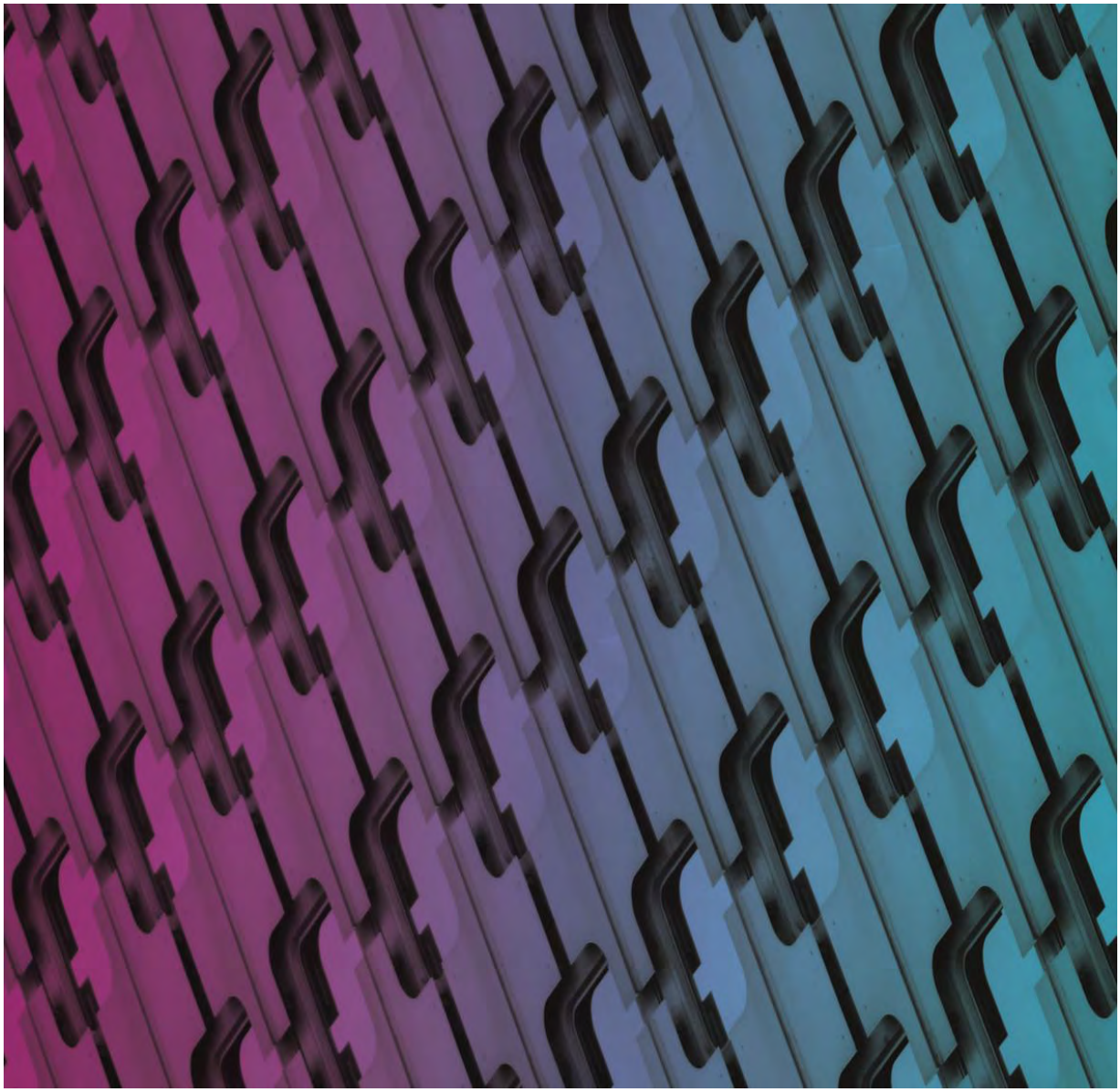
Stack 1 Emissions Testing Report March 2016

Pharmaceutical Waste Trial



Stack 1 Emissions Testing Report March 2016

Pharmaceutical Waste Trial

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Reviewed by Chad Whitburn Approved Signatory

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Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1.0	10 -May-2016	Final Report	Chad Whitburn Compliance Services - Team Leader	

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1.0 Introduction

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

Testing was conducted on 18 March 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 10918-1-P, 11046-0-P, and 10918-0-M:
    - Moisture;
    - Fine Particulate (PM_{10}); and
    - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1601130 and EN1601220:
    - 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_014 and DAU16-070:
    - Polycyclic Aromatic Hydrocarbons; and
    - Dioxins and Furans.
- SGS Leeder Consulting, NATA accreditation number 14429, performed the following analysis detailed in report number M160684:
    - 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 18 March 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 March 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 18 March 2016

Parameter	Stack 1 EPL Point 1
Carbon Monoxide (CO) (ppm)	76 *(100)*
Chlorine (mg/m^3)	<0.5
Cyanide	0.35 *(0.5)*
Fine Particulate (PM_{10}) (mg/m^3)	0.049
Gaseous Fluoride (mg/m^3)	0.018 *(2)*
Hydrogen Chloride (mg/m^3)	<1 *(400)*
Oxides of Nitrogen (as Equivalent NO_2) (mg/m^3)	2 *(2500)*
Oxygen (%)	20.5
Carbon Dioxide (%)	<0.1
Particulate Fluoride (mg/m^3)	0.055
Sulfur Dioxide (SO_2 as SO_3) (mg/m^3)	<8.5
Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	<1.7 *(100)*
Total Particulate (mg/m^3)	1.0 *(25)*
Total Polycyclic Aromatic Hydrocarbons (mg/m^3)	0.082
Dioxins and Furans Lower Bound	0.0014
Dioxins and Furans Middle Bound	0.0016
Type 1 and 2 Substances in Aggregate (Metals) (mg/m^3)	0.011 *(10)*
Volatile Organic Compounds (VOC) (mg/m^3)	5.2

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	10.0

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

Table 7 Calculated Gas Concentrations Data Summary, 18 March 2016

Parameter	Stack 1
Time Period	6:01-7:01
Nitrogen Oxide (NO) (mg/m^3)	1
Nitrogen Dioxide (NO_2) (mg/m^3)	<0.1
Nitrogen Oxides (NO_x) (mg/m^3)	1
Oxides of Nitrogen as Equivalent NO_2 (mg/m^3)	2*(2500)*
Carbon Monoxide (ppm)	76*(100)*
Carbon Monoxide (mg/m^3)	95
Carbon Dioxide (%)	<0.1
Oxygen (%)	20.5

Note – EPL Limits are provided in parenthesis.

