	<0.200	----	----	<1.00
Chloride	16887-00-6	0.1	mg/L		<10.0	<2.00	----	----	<10.0
Fluoride	16984-48-8	0.01	mg/L		<1.00	<0.200	----	----	<1.00
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.002	mg/L		----	----	1.01	<0.004	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**Cl2(NaOH)_Blank**	**Cyanide_Blank**	----	----	----
				Client sampling date / time	[30-Jun-2016]	[30-Jun-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EN1602522-013**	**EN1602522-016**	--------	--------	--------
					Result	Result	----	----	----
ED009: Anions									
Bromide	24959-67-9	0.01	mg/L		<0.200	----	----	----	----
Chloride	16887-00-6	0.1	mg/L		<2.00	----	----	----	----
Fluoride	16984-48-8	0.01	mg/L		<0.200	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.002	mg/L		----	<0.004	----	----	----

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

A.B.N. 44 000 964 278
10 / 585 Blackburn Road
Notting Hill, Vic, 3168
Telephone: (03) 9574 3200

Chartered Chemists

21-Jul-2016

REPORT NUMBER: M161500
Site/Client Ref: 60489919/1.8
Order No: 60489919/1.8

AECOM
17 Warabrook Bvde
Warabrook

NSW 2304
Attention: James Lang

CERTIFICATE OF ANALYSIS

SAMPLES:	Twelve samples were received for analysis
DATE RECEIVED:	**15-Jul-2016**
DATE COMMENCED:	**15-Jul-2016**
METHODS:	See Attached Results
RESULTS:	Please refer to attached pages for results.

Note: Results are based on samples as received at SGS laboratories

REPORTED BY:

Ming

Ming Dai
Senior Chemist

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number: 14429

Accredited for compliance with ISO/IEC 17025.

ANALYTICAL RESULTS

Matrix: Filter
Method: USEPA M29 (Analysis only) - MA-1400.FL.M29.02
Sample units are expressed in µg total

Test Started: 18/07/2016

	Leeder ID	2016019167	2016019168	2016019169
	Client ID	Pharm_Metals 1	Metals 12	Method
Analyte Name	**Sampled Date**	30/06/2016	30/06/2016	
	PQL			Blank
Sb	0.2	nd	nd	nd
As	0.2	nd	nd	nd
Be	0.2	nd	nd	nd
Cd	0.2	nd	nd	nd
Cr	0.2	0.4	0.3	nd
Co	0.2	nd	nd	nd
Cu	0.2	0.3	0.3	nd
Pb	0.2	0.2	0.2	nd
Mg	2	23	20	nd
Mn	0.2	0.6	0.3	nd
Hg	0.2	nd	nd	nd
Ni	0.2	0.2	0.2	nd
Se	0.2	nd	nd	nd
Tl	0.2	nd	nd	nd
Sn	0.2	nd	nd	nd
V	0.2	0.5	0.5	nd
Zn	0.2	280	270	nd

ANALYTICAL RESULTS

Matrix: Impinger Solution
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)
Sample units are expressed in µg total

Test Started: 18/07/2016

	Leeder ID	2016019170	2016019171
	Client ID	Pharm_Metals 3	Pharm_Metals 4
Analyte Name	Sampled Date	30/06/2016	30/06/2016
	PQL		
Sb	0.1	nd	nd
As	0.1	nd	nd
Be	0.1	nd	nd
Cd	0.1	nd	nd
Cr	0.1	nd	7.3
Co	0.1	nd	nd
Cu	0.1	nd	1.2
Pb	0.1	nd	0.7
Mg	0.1	nd	1.1
Mn	0.1	0.9	0.7
Hg	0.1	nd	nd
Ni	0.1	nd	0.3
Se	0.1	nd	nd
Tl	0.1	nd	nd
Sn	0.1	nd	0.4
V	0.1	nd	nd
Zn	0.1	1.1	1.1
Sample Volume		100	300

ANALYTICAL RESULTS

Matrix: Impinger Solution
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)
Sample units are expressed in µg total

Test Started: 18/07/2016

	Leeder ID		2016019172	2016019173	2016019174	2016019175	2016019176
	Client ID		Metals 8A	Metals 9	Pharm_Metals 5A	Pharm_Metals 5C	Metals 8B
Analyte Name	**Sampled Date**	**PQL**	30/06/2016	30/06/2016	30/06/2016	30/06/2016	30/06/2016
Sb		0.1	nd	nd			
As		0.1	nd	nd			
Be		0.1	nd	nd			
Cd		0.1	nd	nd			
Cr		0.1	nd	nd			
Co		0.1	nd	nd			
Cu		0.1	nd	0.4			
Pb		0.1	nd	nd			
Mg		0.1	nd	1.2			
Mn		0.1	nd	0.2			
Hg		0.1	nd	nd	nd	nd	nd
Ni		0.1	nd	nd			
Se		0.1	nd	nd			
Tl		0.1	nd	nd			
Sn		0.1	nd	nd			
V		0.1	nd	nd			
Zn		0.1	nd	0.6			
Sample Volume			310	200	100	250	100

ANALYTICAL RESULTS

Matrix: Impinger Solution
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)
Sample units are expressed in µg total

Test Started: 18/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019177 Metals 11 30/06/2016	2016019178 Method Blank
Sb	0.1		nd
As	0.1		nd
Be	0.1		nd
Cd	0.1		nd
Cr	0.1		nd
Co	0.1		nd
Cu	0.1		nd
Pb	0.1		nd
Mg	0.1		nd
Mn	0.1		nd
Hg	0.1	nd	nd
Ni	0.1		nd
Se	0.1		nd
Tl	0.1		nd
Sn	0.1		nd
V	0.1		nd
Zn	0.1		nd
Sample Volume		260	

Matrix: KMnO4
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.04 Mercury in Impingers (ug total)
Sample units are expressed in µg total

Test Started: 20/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019179 Pharm_Metals 5B 30/06/2016	2016019180 Metals 10 30/06/2016	2016019181 Method Blank
Hg	0.5	nd	nd	nd
Sample Volume		370	110	

QA/QC RESULTS

Matrix: Filter
Method: USEPA M29 (Analysis only) - MA-1400.FL.M29.02
Quality Control Results are expressed in Percent Recovery of expected result

Test Started: 18/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019182 Matrix Spike	2016019183 Matrix Spike Dup
Sb		93	93
As		94	93
Be		106	109
Cd		97	95
Cr		101	99
Co		104	100
Cu		103	99
Pb		97	99
Mg		105	103
Mn		105	102
Hg		102	104
Ni		102	101
Se		92	88
Tl		99	101
Sn		102	101
V		113	111
Zn		97	97