Table 8 Gas Mass Emission Rates Summary, 18 March 2016

Parameter	Stack 1
Time Period	6:01-7:01
Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure)	26
Nitrogen Oxide (NO) (mg/s)	26
Nitrogen Dioxide (NO_2) (mg/s)	<2.6
Nitrogen Oxides (NO_x) (mg/s)	26
Oxides of Nitrogen as Equivalent NO_2 (mg/s)	52
Carbon Monoxide (mg/s)	2470

Table 9 Stack 1 Fine Particulate (PM_{10}), Total Particulate, and Cyanide Results, 18 March 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	74.5	^{o}C	347.7	K
Stack pressure (average)	1004	hPa		
Stack gas velocity (average, stack conditions)	16	m/s		
Stack gas flowrate (stack conditions)	34	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26	m^3/s		
Fine Particulate (PM_{10}) Testing				
Test Period	6:29	-	8:09	
Fine Particulate (PM_{10}) Mass	0.06	mg		
Gas Volume Sampled	1.21	m^3		
Fine Particulate (PM_{10}) Emission*[1]	0.049	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	1.3	mg/s		
Regulatory Limit	NA	mg/m^3		
Total Particulate Testing				
Test Period	6:29	-	8:09	
Total Particulate Mass	1.8	mg		
Gas Volume Sampled	1.72	m^3		
Total Particulate Emission*[1]	1.0	mg/m^3		
Total Particulate Mass Emission Rate*[2]	26	mg/s		
Regulatory Limit	25	mg/m^3		
Cyanide Testing				
Test Period	6:29	-	8:09	
Cyanide Mass	0.61	mg		
Gas Volume Sampled	1.72	m^3		
Cyanide Emission*[1]	0.35	mg/m^3		
Cyanide Mass Emission Rate*[2]	9.2	mg/s		
Regulatory Limit	0.5	mg/m^3		
Moisture Content (%)	**1.7**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

Table 10 Stack 1 Hazardous Substances (Metals), Particulate Fluoride and Gaseous Fluoride Results, 18 March 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	71.0	^{o}C	344.2	K
Stack pressure (average)	1004	hPa		
Stack gas velocity (average, stack conditions)	16	m/s		
Stack gas flowrate (stack conditions)	33	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	25	m^3/s		
Hazardous Substances (Metals) Testing				
Test Period	10:24	-	12:04	
Hazardous Substances (Metals) Mass	0.015	mg		
Gas Volume Sampled	1.37	m^3		
Hazardous Substances (Metals) Emission*1	0.011	mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.28	mg/s		
Regulatory Limit	10	mg/m^3		
Particulate Fluoride Testing				
Test Period	10:24	-	12:04	
Particulate Fluoride Mass	0.061	mg		
Gas Volume Sampled	1.11	m^3		
Particulate Fluoride Emission*1	0.055	mg/m^3		
Particulate Fluoride Mass Emission Rate*2	1.4	mg/s		
Regulatory Limit	NA	mg/m^3		
Gaseous Fluoride Testing				
Test Period	10:24	-	12:04	
Gaseous Fluoride Mass	0.02	mg		
Gas Volume Sampled	1.11	m^3		
Gaseous Fluoride Emission*1	0.018	mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	0.45	mg/s		
Regulatory Limit	2	mg/m^3		
Moisture Content (%)	**3.5**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

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, 18 March 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	69.5	°C	342.7	K
Stack pressure (average)	1004	hPa		
Stack gas velocity (average, stack conditions)	16	m/s		
Stack gas flowrate (stack conditions)	34	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	26	m^3/s		
Sulfuric Acid Mist (H2SO4 as SO3) Testing				
Test Period	8:33	-	10:13	
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass	<2	mg		
Gas Volume Sampled	1.18	m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Emission[*1]	<1.7	mg/m^3		
Sulfuric Acid Mist (H_2SO_4 as SO_3) Mass Emission Rate[*2]	<44	mg/s		
Regulatory Limit	100	mg/m^3		
Sulfur Dioxide (SO2 as SO3) Testing				
Test Period	8:33	-	10:13	
Sulfur Dioxide (SO_2 as SO_3) Mass	<10	mg		
Gas Volume Sampled	1.18	m^3		
Sulfur Dioxide (SO_2 as SO_3) Emission[*1]	<8.5	mg/m^3		
Sulfur Dioxide (SO_2 as SO_3) Mass Emission Rate[*2]	<220	mg/s		
Regulatory Limit	NA	mg/m^3		
Hydrogen Chloride Testing				
Test Period	8:33	-	10:13	
Hydrogen Chloride Mass	<10	mg		
Gas Volume Sampled	9.95	m^3		
Hydrogen Chloride Emission[*1]	<1	mg/m^3		
Hydrogen Chloride Mass Emission Rate[*2]	<27	mg/s		
Regulatory Limit	400	mg/m^3		
Chlorine Testing				
Test Period	8:33	-	10:13	
Chlorine Mass	<5	mg		
Gas Volume Sampled	9.95	m^3		
Chlorine Emission[*1]	<0.5	mg/m^3		
Chlorine Mass Emission Rate[*2]	<13	mg/s		
Regulatory Limit	NA	mg/m^3		
Moisture Content (%)	**2.6**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

Table 12 Stack 1 Polycyclic Aromatic Hydrocarbon (PAH), Dioxins and Furans Results, 18 March 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	76.0	°C	349.2	K
Stack pressure (average)	1004	hPa		
Stack gas velocity (average, stack conditions)	16	m/s		
Stack gas flowrate (stack conditions)	34	m^3/s		
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	25	m^3/s		
Polycyclic Aromatic Hydrocarbons Testing				
Test Period	6:07	-	12:07	
Polycyclic Aromatic Hydrocarbons Mass	0.3571	mg		
Gas Volume Sampled	4.37	m^3		
Polycyclic Aromatic Hydrocarbons Emission*1	0.082	mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	2.1	mg/s		
Regulatory Limit	NA	mg/m^3		
Dioxins and Furans Lower Bound Testing				
Test Period	6:07	-	12:07	
Dioxins and Furans Lower Bound Mass	0.0061	ng		
Gas Volume Sampled	4.37	m^3		
Dioxins and Furans Lower Bound Emission*1	0.0014	ng/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.036	ng/s		
Regulatory Limit	NA	ng/m^3		
Dioxins and Furans Middle Bound Testing				
Test Period	6:07	-	12:07	
Dioxins and Furans Middle Bound Mass	0.0071	ng		
Gas Volume Sampled	4.37	m^3		
Dioxins and Furans Middle Bound Emission*1	0.0016	ng/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.041	ng/s		
Regulatory Limit	NA	ng/m^3		
Moisture Content (%)	**1.9**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