QA/QC RESULTS

Matrix: Impinger Solution
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)
Quality Control Results are expressed in Percent Recovery of expected result

Test Started: 18/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019184 Matrix Spike	2016019185 Matrix Spike Dup
Sb		93	96
As		98	95
Be		105	110
Cd		99	98
Cr		99	99
Co		100	100
Cu		101	100
Pb		100	98
Mg		103	104
Mn		96	95
Hg		105	104
Ni		100	100
Se		97	98
Tl		102	100
Sn		96	97
V		106	104
Zn		114	98

Matrix: KMnO4
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.04 Mercury in Impingers (ug total)
Quality Control Results are expressed in Percent Recovery of expected result

Test Started: 20/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019186 Matrix Spike
Hg		128

Matrix: KMnO4
Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.04 Mercury in Impingers (ug total)
Quality Control Results are expressed in Percent Recovery of expected result

Test Started: 20/07/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016019187 Matrix Spike Dup
Hg		128

QUALIFIERS / NOTES FOR REPORTED RESULTS

PQL	Practical Quantitation Limit
nd	Not Detected – The analyte was not detected above the reported PQL.
is	Insufficient Sample to perform this analysis.
T	Tentative identification based on computer library search of mass spectra.
NC	Not calculated and/or Results below PQL
NV	No Vacuum, Canister received above standard atmospheric pressure
nr	Not Requested for analysis.
R	Rejected Result – results for this analysis failed QC checks.
SQ	Semi-Quantitative result – quantitation based on a generic response factor for this class of analyte.
IM	Inappropriate method of analysis for this compound
U	Unable to provide Quality Control data – high levels of compounds in sample interfered with analysis of QC results.
UF	Unable to provide Quality Control data- Surrogates failed QC checks due to sample matrix effects
L	Analyte detected at a level above the linear response of calibration curve.
E	Estimated result. NATA accreditation does not cover estimated results.
C1	These compounds co-elute.
--	Parameter Not Determined
CT	Elevated concentration. Results reported from carbon tube analysis
**	Sample shows non-petroleum hydrocarbon profile

APPENDIX ONE.

CHAIN OF CUSTODY DOCUMENT

Chain of Custody Record - SGS Leeder Consulting

Dispatch samples to: Unit 5/18 Redland Drive, Mitcham, VIC, 3132

Attn: Lyndall Stevens - Contact Ph: (03) 9874 1988 Fax: (03) 9874 1933 Email: au.samplereceipt.mitcham@sgs.com

CLIENT NAME: AECOM

CLIENT ADDRESS: 17 Warabrook I

Warabrook NSW 2304

CONTACT: James Lang

SAMPLED BY: DT VK

PROJECT REF. / ORDER No: 60489919/1.8

CONTACT PHONE No: 02 4911 4900

CONTACT FAX No: 02 4911 4999

RESULTS REQUIRED BY: Standard

EMAIL REPORT TO: james.lang@aecom.com

LAB QUOTE NUMBER:

Sample Disposal (Please X) After: 4 Weeks ( ) 6 Weeks ( )

Client Sample ID	Date Sampled	Matrix			Containers/Preservation (please tick) (G=glass, P=plastic)										Analyses Required (Analyte + Method Code)	
		Filter	Impinger	KMnO4	0.1-1L Jar(G) n.a.	0.1-1.0 litre(G) Nat.	0.1-1.0 litre(P) Nat.	40ml Vial(G) Nat.	40ml Vial(G) H2SO4	0.1-1L (P) H2SO4	125mL (P) HCl acid washed	125mL (P) Zn Ace. NaOH	125mL (P) Filtered Yes/No HNO3	125mL (P) NaOH	Metals -USEPA Method 29*	Mercury
Pharm_Metals 1	30/06/16	x			x										x	
Pharm_Metals 3	30/06/16		x				x								x	
Pharm_Metals 4	30/06/16		x				x								x	
Pharm_Metals 5A	30/06/16		x				x									x
Pharm_Metals 5B	30/06/16			x		x										x
Pharm_Metals 5C	30/06/16		x				x									x
Metals 8A	30/06/16		x				x								x	
Metals 8B	30/06/16		x				x									x
Metals 9	30/06/16		x				x								x	
Metals 10	30/06/16			x		x										x
Metals 11	30/06/16		x				x									x
Metals 12	30/06/16	x			x										x	
----------	**Totals:**	2	8	2	2	2	8								6	6

CHAIN OF CUSTODY RECORD

RELEASED BY: (Name)	(Signature)	(Date / Time)
Dylan Turnbull		14/07/16
RECEIVED BY: (Name)	(Signature)	(Date / Time)
Sorelle L Robertson		15/7/16 7:40am

Custody Seals Intact? Yes / No

Samples Received Chilled? Yes / No 13.6°C

Please Note: Dissolved metals require filtering in the field.

Please indicate whether the HNO3 acidified sample has been filtered.

Comments: (eg. Highly contaminated samples, reporting requirements etc)

*Sb, As, Be, Cd, Cr, Co, Cu, Pb, Mg, Mn, Hg, Ni, Se, Tl, Sn, V, Zn

Australian Government
National Measurement Institute

ANALYSIS REPORT # ORG16_049

Client	AECOM Australia Pty Ltd 17 Warabrook Boulevarde Warabrook NSW 2304	**Job No.**	AECO01/160715
		Sampled by	Client
		Date Sampled	30-Jun-2016
Contact	James Lang	**Date Received**	15-Jul-2016

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

Method NGCMS 11.27

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
August 16, 2016

Accreditation NATA Accreditation Number : 198

Accredited for compliance with ISO/IEC 17025.