Table 13 Stack 1 Speciated Volatile Organic Compounds Results, 18 March 2016

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m^3)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.094	<2.4
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.094	<2.4
2-Butanone	<1.0	<1.0	<1.0	<0.094	<2.4
Chloroform	<1.0	<1.0	<1.0	<0.094	<2.4
Benzene	16.1	<1.0	15.6	1.5	38
1-heptene	<1.0	<1.0	<1.0	<0.094	<2.4
n-heptane	<1.0	<1.0	<1.0	<0.094	<2.4
Trichloroethene	<1.0	<1.0	<1.0	<0.094	<2.4
MIBK	<1.0	<1.0	<1.0	<0.094	<2.4
Toluene	39.9	<1.0	39.4	3.7	93
2-hexanone	<1.0	<1.0	<1.0	<0.094	<2.4
Chlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
Ethyl Benzene	<1.0	<1.0	<1.0	<0.094	<2.4
m- & p-xylene	<2.0	<0.2	<2.0	<0.19	<4.8
o-xylene	<1.0	<1.0	<1.0	<0.094	<2.4
Styrene	<1.0	<1.0	<1.0	<0.094	<2.4
Cyclohexanone	<1.0	<1.0	<1.0	<0.094	<2.4
Isopropylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
2-chlorotoluene	<1.0	<1.0	<1.0	<0.094	<2.4
4-chlorotoluene	<1.0	<1.0	<1.0	<0.094	<2.4
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
n-decane	<1.0	<1.0	<1.0	<0.094	<2.4
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.094	<2.4
n-butylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.094	<2.4
Total	**56.0**		**55.0**	**5.2**	**131**

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, 18 March 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	0.014	0.1	0.0014	0.0032	0.00032
Total TCDF isomers	0.27				
2,3,7,8-TCDD	<0.001	1	0.0005	<0.00023	0.00011
Total TCDD isomers	0.01				
1,2,3,7,8-PeCDF	0.023	0.05	0.00115	0.0053	0.00026
2,3,4,7,8-PeCDF	0.0026	0.5	0.0013	0.00059	0.0003
Total PeCDF isomers	0.084				
1,2,3,7,8-PeCDD	<0.0008	0.5	0.0002	<0.00018	0.000046
Total PeCDD isomers	<0.005				
1,2,3,4,7,8-HxCDF	0.0092	0.1	0.00092	0.0021	0.00021
1,2,3,6,7,8-HxCDF	0.008	0.1	0.0008	0.0018	0.00018
2,3,4,6,7,8-HxCDF	0.0019	0.1	0.00019	0.00043	0.000043
1,2,3,7,8,9-HxCDF	<0.002	0.1	0.0001	<0.00046	0.000023
Total HxCDF isomers	0.056				
1,2,3,4,7,8-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,6,7,8-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,7,8,9-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
Total HxCDD isomers	0.0028				
1,2,3,4,6,7,8-HpCDF	0.017	0.01	0.00017	0.0039	0.000039
1,2,3,4,7,8,9-Hp CDF	0.011	0.01	0.00011	0.0025	0.000025
Total HpCDF isomers	0.038				
1,2,3,4,6,7,8-HpCDD	0.0049	0.01	0.000049	0.0011	0.000011
Total HpCDD isomers	0.0091				
OCDF	0.028	0.001	0.000028	0.0064	0.0000064
OCDD	0.018	0.001	0.000018	0.0041	0.0000041

I-TEQ$_{DF}$

Lower Bound (excluding LOD Values)	0.0061	ng
Middle Bound (including half LOD Values)	0.0071	ng
Date Tested	18-Mar-16	

Table 15 Stack 1 Elemental Metals Results, 18 March 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	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Arsenic	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Beryllium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Cadmium	0.0008	0.00058	0.00075	0.00055			0.002	0.0015	0.038
Chromium	0.0002	0.00015	0.0099	0.0072			0.01	0.0073	0.19
Cobalt	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Copper	<0.0012	<0.00088	0.0014	0.001			0.0014	0.001	0.026
Lead	<0.0002	<0.00015	0.00055	0.0004			0.00055	0.0004	0.01
Magnesium	<0.0496	<0.036	0.0054	0.0039			0.0054	0.0039	0.1
Manganese	<0.0011	<0.0008	0.0017	0.0012			0.0017	0.0012	0.031
Mercury	<0.0002	<0.00015	<0.0001	<0.000073	<0.0005	<0.00037	<0.0005	<0.00037	<0.0094
Nickel	<0.0006	<0.00044	0.00079	0.00058			0.00079	0.00058	0.015
Selenium	<0.0009	<0.00066	<0.0009	<0.00066			<0.0002	<0.00015	<0.0038
Thallium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Tin	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Vanadium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Zinc	<0.7812	<0.57	0.0052	0.0038			0.0052	0.0038	0.097
Total Hazardous Metals*	**0.001**	**0.00073**	**0.014**	**0.0099**	**<0.0005**	**<0.00037**	**0.015**	**0.011**	**0.28**
Total Metals	**0.001**	**0.00073**	**0.026**	**0.019**			**0.027**	**0.02**	**0.5**

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

Table 16 Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 18 March 2016

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m^3)	(mg/m^3)	(µg/s)	(mg/s)
Naphthalene	42000	42	0.042	9.6	0.0096	240	0.24
2 - Methylnaphthalene	46000	46	0.046	11	0.011	270	0.27
Acenaphthylene	120000	120	0.12	27	0.027	700	0.7
Acenaphthene	11000	11	0.011	2.5	0.0025	64	0.064
Fluorene	43000	43	0.043	9.8	0.0098	250	0.25
Phenanthrene	64000	64	0.064	15	0.015	370	0.37
Anthracene	2200	2.2	0.0022	0.5	0.0005	13	0.013
Fluoranthene	19000	19	0.019	4.3	0.0043	110	0.11
Pyrene	9900	9.9	0.0099	2.3	0.0023	58	0.058
Benz(a)anthracene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Chrysene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(b)fluoranthene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Perylene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(ghi)perylene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Sum of reported PAH's	**360000**	**360**	**0.36**	**82**	**0.082**	**2100**	**2.1**

Appendix A

Field Sheets and Final Calculations (70 pages)

Appendix A Field Sheets and Final Calculations (70 pages)

Emission Measurement Calculations Spreadsheet

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 18-Mar-16

ANALYTE(S)	METHOD
Fine Particulate (PM10)	NSW EPA OM - 5
Total Particulate	NSW EPA TM - 15
Cyanide	USEPA OTM - 29

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

for Dylan Turnbull

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 18-Mar-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: 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= 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: .....

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 18-Mar-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: Cyanide

Sampling time start: 6:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	6:00	7	20.4	0.3
2	6:01	8	20.4	0.3
3	6:02	10	20.4	0.3
4	6:03	14	20.5	0.2
5	6:04	15	20.5	0.2
6	6:05	11	20.5	0.2
7	6:06	10	20.5	0.2
8	6:07	13	20.5	0.2
	Averages:	11.0 ppm	20.5 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.40 %

Measurements

CO:	0.0011 %,(dry)	N_2:	79.3 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.5 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0011 %,(wet)	N_2:	77.4 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.0 %,(wet)
H_2O:	2.40 %(=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: 18-Mar-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: Cyanide

Sampling time start: 8:02		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	8:02	32	20.4	0.3
2	8:03	37	20.4	0.3
3	8:04	36	20.3	0.3
4	8:05	31	20.3	0.3
5	8:06	29	20.3	0.3
6	8:07	27	20.3	0.3
7	8:08	25	20.3	0.3
8	8:09	23	20.3	0.3
	Averages:	30.0 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.89 %

Measurements

CO:	0.0030 %,(dry)	N_2:	79.4 %,(dry)
CO_2:	0.3 %,(dry)	O_2:	20.3 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0029 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.3 %,(wet)	O_2:	19.9 %,(wet)
H_2O:	1.89 %(=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 - Pre Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Cyanide