ACCREDITED FOR TECHNICAL COMPETENCE

Sample Details : Job No. AECO01/160715

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/019309	60489919 - ST1 Pharma	Emission	Resin DAU150616B, Filter, Rinses

Project Details

Project Name	*Not Specified*
Project Number	*PO No. 60489919 / 1.8*

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
$BaP\text{-}TEQ_{PAH}$	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:

$$BaP\text{-}TEQ_{PAH} = \sum_{i=1}^{n} [PAH_i \times BaP\text{-}PEF_i]$$

i = toxic PAH analyte index (1 to n=7)

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. AECO01/160715

Laboratory Reg. No.	N16/019309	**Date Reported**	16-Aug-2016
Client Sample Ref.	60489919 - ST1 Pharma	**Date Extracted**	29-Jul-2016
Matrix	Emission		
Description	Resin DAU150616B, Filter, Rinses		

PAH	Conc. ng	Reporting Level (LOR, ng)	BaP-PEF Value	BaP-TEQ Contribution	Labelled Internal recovery (%)	Flags
Naphthalene	120000	1100	-	-	56	
2-Methylnaphthalene	6400	68	-	-		
Acenaphthylene	34000	200	-	-	47	*
Acenaphthene	440	20	-	-	59	
Fluorene	3800	160	-	-	81	
Phenanthrene	9800	55	-	-	99	
Anthracene	330	21	-	-		
Fluoranthene	710	28	-	-	90	
Pyrene	550	20	-	-		
Benz(a)anthracene	190	30	0.1	19	105	
Chrysene	250	23	0.01	2.5	111	
Benzo(b)fluoranthene	170	35	0.1	17	94	
Benzo(k)fluoranthene	130	24	0.1	13	101	
Benzo(e)pyrene	130	20	-	-		
Benzo(a)pyrene	87	20	1.0	87	93	
Perylene	270	20	-	-		
Indeno(1,2,3-cd)pyrene	120	20	0.1	12	85	
Dibenz(ah)anthracene	63	36	0.4	25	85	
Benzo(ghi)perylene	160	20	-	-	76	

Flags
" * " : indicates the recovery is outside range but signal to noise is >10.
Acceptable recovery range set at 50 to 150%.

Surrogate Recovery	%
d14-Terphenyl	62

Summary Results		
BaP -TEQ$_{PAH}$		
Lower Bound [excluding LOD values]	**180**	ng
Middle Bound [including half LOD values]	**180**	ng
Upper Bound [including LOD values]	**180**	ng

Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU16_166

Client	AECOM 17 Warabrook Boulevarde Warabrook NSW 2304	**Job No.**	AECO01/160715
		Sampled by	Client
		Date Sampled	30-Jun-16
Contact	James Lang	**Date Received**	15-Jul-16

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

Method AUTL_02 **Date Reported** 9-Aug-16

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
Dioxin Analysis Unit

Robert Crough
Chemist
Dioxin Analysis Unit

Accreditation

NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025.

ACCREDITED FOR TECHNICAL COMPETENCE

Sample Details : Job No. AECO01/160715

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/019309X	60489919 - ST1 Pharma	Emission	Resin DAU150616B, Filter, Solvent Rinse

Project Details

Project Name	*Not Specified*
Project Number	*PO No. 60489919 / 1.8*

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:

$$\text{I-TEQ} = \sum_{i=1}^{7}[\text{PCDD}_i \times \text{TEF}_i] + \sum_{j=1}^{10}[\text{PCDF}_j \times \text{TEF}_j]$$

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
[	Laboratory surrogate recovery outside normal acceptance criteria: **40-130%** for Tetra/Penta/Hexa congeners - **25-130%** for Hepta/Octa congeners
]	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. AECO01/160715

Laboratory Reg. No. N16/019309X **Date Extracted** 29-Jul-16

Client Sample Ref. 60489919 - ST1 Pharma **DB5 Analysis** 05-Aug-16
Matrix Emission **DB-Dioxin Analysis** 03-Aug-16
Description Resin DAU150616B, Filter, Solvent Rinse

PCDD/F Congeners	Level pg	I-TEF	I-TEQ middle bound contribution	Labelled Surrogate recovery
2,3,7,8-TCDF	4.9	0.1	0.49	47
2,3,7,8-TCDD	5.4	1	5.4	51
1,2,3,7,8-PeCDF	4.1	0.05	0.20	52
2,3,4,7,8-PeCDF	3.5	0.5	1.7	**114**
1,2,3,7,8-PeCDD	1.7	0.5	0.86	67
1,2,3,4,7,8-HxCDF	9.2	0.1	0.92	**101**
1,2,3,6,7,8-HxCDF	3.0	0.1	0.30	77
2,3,4,6,7,8-HxCDF	<1	0.1	0.05	
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	
1,2,3,4,7,8-HxCDD	<2	0.1	0.1	**114**
1,2,3,6,7,8-HxCDD	5.6	0.1	0.56	79
1,2,3,7,8,9-HxCDD	2.2	0.1	0.22	
1,2,3,4,6,7,8-HpCDF	9.1	0.01	0.091	50
1,2,3,4,7,8,9-HpCDF	1.8	0.01	0.018	**86**
1,2,3,4,6,7,8-HpCDD	120	0.01	1.2	56
OCDF	18	0.001	0.018	
OCDD	6230	0.001	6.2	55

PCDD/F Homologue Groups	Level pg
Total TCDF isomers	57
Total TCDD isomers	38
Total PeCDF isomers	26
Total PeCDD isomers	27
Total HxCDF isomers	19
Total HxCDD isomers	67
Total HpCDF isomers	29
Total HpCDD isomers	250

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values	6760	pg

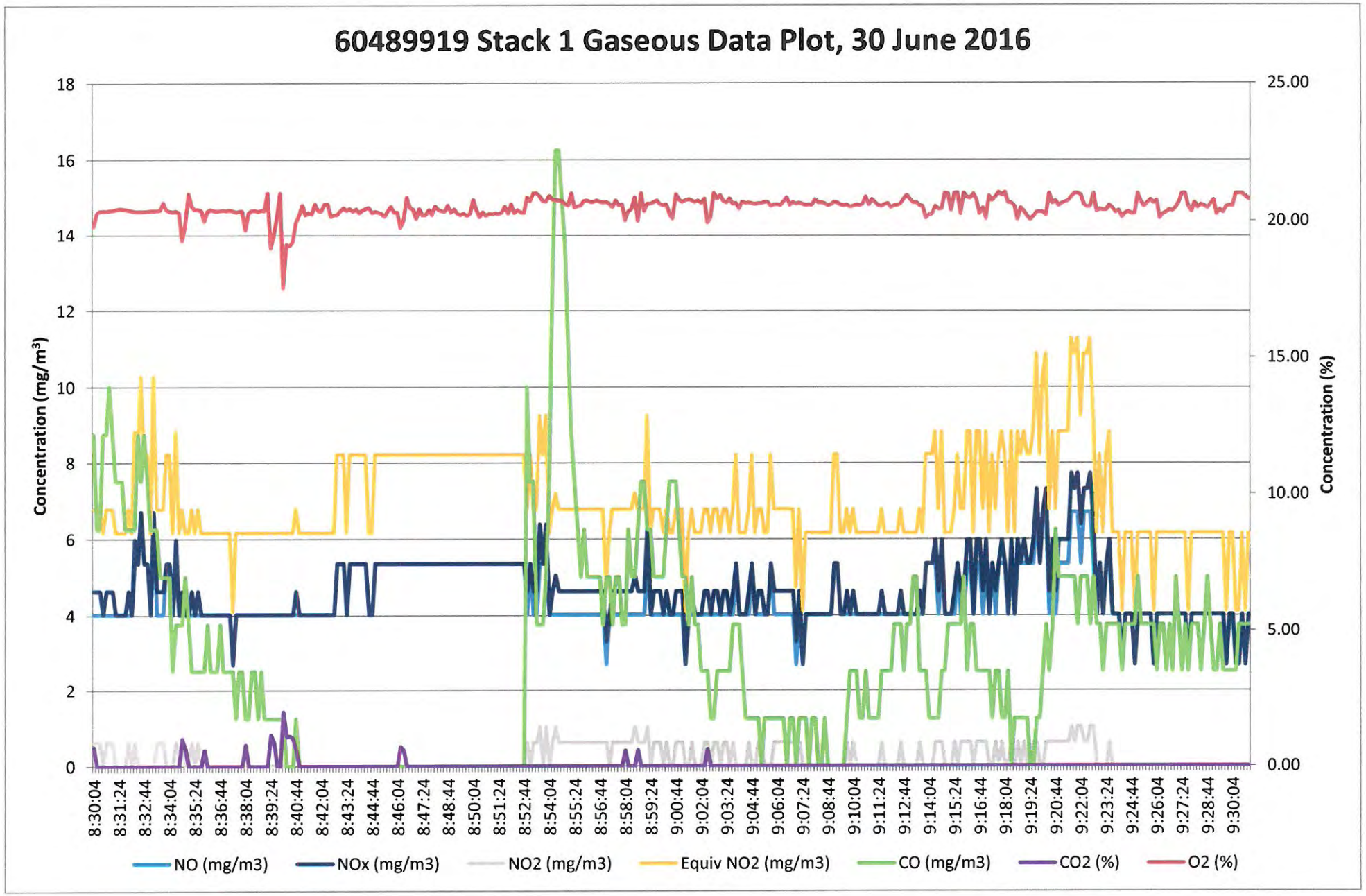
I-TEQ

Lower Bound [excluding LOD values]	**18**	pg
Middle Bound [including half LOD values]	**18**	pg
Upper Bound [including LOD values]	**19**	pg

Appendix C

Raw & Calculated Gas Data (4 pages)

Appendix C Raw & Calculated Gas Data (4 pages)


60489919 Stack 1 Gaseous Data Plot, 30 June 2016
Concentration (mg/m³)
Concentration (%)
18
16
14
12
10
8
6
4
2
0
25.00
20.00
15.00
10.00
5.00
0.00
8:30:04
8:31:24
8:32:44
8:34:04
8:35:24
8:36:44
8:38:04
8:39:24
8:40:44
8:42:04
8:43:24
8:44:44
8:46:04
8:47:24
8:48:44
8:50:04
8:51:24
8:52:44
8:54:04
8:55:24
8:56:44
8:58:04
8:59:24
9:00:44
9:02:04
9:03:24
9:04:44
9:06:04
9:07:24
9:08:44
9:10:04
9:11:24
9:12:44
9:14:04
9:15:24
9:16:44
9:18:04
9:19:24
9:20:44
9:22:04
9:23:24
9:24:44
9:26:04
9:27:24
9:28:44
9:30:04
NO (mg/m3)
NOx (mg/m3)
NO2 (mg/m3)
Equiv NO2 (mg/m3)
CO (mg/m3)
CO2 (%)
O2 (%)