Time :	6:00	Barometric Pressure :		1005	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 (0 °C, Wet, 1 Atm)
Pitot Tube Type :	S				

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	0.163	83.0	356.2	15.4
1/2	165	0.136	83.0	356.2	14.1
1/3	262	0.181	83.0	356.2	16.2
1/4	383	0.199	83.0	356.2	17.0
1/5	554	0.175	83.0	356.2	15.9
1/6	1036	0.165	83.0	356.2	15.5
1/7	1208	0.151	83.0	356.2	14.8
1/8	1328	0.171	83.0	356.2	15.8
1/9	1425	0.179	83.0	356.2	16.1
1/10	1509	0.197	83.0	356.2	16.9
2/1	81	0.164	83.0	356.2	15.4
2/2	165	0.163	83.0	356.2	15.4
2/3	262	0.176	83.0	356.2	16.0
2/4	383	0.181	83.0	356.2	16.2
2/5	554	0.188	83.0	356.2	16.5
2/6	1036	0.183	83.0	356.2	16.3
2/7	1208	0.173	83.0	356.2	15.8
2/8	1328	0.192	83.0	356.2	16.7
2/9	1425	0.201	83.0	356.2	17.1
2/10	1509	0.180	83.0	356.2	16.2
Average			83.0	356.2	16.0

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -7.5 mm
Absolute pressure in stack (hPa) : 1004.26 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: fine4
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.6 x 10^{-5} m^2
Thimble No: T405
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 320.2212 Meter finish: 320.2212
Time start: 6:25 Time finish: 6:26

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 321.5912 Meter finish: 321.5912
Time start: 8:10 Time finish: 8:11

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 320.2254 Time start: 6:29
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	13.6	22.0	21.0		Yes
1/2	0:08:45	241	13.6	24.0	22.0		Yes
1/3	0:08:15	488	13.6	25.0	22.0		Yes
1/4	0:08:00	1162	13.6	25.0	22.0		Yes
1/5	0:07:45	1409	13.6	25.0	22.0		Yes
1/6	0:08:15	1577	13.6	25.0	22.0		Yes
2/1	0:08:15	73	13.6	26.0	23.0		Yes
2/2	0:08:30	241	13.6	26.0	23.0		Yes
2/3	0:08:30	488	13.6	26.0	23.0		Yes
2/4	0:08:30	1162	13.6	26.0	23.0		Yes
2/5	0:08:15	1409	13.6	27.0	24.0		Yes
2/6	0:08:45	1577	13.6	27.0	24.0		Yes
Averages				25.3	22.6	no result	

Meter Finish: 321.5422 Time Finish: 8:09
Total Condensate collected: 8 ml Silica gel No(s) used: C19

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 6
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 2.12 x $10^{-5}m^2$
Thimble No: SRT-74
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 27.3055 Meter finish: 27.3055
Time start: 6:27 Time finish: 6:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 29.2104 Meter finish: 29.2104
Time start: 8:12 Time finish: 8:13

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 27.3082 Time start: 6:29
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	16.4	25.0	21.0		Yes
1/2	0:10:00	195	15.0	25.0	21.0		Yes
1/3	0:15:00	292	17.2	26.0	21.0		Yes
1/4	0:20:00	413	18.1	27.0	21.0		Yes
1/5	0:25:00	584	16.9	28.0	21.0		Yes
1/6	0:30:00	1066	16.5	29.0	22.0		Yes
1/7	0:35:00	1238	15.8	30.0	22.0		Yes
1/8	0:40:00	1358	16.8	30.0	22.0		Yes
1/9	0:45:00	1455	17.1	30.0	22.0		Yes
1/10	0:50:00	1539	18.0	30.0	22.0		Yes
2/1	0:55:00	111	16.4	31.0	22.0		Yes
2/2	1:00:00	195	16.4	31.0	22.0		Yes
2/3	1:05:00	292	17.0	31.0	22.0		Yes
2/4	1:10:00	413	17.2	30.0	23.0		Yes
2/5	1:15:00	584	17.6	29.0	23.0		Yes
2/6	1:20:00	1066	17.4	28.0	23.0		Yes
2/7	1:25:00	1238	16.8	28.0	23.0		Yes
2/8	1:30:00	1358	17.8	27.0	23.0		Yes
2/9	1:35:00	1455	18.2	27.0	23.0		Yes
2/10	1:40:00	1539	17.2	27.0	23.0		Yes
Averages				28.5	22.1	no result	

Meter Finish: 29.2080 Time Finish: 8:09
Total Condensate collected: 15 ml Silica gel No(s) used: I01

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS
SAMPLING OF CYANIDE

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 6
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 2.12 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 27.3055 Meter finish: 27.3055
Time start: 6:27 Time finish: 6:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 29.2104 Meter finish: 29.2104
Time start: 8:12 Time finish: 8:13

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 27.3082 Time start: 6:29
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	16.4	25.0	21.0		Yes
1/2	0:10:00	195	15.0	25.0	21.0		Yes
1/3	0:15:00	292	17.2	26.0	21.0		Yes
1/4	0:20:00	413	18.1	27.0	21.0		Yes
1/5	0:25:00	584	16.9	28.0	21.0		Yes
1/6	0:30:00	1066	16.5	29.0	22.0		Yes
1/7	0:35:00	1238	15.8	30.0	22.0		Yes
1/8	0:40:00	1358	16.8	30.0	22.0		Yes
1/9	0:45:00	1455	17.1	30.0	22.0		Yes
1/10	0:50:00	1539	18.0	30.0	22.0		Yes
2/1	0:55:00	111	16.4	31.0	22.0		Yes
2/2	1:00:00	195	16.4	31.0	22.0		Yes
2/3	1:05:00	292	17.0	31.0	22.0		Yes
2/4	1:10:00	413	17.2	30.0	23.0		Yes
2/5	1:15:00	584	17.6	29.0	23.0		Yes
2/6	1:20:00	1066	17.4	28.0	23.0		Yes
2/7	1:25:00	1238	16.8	28.0	23.0		Yes
2/8	1:30:00	1358	17.8	27.0	23.0		Yes
2/9	1:35:00	1455	18.2	27.0	23.0		Yes
2/10	1:40:00	1539	17.2	27.0	23.0		Yes
Averages				28.5	22.1	no result	

Meter Finish: 29.2080 Time Finish: 8:09
Total Condensate collected: 15 ml Silica gel No(s) used: I01