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
30-Jun-16	8:30:04	3	4	3	5	0.3	1	5	7	7	9	0.70	19.8
30-Jun-16	8:30:14	3	4	3	5	0.3	1	5	7	5	6	0.00	20.2
30-Jun-16	8:30:24	3	4	3	5	0.3	1	5	7	5	6	0.00	20.3
30-Jun-16	8:30:34	3	4	3	4	0.0	0	5	6	7	9	0.00	20.3
30-Jun-16	8:30:44	3	4	4	5	0.3	1	5	7	7	9	0.00	20.3
30-Jun-16	8:30:54	3	4	4	5	0.3	1	5	7	8	10	0.00	20.4
30-Jun-16	8:31:04	3	4	3	5	0.3	1	5	7	7	9	0.00	20.4
30-Jun-16	8:31:14	3	4	3	4	0.0	0	5	6	6	8	0.00	20.4
30-Jun-16	8:31:24	3	4	3	4	0.0	0	5	6	6	8	0.00	20.4
30-Jun-16	8:31:34	3	4	3	4	0.0	0	5	6	6	8	0.00	20.4
30-Jun-16	8:31:44	3	4	3	4	0.0	0	5	6	5	6	0.00	20.4
30-Jun-16	8:31:54	3	4	4	5	0.3	1	5	7	5	6	0.00	20.4
30-Jun-16	8:32:04	3	4	3	4	0.0	0	5	6	5	6	0.00	20.3
30-Jun-16	8:32:14	4	5	4	6	0.3	1	6	9	5	6	0.00	20.3
30-Jun-16	8:32:24	4	5	4	5	0.0	0	6	8	7	9	0.00	20.3
30-Jun-16	8:32:34	5	7	5	7	0.0	0	8	10	6	8	0.00	20.3
30-Jun-16	8:32:44	4	5	4	5	0.0	0	6	8	7	9	0.00	20.3
30-Jun-16	8:32:54	4	5	4	5	0.0	0	6	8	6	8	0.00	20.3
30-Jun-16	8:33:04	3	4	3	4	0.0	0	5	6	5	6	0.00	20.3
30-Jun-16	8:33:14	5	7	5	7	0.0	0	8	10	5	6	0.00	20.3
30-Jun-16	8:33:24	3	4	4	5	0.3	1	5	7	5	6	0.00	20.3
30-Jun-16	8:33:34	3	4	4	5	0.3	1	5	7	4	5	0.00	20.4
30-Jun-16	8:33:44	3	4	3	5	0.3	1	5	7	4	5	0.00	20.6
30-Jun-16	8:33:54	4	5	4	5	0.0	0	6	8	4	5	0.00	20.4
30-Jun-16	8:34:04	4	5	4	5	0.0	0	6	8	4	5	0.00	20.3
30-Jun-16	8:34:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:34:24	4	5	4	6	0.3	1	6	9	3	4	0.00	20.3
30-Jun-16	8:34:34	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	8:34:44	3	4	4	5	0.3	1	5	7	3	4	1.00	19.2
30-Jun-16	8:34:54	3	4	3	4	0.0	0	5	6	4	5	0.67	19.8
30-Jun-16	8:35:04	3	4	3	4	0.0	0	5	6	3	4	0.00	21.0
30-Jun-16	8:35:14	3	4	4	5	0.3	1	5	7	2	3	0.00	20.5
30-Jun-16	8:35:24	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:35:34	3	4	4	5	0.3	1	5	7	2	3	0.00	20.4
30-Jun-16	8:35:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:35:54	3	4	3	4	0.0	0	5	6	2	3	0.59	20.0
30-Jun-16	8:36:04	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	8:36:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:36:24	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:36:34	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:36:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	8:36:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:37:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:37:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:37:24	2	3	2	3	0.0	0	3	4	2	3	0.00	20.3
30-Jun-16	8:37:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.3
30-Jun-16	8:37:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:37:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	8:38:04	3	4	3	4	0.0	0	5	6	1	1	0.78	19.6
30-Jun-16	8:38:14	3	4	3	4	0.0	0	5	6	1	1	0.00	20.3
30-Jun-16	8:38:24	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:38:34	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:38:44	3	4	3	4	0.0	0	5	6	1	1	0.00	20.3
30-Jun-16	8:38:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	8:39:04	3	4	3	4	0.0	0	5	6	1	1	0.00	20.3
30-Jun-16	8:39:14	3	4	3	4	0.0	0	5	6	1	1	0.00	21.0
30-Jun-16	8:39:24	3	4	3	4	0.0	0	5	6	1	1	1.15	19.0
30-Jun-16	8:39:34	3	4	3	4	0.0	0	5	6	1	1	0.88	19.5
30-Jun-16	8:39:44	3	4	3	4	0.0	0	5	6	1	1	0.00	20.1
30-Jun-16	8:39:54	3	4	3	4	0.0	0	5	6	1	1	0.00	21.0
30-Jun-16	8:40:04	3	4	3	4	0.0	0	5	6	1	1	1.99	17.5
30-Jun-16	8:40:14	3	4	3	4	0.0	0	5	6	0	0	1.08	19.1
30-Jun-16	8:40:24	3	4	3	4	0.0	0	5	6	0	0	1.11	19.0
30-Jun-16	8:40:34	3	4	3	4	0.0	0	5	6	0	0	1.02	19.2
30-Jun-16	8:40:44	3	4	4	5	0.3	1	5	7	1	1	0.62	19.9
30-Jun-16	8:40:54	3	4	3	4	0.0	0	5	6	0	0	0.00	20.2
30-Jun-16	8:41:04	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	8:41:14	3	4	3	4	0.0	0	5	6	0	0	0.00	20.2
30-Jun-16	8:41:24	3	4	3	4	0.0	0	5	6	0	0	0.00	20.3
30-Jun-16	8:41:34	3	4	3	4	0.0	0	5	6	0	0	0.00	20.2
30-Jun-16	8:41:44	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	8:41:54	3	4	3	4	0.0	0	5	6	0	0	0.00	20.3
30-Jun-16	8:42:04	3	4	3	4	0.0	0	5	6	0	0	0.00	20.3
30-Jun-16	8:42:14	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	8:42:24	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	8:42:34	3	4	3	4	0.0	0	5	6	0	0	0.00	20.1
30-Jun-16	8:42:44	3	4	3	4	0.0	0	5	6	0	0	0.00	20.2
30-Jun-16	8:42:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:43:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:43:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.5
30-Jun-16	8:43:24	3	4	3	4	0.0	0	5	6	0	0	0.00	20.4
30-Jun-16	8:43:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:43:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:43:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:44:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:44:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:44:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:44:34	3	4	3	4	0.0	0	5	6	0	0	0.00	20.5
30-Jun-16	8:44:44	3	4	3	4	0.0	0	5	6	0	0	0.00	20.3
30-Jun-16	8:44:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:45:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:45:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:45:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.1
30-Jun-16	8:45:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:45:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.5
30-Jun-16	8:45:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:46:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:46:14	4	5	4	5	0.0	0	6	8	0	0	0.72	19.7
30-Jun-16	8:46:24	4	5	4	5	0.0	0	6	8	0	0	0.58	20.0
30-Jun-16	8:46:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.8
30-Jun-16	8:46:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.5