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Cyanide

Time :	8:15	Barometric Pressure :		1005	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 (0 °C, Wet, 1 Atm)
Pitot Tube Type :	S				
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	0.204	66.0	339.2	16.8
1/2	165	0.221	66.0	339.2	17.5
1/3	262	0.181	66.0	339.2	15.8
1/4	383	0.166	66.0	339.2	15.1
1/5	554	0.206	66.0	339.2	16.9
1/6	1036	0.199	66.0	339.2	16.6
1/7	1208	0.196	66.0	339.2	16.5
1/8	1328	0.179	66.0	339.2	15.7
1/9	1425	0.174	66.0	339.2	15.5
1/10	1509	0.191	66.0	339.2	16.3
2/1	81	0.185	66.0	339.2	16.0
2/2	165	0.198	66.0	339.2	16.5
2/3	262	0.213	66.0	339.2	17.1
2/4	383	0.182	66.0	339.2	15.9
2/5	554	0.175	66.0	339.2	15.5
2/6	1036	0.193	66.0	339.2	16.3
2/7	1208	0.161	66.0	339.2	14.9
2/8	1328	0.153	66.0	339.2	14.5
2/9	1425	0.183	66.0	339.2	15.9
2/10	1509	0.186	66.0	339.2	16.0
Average			66.0	339.2	16.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.3 mm
Absolute pressure in stack (hPa) : 1004.09 hPa

STACK ANALYSIS - PM10 CALCULATIONS

Date:	18-Mar-16	Client:	Weston Aluminium
AECOM's Project No:	60489919	Stack/Duct Description:	Stack 1

1. Gas Analysis

	%		
$\%CO_2$	0.3		
$\%O_2$	20.3		
$\%N_2+\%CO$	79.3		
Fraction Moisture Content, Bws	0.02	M_s=	0.98

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.86
Mol. Wt. of Stack Gas (wet)	28.60

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	100500	29.67
Stack Static Pressure (Pg)	100409	29.64
Absolute Stack Pressure		29.64

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	66.0	150.8
Average Meter Temperature:	24.0	
Stack Gas Viscosity		200.8

5. Cyclone Flow Rate

	ft^3/min	m^3/min	L/min	L/s
Cyclone Flow Rate	0.52	0.0183	18.26	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	0.122	106.77	35.15	0.768	1.222	82.04	26.92	130.51	42.82
1	0.132	90.30	29.72	0.759	1.229	68.53	22.49	110.94	36.40
2	0.146	73.67	24.25	0.743	1.238	54.77	17.97	91.24	29.93
3	0.159	62.77	20.66	0.727	1.249	45.64	14.97	78.37	25.71
4	0.178	50.12	16.50	0.694	1.267	34.80	11.42	63.52	20.84
5	0.202	38.89	12.80	0.636	1.297	24.73	8.11	50.42	16.54
6	0.217	33.58	11.05	0.583	1.319	19.59	6.43	44.28	14.53
7	0.235	28.70	9.45	0.496	1.348	14.35	4.71	38.68	12.69
8	0.256	24.06	7.92	#NUM!	1.388	12.03	3.95	33.38	10.95
9	0.291	18.67	6.14	#NUM!	1.463	9.33	3.06	27.31	8.96
10	0.341	13.63	4.49	#NUM!	1.593	6.81	2.24	20.44	6.71
11	0.392	10.30	3.39	#NUM!	1.752	5.15	1.69	15.45	5.07

Selected Nozzle	Nozzle Diameter (inches)	Nozzle Diameter (m)	Nozzle Area (m^2)	Sample Rate (L/min)
4	0.178	0.005	0.000016	13.5

STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 18-Mar-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
181.49	0.73	0.85	8.3
165.79	0.67	0.82	7.9
206.01	0.83	0.91	8.8
199.14	0.80	0.89	8.7
196.20	0.79	0.89	8.6
178.54	0.72	0.85	8.2
212.88	0.85	0.92	9.0
182.47	0.73	0.86	8.3
174.62	0.70	0.84	8.1
193.26	0.78	0.88	8.6
160.88	0.65	0.80	7.8
153.04	0.61	0.78	7.6
Average		0.86	100.00
Square		0.74	

Total time min	Full hours	Full minutes	Seconds
8.5	0	8	30
17.3	0	17	15
25.5	0	25	30
33.5	0	33	30
41.3	0	41	15
49.5	0	49	30
57.8	0	57	45
66.3	1	6	15
74.8	1	14	45
83.3	1	23	15
91.5	1	31	30
100.3	1	40	15

Aerodynamic Cut Size (u_{cyc})
201.9

PM_{10} Flow rate at actual cyclone conditions (Q_a)
0.0148

Actual D_{50}
10.0

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: 18-Mar-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): 1.3300 m^3

Average gas meter temp. ($T_{M,2}$): 24.0 °C

297.2 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.2126 m^3

(B) PM10 concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T405

Blank weight: g

PM10 Weight 0.00006 g

Final PM10 Weight (Mp1): 0.00006 g

PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.000049 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.049 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0022 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 2.2 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.4 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0011 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 1.1 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: C19

V_v = 13.1 g (from laboratory report) V_w = 8 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0107

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0175

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

B_{ws} = 2.27 %

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 $\frac{(Ps)}{(1013.25)}$

= 0.997 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.06 m/s

(ii) Average of post-sampling velocities: 15.90 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.98 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 = 34.17 m^3/s (stack conditions)

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

Qstd = 26.0 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0013	g/s (0°C, dry gas, 1 atm pressure)		
	=	1.3	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.057	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	57	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.029	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	29	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

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

Date: 18-Mar-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):	1.8998 m^3	Average barometric pressure (P_{BARO})	1005	hPa
Average gas meter temp. ($T_{M,2}$):	25.3 °C			
	298.5 K	Average pressure at meter ($P_{M,2}$)	1005.00	hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.7246 m^3			

(B) Total Particulate concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	SRT-74	Total Particulate Weight	0.0018 g
Final Total Particulate Weight (Mp1):	0.00180 g		
Total Particulate Concentration (C1):	$=M_{p1}/MV_4=$	0.001	g/m^3 (0°C, dry gas, 1atm pressure)
	;and C_2 =	1.0	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.045 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 45 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.4 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.023 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 23 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: I01

V_v = 7.3 g (from laboratory report) V_w = 15 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0200

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0097

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

B_{ws} = 1.70 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

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

(i) Initial gas density for sampling: 1.28 kg/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 $\frac{(273.2)}{(273.2+Ts)} \times \frac{(Ps)}{(1013.25)}$

= 0.989 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.97 m/s

(ii) Average of post-sampling velocities: 16.07 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 16.02 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 = 34.25 m^3/s (stack conditions)

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

Qstd = 26.2 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.026	g/s (0°C, dry gas, 1 atm pressure)		
	=	26	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	1.2	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1200	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.61	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	610	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Cyanide

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

Date: 18-Mar-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):	1.8998	m^3	Average barometric pressure (P_{BARO})	1005 hPa
Average gas meter temp. ($T_{M,2}$):	25.3	°C		
	298.5	K	Average pressure at meter ($P_{M,2}$)	1005.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.7246	m^3		

(B) Cyanide concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Cyanide Weight	0.00061 g
Final Cyanide Weight (Mp1):	0.00061	g		
Cyanide Concentration (C1):		$=M_{p1}/MV_4=$	0.00035	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.35	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.016 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 16 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.4 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0081 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 8.1 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: I01

V_v = 7.3 g (from laboratory report) V_w = 15 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0200

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0097

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

B_{ws} = 1.70 %

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

= 0.989 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.97 m/s

(ii) Average of post-sampling velocities: 16.07 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 16.02 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 = 34.25 m^3/s (stack conditions)

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

Qstd = 26.2 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0092	g/s (0°C, dry gas, 1 atm pressure)		
	=	9.2	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.41	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	410	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.21	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	210	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
18-Mar-16
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
CYANIDE

Sampling Conditions:			
Stack internal diameter at test location	1650	mm	
Stack gas temperature (average)	74.5	°C	347.7 K
Stack pressure (average)	1004	hPa	
Stack gas velocity (average, stack conditions)	16	m/s	
Stack gas flowrate (stack conditions)	34	m^3/s	
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	26	m^3/s	
Fine Particulate (PM10) Testing			
Test Period	6:29	-	8:09
Fine Particulate (PM10) Mass	0.06	mg	
Gas Volume Sampled	1.21	m^3	
Fine Particulate (PM10) Emission*1	0.049	mg/m^3	
Fine Particulate (PM10) Mass Emission Rate*2	1.3	mg/s	
Regulatory Limit	NA	mg/m^3	
Total Particulate Testing			
Test Period	6:29	-	8:09
Total Particulate Mass	1.8	mg	
Gas Volume Sampled	1.72	m^3	
Total Particulate Emission*1	1.0	mg/m^3	
Total Particulate Mass Emission Rate*2	26	mg/s	
Regulatory Limit	25	mg/m^3	
Cyanide Testing			
Test Period	6:29	-	8:09
Cyanide Mass	0.61	mg	
Gas Volume Sampled	1.72	m^3	
Cyanide Emission*1	0.35	mg/m^3	
Cyanide Mass Emission Rate*2	9.2	mg/s	
Regulatory Limit	0.5	mg/m^3	
Moisture Content (%)	1.7		
Gas Density (dry at 1 atmosphere)	1.29	kg/m^3	
Dry Molecular Weight	28.9	g/g-mole	

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

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 18-Mar-16

ANALYTE(S)	METHOD
Hazardous Substances (Metals)	NSW EPA TM - 12, 13 & 14
Particulate Fluoride	NSW EPA TM - 9
Gaseous Fluoride	NSW EPA TM - 9

Observations made during testing period:

VOC start 10:48
VOC end 11:18
Roto factor 1.01
Temp 25
Baro 1003

Sampling Performed By:

Vilai Kelemete-Manua

for Dylan Turnbull

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Particulate Fluoride
Test 3: 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= 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	B PM10/2.5 A Distance from wall	B 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: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Particulate Fluoride
Test 3: Gaseous Fluoride

Sampling time start: 10:17		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:17	22	20.8	0.1
2	10:18	21	20.7	0.1
3	10:19	17	20.6	0.2
4	10:20	13	20.7	0.1
5	10:21	12	20.8	0.1
6	10:22	14	20.7	0.1
7	10:23	15	20.8	0.1
8	10:24	9	20.8	0.1
	Averages:	15.4 ppm	20.7 %	0.1 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.40 %

Measurements

CO:	0.0015 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0015 %,(wet)	N_2:	77.2 %,(wet)
CO_2:	0.1 %,(wet)	O_2:	20.2 %,(wet)
H_2O:	2.40 %(=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: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)
Test 2: Particulate Fluoride
Test 3: Gaseous Fluoride

Sampling time start: 12:06		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:06	1	20.3	0.3
2	12:07	1	20.3	0.3
3	12:08	2	20.3	0.3
4	12:09	2	20.3	0.3
5	12:10	2	20.3	0.3
6	12:11	2	20.3	0.3
7	12:12	1	20.3	0.3
8	12:13	1	20.3	0.3
	Averages:	1.5 ppm	20.3 %	0.3 %

Moisture content (M3): 0.97
Moisture percentage (M2): 3.48 %

Measurements

CO:	0.0002 %,(dry)	N_2:	79.4 %,(dry)
CO_2:	0.3 %,(dry)	O_2:	20.3 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0001 %,(wet)	N_2:	76.6 %,(wet)
CO_2:	0.3 %,(wet)	O_2:	19.6 %,(wet)
H_2O:	3.48 %(=M2)		
Therefore, stack gas density (GD) =	1.27 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: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)
Test 2:Particulate Fluoride
Test 3:Gaseous Fluoride

Time :	10:17	Barometric Pressure :		1005	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 (0 °C, Wet, 1 Atm)
Pitot Tube Type :	S				

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	0.169	73.0	346.2	15.4
1/2	165	0.148	73.0	346.2	14.5
1/3	262	0.135	73.0	346.2	13.8
1/4	383	0.134	73.0	346.2	13.8
1/5	554	0.189	73.0	346.2	16.4
1/6	1036	0.208	73.0	346.2	17.1
1/7	1208	0.159	73.0	346.2	15.0
1/8	1328	0.219	73.0	346.2	17.6
1/9	1425	0.213	73.0	346.2	17.3
1/10	1509	0.222	73.0	346.2	17.7
2/1	81	0.185	73.0	346.2	16.2
2/2	165	0.211	73.0	346.2	17.3
2/3	262	0.191	73.0	346.2	16.4
2/4	383	0.193	73.0	346.2	16.5
2/5	554	0.164	73.0	346.2	15.2
2/6	1036	0.131	73.0	346.2	13.6
2/7	1208	0.153	73.0	346.2	14.7
2/8	1328	0.170	73.0	346.2	15.5
2/9	1425	0.182	73.0	346.2	16.1
2/10	1509	0.177	73.0	346.2	15.8
Average			73.0	346.2	15.8

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -8 mm
Absolute pressure in stack (hPa) : 1004.22 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 5
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.76 x 10^{-5} m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 322.8852 Meter finish: 322.8852
Time start: 10:21 Time finish: 10:22

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 324.4126 Meter finish: 324.4126
Time start: 12:05 Time finish: 12:06

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 322.8876 Time start: 10:24
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	14.1	31.0	27.0		Yes
1/2	0:10:00	195	13.3	31.0	27.0		Yes
1/3	0:15:00	292	12.7	32.0	28.0		Yes
1/4	0:20:00	413	12.7	32.0	28.0		Yes
1/5	0:25:00	584	15.1	32.0	28.0		Yes
1/6	0:30:00	1066	15.7	32.0	28.0		Yes
1/7	0:35:00	1238	13.8	33.0	29.0		Yes
1/8	0:40:00	1358	16.2	33.0	29.0		Yes
1/9	0:45:00	1455	15.9	33.0	29.0		Yes
1/10	0:50:00	1539	16.3	33.0	29.0		Yes
2/1	0:55:00	111	14.9	33.0	30.0		Yes
2/2	1:00:00	195	15.9	33.0	30.0		Yes
2/3	1:05:00	292	15.1	33.0	30.0		Yes
2/4	1:10:00	413	15.2	33.0	30.0		Yes
2/5	1:15:00	584	14.0	34.0	30.0		Yes
2/6	1:20:00	1066	12.5	34.0	31.0		Yes
2/7	1:25:00	1238	13.5	34.0	31.0		Yes
2/8	1:30:00	1358	14.2	34.0	31.0		Yes
2/9	1:35:00	1455	14.8	34.0	31.0		Yes
2/10	1:40:00	1539	14.5	34.0	31.0		Yes
Averages				32.9	29.4	no result	