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
30-Jun-16	8:46:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:47:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.1
30-Jun-16	8:47:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:47:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:47:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:47:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:47:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:48:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.5
30-Jun-16	8:48:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:48:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:48:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:48:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.6
30-Jun-16	8:48:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:49:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:49:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:49:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:49:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:49:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:49:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:50:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.8
30-Jun-16	8:50:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:50:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.1
30-Jun-16	8:50:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:50:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:50:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:51:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:51:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:51:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:51:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:51:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.5
30-Jun-16	8:51:54	4	5	4	5	0.0	0	6	8	0	0	0.00	20.2
30-Jun-16	8:52:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.6
30-Jun-16	8:52:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:52:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.4
30-Jun-16	8:52:34	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:52:44	4	5	4	5	0.0	0	6	8	0	0	0.00	20.3
30-Jun-16	8:52:54	3	4	4	5	0.3	1	5	7	8	10	0.00	20.8
30-Jun-16	8:53:04	4	5	4	5	0.0	0	6	8	6	8	0.00	20.7
30-Jun-16	8:53:14	3	4	4	5	0.3	1	5	7	6	8	0.00	21.0
30-Jun-16	8:53:24	3	4	4	5	0.3	1	5	7	3	4	0.00	21.0
30-Jun-16	8:53:34	4	5	4	6	0.5	1	7	9	3	4	0.00	20.9
30-Jun-16	8:53:44	4	5	4	5	0.0	0	6	8	3	4	0.00	20.7
30-Jun-16	8:53:54	4	5	4	6	0.5	1	7	9	4	5	0.00	20.7
30-Jun-16	8:54:04	3	4	3	4	0.0	0	5	6	6	8	0.00	20.9
30-Jun-16	8:54:14	3	4	4	5	0.3	1	5	7	10	13	0.00	20.8
30-Jun-16	8:54:24	3	4	4	5	0.5	1	5	7	13	16	0.00	20.8
30-Jun-16	8:54:34	3	4	3	5	0.3	1	5	7	13	16	0.00	20.7
30-Jun-16	8:54:44	3	4	3	5	0.3	1	5	7	12	15	0.00	20.7
30-Jun-16	8:54:54	3	4	3	5	0.3	1	5	7	11	14	0.00	20.6
30-Jun-16	8:55:04	3	4	3	5	0.3	1	5	7	9	11	0.00	20.5
30-Jun-16	8:55:14	3	4	3	5	0.3	1	5	7	7	9	0.00	21.0
30-Jun-16	8:55:24	3	4	4	5	0.3	1	5	7	6	8	0.00	20.5
30-Jun-16	8:55:34	3	4	3	5	0.3	1	5	7	5	6	0.00	20.5
30-Jun-16	8:55:44	3	4	4	5	0.3	1	5	7	4	5	0.00	20.5
30-Jun-16	8:55:54	3	4	3	5	0.3	1	5	7	5	6	0.00	20.7
30-Jun-16	8:56:04	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:56:14	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:56:24	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:56:34	3	4	4	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:56:44	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:56:54	3	4	4	5	0.3	1	5	7	3	4	0.00	20.7
30-Jun-16	8:57:04	2	3	2	3	0.3	1	3	5	4	5	0.00	20.7
30-Jun-16	8:57:14	3	4	3	4	0.0	0	5	6	4	5	0.00	20.6
30-Jun-16	8:57:24	3	4	3	5	0.3	1	5	7	3	4	0.00	20.5
30-Jun-16	8:57:34	3	4	4	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:57:44	3	4	4	5	0.3	1	5	7	4	5	0.00	20.5
30-Jun-16	8:57:54	3	4	3	5	0.3	1	5	7	3	4	0.00	20.6
30-Jun-16	8:58:04	3	4	4	5	0.3	1	5	7	3	4	0.57	20.0
30-Jun-16	8:58:14	3	4	4	5	0.3	1	5	7	5	6	0.00	20.3
30-Jun-16	8:58:24	3	4	4	5	0.3	1	5	7	4	5	0.00	20.4
30-Jun-16	8:58:34	3	4	4	5	0.5	1	5	7	4	5	0.00	20.8
30-Jun-16	8:58:44	3	4	4	5	0.3	1	5	7	5	6	0.59	20.0
30-Jun-16	8:58:54	3	4	3	5	0.3	1	5	7	6	8	0.00	21.0
30-Jun-16	8:59:04	3	4	3	5	0.3	1	5	7	6	8	0.00	20.3
30-Jun-16	8:59:14	4	5	5	6	0.5	1	7	9	5	6	0.00	20.6
30-Jun-16	8:59:24	3	4	3	4	0.0	0	5	6	5	6	0.00	20.6
30-Jun-16	8:59:34	3	4	4	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:59:44	3	4	4	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	8:59:54	3	4	4	5	0.3	1	5	7	4	5	0.00	20.6
30-Jun-16	9:00:04	3	4	3	4	0.0	0	5	6	4	5	0.00	20.5
30-Jun-16	9:00:14	3	4	4	5	0.3	1	5	7	5	6	0.00	20.6
30-Jun-16	9:00:24	3	4	3	4	0.0	0	5	6	6	8	0.00	20.2
30-Jun-16	9:00:34	3	4	3	4	0.0	0	5	6	6	8	0.00	20.1
30-Jun-16	9:00:44	3	4	3	5	0.3	1	5	7	6	8	0.00	21.0
30-Jun-16	9:00:54	3	4	3	5	0.3	1	5	7	5	6	0.00	20.8
30-Jun-16	9:01:04	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	9:01:14	2	3	2	3	0.0	0	3	4	4	5	0.00	20.7
30-Jun-16	9:01:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.8
30-Jun-16	9:01:34	3	4	3	5	0.3	1	5	7	4	5	0.00	20.7
30-Jun-16	9:01:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:01:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:02:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:02:14	3	4	3	5	0.3	1	5	7	2	3	0.00	20.8
30-Jun-16	9:02:24	3	4	4	5	0.3	1	5	7	2	3	0.62	19.9
30-Jun-16	9:02:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.1
30-Jun-16	9:02:44	3	4	3	5	0.3	1	5	7	1	1	0.00	21.0
30-Jun-16	9:02:54	3	4	3	5	0.3	1	5	7	2	3	0.00	20.8
30-Jun-16	9:03:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.9
30-Jun-16	9:03:14	3	4	4	5	0.3	1	5	7	2	3	0.00	20.7
30-Jun-16	9:03:24	3	4	4	5	0.3	1	5	7	2	3	0.00	20.7
30-Jun-16	9:03:34	3	4	3	4	0.0	0	5	6	2	3	0.00	20.8