Meter Finish: 324.4093 Time Finish: 12:04
Total Condensate collected: 17 ml Silica gel No(s) used: c15

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF PARTICULATE FLUORIDE

Date: 18-Mar-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): 1.49 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 30.4612 Meter finish: 30.4612
Time start: 10:23 Time finish: 10:24
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 31.7408 Meter finish: 31.7408
Time start: 12:07 Time finish: 12:08
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 30.4642 Time start: 10:24
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	11.9	38.0	29.0		Yes
1/2	0:10:00	195	11.2	39.0	29.0		Yes
1/3	0:15:00	292	10.6	41.0	30.0		Yes
1/4	0:20:00	413	10.6	42.0	30.0		Yes
1/5	0:25:00	584	12.6	42.0	30.0		Yes
1/6	0:30:00	1066	13.2	43.0	30.0		Yes
1/7	0:35:00	1238	11.5	43.0	30.0		Yes
1/8	0:40:00	1358	13.5	44.0	31.0		Yes
1/9	0:45:00	1455	13.3	44.0	31.0		Yes
1/10	0:50:00	1539	13.6	44.0	31.0		Yes
2/1	0:55:00	111	12.5	44.0	32.0		Yes
2/2	1:00:00	195	13.3	44.0	32.0		Yes
2/3	1:05:00	292	12.6	44.0	32.0		Yes
2/4	1:10:00	413	12.7	44.0	32.0		Yes
2/5	1:15:00	584	11.7	44.0	32.0		Yes
2/6	1:20:00	1066	10.5	45.0	32.0		Yes
2/7	1:25:00	1238	11.3	45.0	33.0		Yes
2/8	1:30:00	1358	11.9	45.0	33.0		Yes
2/9	1:35:00	1455	12.4	44.0	33.0		Yes
2/10	1:40:00	1539	12.2	44.0	33.0		Yes
Averages				43.2	31.3	no result	

Meter Finish: 31.7380 Time Finish: 12:04
Total Condensate collected: 24 ml Silica gel No(s) used: F23

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)
Test 2:Particulate Fluoride
Test 3:Gaseous Fluoride

Time :	12:10	Barometric Pressure :		1005	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.27	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	0.171	69.0	342.2	15.5
1/2	165	0.168	69.0	342.2	15.3
1/3	262	0.192	69.0	342.2	16.4
1/4	383	0.164	69.0	342.2	15.2
1/5	554	0.128	69.0	342.2	13.4
1/6	1036	0.170	69.0	342.2	15.4
1/7	1208	0.213	69.0	342.2	17.3
1/8	1328	0.113	69.0	342.2	12.6
1/9	1425	0.163	69.0	342.2	15.1
1/10	1509	0.173	69.0	342.2	15.6
2/1	81	0.181	69.0	342.2	16.0
2/2	165	0.189	69.0	342.2	16.3
2/3	262	0.208	69.0	342.2	17.1
2/4	383	0.193	69.0	342.2	16.5
2/5	554	0.169	69.0	342.2	15.4
2/6	1036	0.175	69.0	342.2	15.6
2/7	1208	0.181	69.0	342.2	15.9
2/8	1328	0.152	69.0	342.2	14.6
2/9	1425	0.140	69.0	342.2	14.0
2/10	1509	0.166	69.0	342.2	15.2
Average			69.0	342.2	15.4

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.5 mm
Absolute pressure in stack (hPa) : 1004.07 hPa

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 18-Mar-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	0.0008	0.00075			
Chromium	0.0002	0.0099			
Cobalt	<0.0002	<0.0001			
Copper	<0.0012	0.0014			
Lead	<0.0002	0.00055			
Magnesium	<0.0496	0.0054			
Manganese	<0.0011	0.0017			
Mercury	<0.0002	<0.0001	<0.0001	<0.0005	<0.0001
Nickel	<0.0006	0.00079			
Selenium	<0.0009	<0.0009			
Thallium	<0.0002	<0.0001			
Tin	<0.0002	<0.0001			
Vanadium	<0.0002	<0.0001			
Zinc	<0.7812	0.0052			

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: 18-Mar-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	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Arsenic	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Beryllium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Cadmium	0.0008	0.00058	0.00075	0.00055			0.002	0.0015	0.038
Chromium	0.0002	0.00015	0.0099	0.0072			0.01	0.0073	0.19
Cobalt	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Copper	<0.0012	<0.00088	0.0014	0.001			0.0014	0.001	0.026
Lead	<0.0002	<0.00015	0.00055	0.0004			0.00055	0.0004	0.01
Magnesium	<0.0496	<0.036	0.0054	0.0039			0.0054	0.0039	0.1
Manganese	<0.0011	<0.0008	0.0017	0.0012			0.0017	0.0012	0.031
Mercury	<0.0002	<0.00015	<0.0001	<0.000073	<0.0005	<0.00037	<0.0005	<0.00037	<0.0094
Nickel	<0.0006	<0.00044	0.00079	0.00058			0.00079	0.00058	0.015
Selenium	<0.0009	<0.00066	<0.0009	<0.00066			<0.0002	<0.00015	<0.0038
Thallium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Tin	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Vanadium	<0.0002	<0.00015	<0.0001	<0.000073			<0.0002	<0.00015	<0.0038
Zinc	<0.7812	<0.57	0.0052	0.0038			0.0052	0.0038	0.097
Total Hazardous Metals*	0.001	0.00073	0.014	0.0099	<0.0005	<0.00037	0.015	0.011	0.28
Total Metals	0.001	0.00073	0.026	0.019			0.027	0.02	0.5

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

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: 18-Mar-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):	1.5369	m^3	Average barometric pressure (P_{BARO})	1005 hPa
Average gas meter temp. ($T_{M,2}$):	31.1	°C		
	304.3	K	Average pressure at meter ($P_{M,2}$)	1005.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.3686	m^3		

(B) Metals concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Metals Weight	0.000015 g
Final Metals Weight (Mp1):	0.00002	g		
Metals Concentration (C1):		$=M_{p1}/MV_4=$	0.000011	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.011	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.00064 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.64 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00032 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.32 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: c15

V_v = 12.8 g (from laboratory report) V_w = 17 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0227

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0171

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

B_{ws} = 2.82 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Hazardous Substances (Metals)

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

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.28 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

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

= 1.007 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.80 m/s

(ii) Average of post-sampling velocities: 15.42 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.61 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 = 33.38 m^3/s (stack conditions)

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

Qstd = 25.5 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00028	g/s (0°C, dry gas, 1 atm pressure)		
	=	0.28	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.016	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	16	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.0082	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	8.2	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Particulate Fluoride

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

Date: 18-Mar-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 gas meter temp. ($T_{M,2}$): 37.2 °C
310.4 K
Average barometric pressure (P_{BARO}) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1120 m^3