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
30-Jun-16	9:03:44	3	4	4	5	0.3	1	5	7	3	4	0.00	20.6
30-Jun-16	9:03:54	4	5	4	5	0.0	0	6	8	3	4	0.00	20.6
30-Jun-16	9:04:04	3	4	3	4	0.0	0	5	6	3	4	0.00	20.4
30-Jun-16	9:04:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.7
30-Jun-16	9:04:24	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:04:34	3	4	4	5	0.3	1	5	7	1	1	0.00	20.7
30-Jun-16	9:04:44	4	5	4	5	0.0	0	6	8	1	1	0.00	20.6
30-Jun-16	9:04:54	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:05:04	3	4	4	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:05:14	3	4	4	5	0.3	1	5	7	0	0	0.00	20.6
30-Jun-16	9:05:24	3	4	3	4	0.0	0	5	6	1	1	0.00	20.7
30-Jun-16	9:05:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.7
30-Jun-16	9:05:44	4	5	4	5	0.0	0	6	8	1	1	0.00	20.5
30-Jun-16	9:05:54	3	4	4	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:06:04	3	4	4	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:06:14	3	4	3	5	0.3	1	5	7	1	1	0.00	20.5
30-Jun-16	9:06:24	3	4	4	5	0.3	1	5	7	1	1	0.00	20.7
30-Jun-16	9:06:34	3	4	4	5	0.3	1	5	7	0	0	0.00	20.8
30-Jun-16	9:06:44	3	4	4	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:06:54	3	4	3	5	0.3	1	5	7	1	1	0.00	20.7
30-Jun-16	9:07:04	2	3	2	3	0.3	1	3	5	0	0	0.00	20.6
30-Jun-16	9:07:14	3	4	3	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:07:24	2	3	2	3	0.0	0	3	4	1	1	0.00	20.6
30-Jun-16	9:07:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:07:44	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	9:07:54	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:08:04	3	4	3	4	0.0	0	5	6	1	1	0.00	20.8
30-Jun-16	9:08:14	3	4	3	4	0.0	0	5	6	0	0	0.00	20.7
30-Jun-16	9:08:24	3	4	3	4	0.0	0	5	6	0	0	0.00	20.7
30-Jun-16	9:08:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:08:44	3	4	3	4	0.0	0	5	6	0	0	0.00	20.5
30-Jun-16	9:08:54	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	9:09:04	4	5	4	5	0.0	0	6	8	0	0	0.00	20.7
30-Jun-16	9:09:14	4	5	4	5	0.0	0	6	8	0	0	0.00	20.7
30-Jun-16	9:09:24	3	4	3	4	0.0	0	5	6	0	0	0.00	20.6
30-Jun-16	9:09:34	3	4	3	4	0.0	0	5	6	0	0	0.00	20.5
30-Jun-16	9:09:44	3	4	4	5	0.3	1	5	7	1	1	0.00	20.6
30-Jun-16	9:09:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.5
30-Jun-16	9:10:04	3	4	4	5	0.3	1	5	7	2	3	0.00	20.5
30-Jun-16	9:10:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:10:24	3	4	3	4	0.0	0	5	6	1	1	0.00	20.5
30-Jun-16	9:10:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:10:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.9
30-Jun-16	9:10:54	3	4	3	4	0.0	0	5	6	1	1	0.00	20.6
30-Jun-16	9:11:04	3	4	3	4	0.0	0	5	6	1	1	0.00	20.8
30-Jun-16	9:11:14	3	4	3	4	0.0	0	5	6	1	1	0.00	20.7
30-Jun-16	9:11:24	3	4	3	4	0.0	0	5	6	1	1	0.00	20.5
30-Jun-16	9:11:34	3	4	3	5	0.3	1	5	7	2	3	0.00	20.5
30-Jun-16	9:11:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:11:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:12:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.5
30-Jun-16	9:12:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.5
30-Jun-16	9:12:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.6
30-Jun-16	9:12:34	3	4	4	5	0.3	1	5	7	3	4	0.00	20.6
30-Jun-16	9:12:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.8
30-Jun-16	9:12:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.9
30-Jun-16	9:13:04	3	4	3	4	0.0	0	5	6	3	4	0.00	20.8
30-Jun-16	9:13:14	3	4	3	4	0.0	0	5	6	4	5	0.00	20.7
30-Jun-16	9:13:24	3	4	3	4	0.0	0	5	6	4	5	0.00	20.7
30-Jun-16	9:13:34	3	4	4	5	0.3	1	5	7	2	3	0.00	20.5
30-Jun-16	9:13:44	3	4	3	4	0.0	0	5	6	2	3	0.00	20.5
30-Jun-16	9:13:54	4	5	4	5	0.0	0	6	8	2	3	0.00	20.1
30-Jun-16	9:14:04	4	5	4	5	0.0	0	6	8	1	1	0.00	20.2
30-Jun-16	9:14:14	4	5	4	5	0.0	0	6	8	1	1	0.00	20.2
30-Jun-16	9:14:24	4	5	4	6	0.3	1	6	9	1	1	0.00	20.5
30-Jun-16	9:14:34	3	4	4	5	0.3	1	5	7	1	1	0.00	20.4
30-Jun-16	9:14:44	4	5	4	6	0.3	1	6	9	2	3	0.00	20.4
30-Jun-16	9:14:54	3	4	3	4	0.0	0	5	6	2	3	0.00	21.0
30-Jun-16	9:15:04	3	4	3	4	0.0	0	5	6	3	4	0.00	21.0
30-Jun-16	9:15:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.4
30-Jun-16	9:15:24	3	4	4	5	0.3	1	5	7	3	4	0.00	21.0
30-Jun-16	9:15:34	4	5	4	5	0.0	0	6	8	3	4	0.00	21.0
30-Jun-16	9:15:44	3	4	4	5	0.3	1	5	7	3	4	0.00	20.2
30-Jun-16	9:15:54	3	4	4	5	0.3	1	5	7	4	5	0.00	21.0
30-Jun-16	9:16:04	4	5	4	6	0.3	1	6	9	2	3	0.00	20.9
30-Jun-16	9:16:14	4	5	4	6	0.3	1	6	9	3	4	0.00	20.8
30-Jun-16	9:16:24	3	4	3	4	0.0	0	5	6	3	4	0.00	21.0
30-Jun-16	9:16:34	4	5	4	6	0.3	1	6	9	2	3	0.00	20.8
30-Jun-16	9:16:44	4	5	4	6	0.3	1	6	9	2	3	0.00	20.2
30-Jun-16	9:16:54	3	4	4	5	0.3	1	5	7	2	3	0.00	20.5
30-Jun-16	9:17:04	4	5	4	6	0.3	1	6	9	2	3	0.00	20.1
30-Jun-16	9:17:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.9
30-Jun-16	9:17:24	4	5	4	5	0.0	0	6	8	1	1	0.00	20.7
30-Jun-16	9:17:34	3	4	4	5	0.3	1	5	7	2	3	0.00	20.9
30-Jun-16	9:17:44	4	5	4	5	0.0	0	6	8	2	3	0.00	21.0
30-Jun-16	9:17:54	4	5	4	6	0.3	1	6	9	1	1	0.00	20.9
30-Jun-16	9:18:04	4	5	4	5	0.0	0	6	8	1	1	0.00	21.0
30-Jun-16	9:18:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.7
30-Jun-16	9:18:24	4	5	4	6	0.3	1	6	9	0	0	0.00	20.7
30-Jun-16	9:18:34	3	4	3	4	0.0	0	5	6	1	1	0.00	20.5
30-Jun-16	9:18:44	4	5	4	6	0.3	1	6	9	1	1	0.00	20.0
30-Jun-16	9:18:54	4	5	4	5	0.0	0	6	8	1	1	0.00	20.5
30-Jun-16	9:19:04	4	5	4	6	0.3	1	6	9	1	1	0.00	20.3
30-Jun-16	9:19:14	4	5	4	5	0.0	0	6	8	1	1	0.00	20.2
30-Jun-16	9:19:24	4	5	4	5	0.0	0	6	8	0	0	0.00	20.0
30-Jun-16	9:19:34	4	5	4	6	0.3	1	6	9	0	0	0.00	20.1
30-Jun-16	9:19:44	5	7	5	7	0.3	1	8	11	1	1	0.00	20.3
30-Jun-16	9:19:54	4	5	4	5	0.0	0	6	8	1	1	0.00	20.3
30-Jun-16	9:20:04	5	7	5	7	0.0	0	8	10	2	3	0.00	20.3
30-Jun-16	9:20:14	5	7	5	7	0.3	1	8	11	3	4	0.00	20.2
30-Jun-16	9:20:24	3	4	4	5	0.3	1	5	7	2	3	0.00	21.0

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
30-Jun-16	9:20:34	4	5	4	6	0.3	1	6	9	3	4	0.00	20.6
30-Jun-16	9:20:44	3	4	4	5	0.3	1	5	7	5	6	0.00	20.7
30-Jun-16	9:20:54	4	5	4	6	0.3	1	6	9	4	5	0.00	20.5
30-Jun-16	9:21:04	4	5	4	6	0.3	1	6	9	4	5	0.00	20.6
30-Jun-16	9:21:14	4	5	4	6	0.3	1	6	9	4	5	0.00	20.7
30-Jun-16	9:21:24	4	5	4	6	0.3	1	6	9	4	5	0.00	20.7
30-Jun-16	9:21:34	5	7	5	8	0.5	1	8	11	4	5	0.00	20.9
30-Jun-16	9:21:44	5	7	5	7	0.3	1	8	11	4	5	0.00	21.0
30-Jun-16	9:21:54	5	7	5	8	0.5	1	8	11	3	4	0.00	21.0
30-Jun-16	9:22:04	4	5	5	6	0.5	1	7	9	4	5	0.00	20.9
30-Jun-16	9:22:14	5	7	5	7	0.3	1	8	11	4	5	0.00	20.6
30-Jun-16	9:22:24	5	7	5	7	0.3	1	8	11	4	5	0.00	20.5
30-Jun-16	9:22:34	5	7	5	8	0.5	1	8	11	3	4	0.00	20.5
30-Jun-16	9:22:44	4	5	5	6	0.5	1	7	9	4	5	0.00	21.0
30-Jun-16	9:22:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:23:04	4	5	4	5	0.0	0	6	8	3	4	0.00	20.4
30-Jun-16	9:23:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	9:23:24	4	5	4	5	0.0	0	6	8	3	4	0.00	20.4
30-Jun-16	9:23:34	4	5	4	6	0.3	1	6	9	3	4	0.00	20.6
30-Jun-16	9:23:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.5
30-Jun-16	9:23:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:24:04	3	4	3	4	0.0	0	5	6	3	4	0.00	20.4
30-Jun-16	9:24:14	2	3	2	3	0.0	0	3	4	2	3	0.00	20.1
30-Jun-16	9:24:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:24:34	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:24:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:24:54	2	3	2	3	0.0	0	3	4	3	4	0.00	20.3
30-Jun-16	9:25:04	3	4	3	4	0.0	0	5	6	4	5	0.00	21.0
30-Jun-16	9:25:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:25:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.5
30-Jun-16	9:25:34	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:25:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.8
30-Jun-16	9:25:54	2	3	2	3	0.0	0	3	4	3	4	0.00	20.7
30-Jun-16	9:26:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.7
30-Jun-16	9:26:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.1
30-Jun-16	9:26:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.2
30-Jun-16	9:26:34	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	9:26:44	3	4	3	4	0.0	0	5	6	3	4	0.00	20.4
30-Jun-16	9:26:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.4
30-Jun-16	9:27:04	3	4	3	4	0.0	0	5	6	4	5	0.00	20.5
30-Jun-16	9:27:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:27:24	3	4	3	4	0.0	0	5	6	2	3	0.00	21.0
30-Jun-16	9:27:34	3	4	3	4	0.0	0	5	6	3	4	0.00	21.0
30-Jun-16	9:27:44	2	3	2	3	0.0	0	3	4	2	3	0.00	20.5
30-Jun-16	9:27:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.3
30-Jun-16	9:28:04	3	4	3	4	0.0	0	5	6	3	4	0.00	20.7
30-Jun-16	9:28:14	3	4	3	4	0.0	0	5	6	3	4	0.00	20.5
30-Jun-16	9:28:24	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:28:34	3	4	3	4	0.0	0	5	6	3	4	0.00	20.5
30-Jun-16	9:28:44	3	4	3	4	0.0	0	5	6	4	5	0.00	20.5
30-Jun-16	9:28:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.6
30-Jun-16	9:29:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.8
30-Jun-16	9:29:14	3	4	3	4	0.0	0	5	6	2	3	0.00	20.2
30-Jun-16	9:29:24	3	4	3	4	0.0	0	5	6	3	4	0.00	20.4
30-Jun-16	9:29:34	3	4	3	4	0.0	0	5	6	2	3	0.00	20.3
30-Jun-16	9:29:44	2	3	2	3	0.0	0	3	4	2	3	0.00	20.5
30-Jun-16	9:29:54	3	4	3	4	0.0	0	5	6	2	3	0.00	20.6
30-Jun-16	9:30:04	3	4	3	4	0.0	0	5	6	2	3	0.00	20.5
30-Jun-16	9:30:14	2	3	2	3	0.0	0	3	4	2	3	0.00	21.0
30-Jun-16	9:30:24	2	3	2	3	0.0	0	3	4	3	4	0.00	21.0
30-Jun-16	9:30:34	3	4	3	4	0.0	0	5	6	3	4	0.00	21.0
30-Jun-16	9:30:44	2	3	2	3	0.0	0	3	4	3	4	0.00	20.9
30-Jun-16	9:30:54	3	4	3	4	0.0	0	5	6	3	4	0.00	20.8
	Average	**3**	**4**	**3**	**5**	**0.1**	**0**	**5**	**7**	**2**	**3**	**0.0**	**20.5**
	Maximum	**5**	**7**	**5**	**8**	**0.5**	**1**	**8**	**11**	**13**	**16**	**2.0**	**21.0**
	Minimum	**2**	**3**	**2**	**3**	**0.0**	**0**	**3**	**4**	**0**	**0**	**0.0**	**17.5**

AECOM
AECOM Australia Pty Ltd
17 Warabrook Boulevard
Warabrook NSW 2304
PO Box 73
Hunter Region MC NSW 2310
T +612 4911 4900
F + 612 4911 4999
www.aecom.com
ABN 20 093 846 925