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
Particulate Fluoride Weight 0.000061 g
Final Particulate Fluoride Weight (Mp1): 0.00006 g
Particulate Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.000055 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.055 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %
Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0032 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 3.2 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %
Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0016 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 1.6 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F23
V_v = 9 g (from laboratory report) V_w = 24 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0320
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0120

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

B_{ws} = 3.81 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Particulate Fluoride

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

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

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

= 1.015 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.80 m/s

(ii) Average of post-sampling velocities: 15.42 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.61 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 = 33.38 m^3/s (stack conditions)

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

Qstd = 25.3 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 =	0.081	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	81	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.04	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	40	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: 18-Mar-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 gas meter temp. ($T_{M,2}$): 37.2 °C

310.4 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1120 m^3

(B) Gaseous Fluoride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Gaseous Fluoride Weight 0.00002 g

Final Gaseous Fluoride Weight (Mp1): 0.00002 g

Gaseous Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.000018 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.018 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.001 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

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

O_2 Basis 7 %

Average O_2%: 20.5 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00052 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.52 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F23

V_v = 9 g (from laboratory report) V_w = 24 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0320

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0120

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

B_{ws} = 3.81 %

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): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

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

= 1.015 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.80 m/s

(ii) Average of post-sampling velocities: 15.42 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.61 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 = 33.38 m^3/s (stack conditions)

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

Qstd = 25.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00045	g/s (0°C, dry gas, 1 atm pressure)		
	=	0.45	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.026	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	26	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.013	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	13	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
18-Mar-16
HAZARDOUS SUBSTANCES (METALS)
PARTICULATE FLUORIDE
GASEOUS FLUORIDE

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	71.0 °C		344.2 K
Stack pressure (average)	1004 hPa		
Stack gas velocity (average, stack conditions)	16 m/s		
Stack gas flowrate (stack conditions)	33 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	25 m^3/s		
Hazardous Substances (Metals) Testing			
Test Period	10:24	-	12:04
Hazardous Substances (Metals) Mass	0.015 mg		
Gas Volume Sampled	1.37 m^3		
Hazardous Substances (Metals) Emission*1	0.011 mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.28 mg/s		
Regulatory Limit	10 mg/m^3		
Particulate Fluoride Testing			
Test Period	10:24	-	12:04
Particulate Fluoride Mass	0.061 mg		
Gas Volume Sampled	1.11 m^3		
Particulate Fluoride Emission*1	0.055 mg/m^3		
Particulate Fluoride Mass Emission Rate*2	1.4 mg/s		
Regulatory Limit	NA mg/m^3		
Gaseous Fluoride Testing			
Test Period	10:24	-	12:04
Gaseous Fluoride Mass	0.02 mg		
Gas Volume Sampled	1.11 m^3		
Gaseous Fluoride Emission*1	0.018 mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	0.45 mg/s		
Regulatory Limit	2 mg/m^3		
Moisture Content (%)	3.5		
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: 18-Mar-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

for Dylan Turnbull

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 18-Mar-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: 18-Mar-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: 8:26		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	8:26	10	20.5	0.2
2	8:27	33	20.6	0.2
3	8:28	40	20.6	0.2
4	8:29	56	20.6	0.2
5	8:30	83	20.6	0.2
6	8:31	92	20.6	0.2
7	8:32	107	20.6	0.2
8	8:33	109	20.6	0.2
	Averages:	66.3 ppm	20.6 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.40 %

Measurements

CO:	0.0066 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0065 %,(wet)	N_2:	77.3 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.1 %,(wet)
H_2O:	2.40 %(=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: 18-Mar-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: 10:06		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	10:06	76	20.6	0.2
2	10:07	71	20.6	0.2
3	10:08	69	20.6	0.2
4	10:09	30	20.6	0.2
5	10:10	28	20.6	0.2
6	10:11	25	20.6	0.2
7	10:12	21	20.6	0.2
8	10:13	25	20.6	0.2
	Averages:	43.1 ppm	20.6 %	0.2 %

Moisture content (M3): 0.97
Moisture percentage (M2): 2.60 %

Measurements

CO:	0.0043 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0042 %,(wet)	N_2:	77.1 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.1 %,(wet)
H_2O:	2.60 %(=M2)		

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

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-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 :	8:15	Barometric Pressure :		1005	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	0.204	66.0	339.2	16.8
1/2	165	0.221	66.0	339.2	17.5
1/3	262	0.181	66.0	339.2	15.9
1/4	383	0.166	66.0	339.2	15.2
1/5	554	0.206	66.0	339.2	16.9
1/6	1036	0.199	66.0	339.2	16.6
1/7	1208	0.196	66.0	339.2	16.5
1/8	1328	0.179	66.0	339.2	15.7
1/9	1425	0.174	66.0	339.2	15.5
1/10	1509	0.191	66.0	339.2	16.3
2/1	81	0.185	66.0	339.2	16.0
2/2	165	0.198	66.0	339.2	16.6
2/3	262	0.213	66.0	339.2	17.2
2/4	383	0.182	66.0	339.2	15.9
2/5	554	0.175	66.0	339.2	15.5
2/6	1036	0.193	66.0	339.2	16.4
2/7	1208	0.161	66.0	339.2	14.9
2/8	1328	0.153	66.0	339.2	14.6
2/9	1425	0.183	66.0	339.2	15.9
2/10	1509	0.186	66.0	339.2	16.1
Average			66.0	339.2	16.1

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.3 mm
Absolute pressure in stack (hPa) : 1004.09 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)

Date: 18-Mar-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): 1.49 x 10^{-5} m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 321.5796 Meter finish: 321.5796
Time start: 8:28 Time finish: 8:29

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 322.8802 Meter finish: 322.8802
Time start: 10:14 Time finish: 10:15

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 321.5822 Time start: 8:33
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	13.3	25.0	24.0		Yes
1/2	0:10:00	195	13.9	25.0	24.0		Yes
1/3	0:15:00	292	12.6	26.0	25.0		Yes
1/4	0:20:00	413	12.1	27.0	25.0		Yes
1/5	0:25:00	584	13.4	27.0	25.0		Yes
1/6	0:30:00	1066	13.2	28.0	26.0		Yes
1/7	0:35:00	1238	13.1	28.0	26.0		Yes
1/8	0:40:00	1358	12.5	29.0	26.0		Yes
1/9	0:45:00	1455	12.3	29.0	26.0		Yes
1/10	0:50:00	1539	12.9	29.0	27.0		Yes
2/1	0:55:00	111	12.7	30.0	27.0		Yes
2/2	1:00:00	195	13.2	30.0	27.0		Yes
2/3	1:05:00	292	13.6	30.0	28.0		Yes
2/4	1:10:00	413	12.6	31.0	28.0		Yes
2/5	1:15:00	584	12.3	31.0	29.0		Yes
2/6	1:20:00	1066	13.0	31.0	29.0		Yes
2/7	1:25:00	1238	11.8	31.0	29.0		Yes
2/8	1:30:00	1358	11.6	31.0	29.0		Yes
2/9	1:35:00	1455	12.6	31.0	29.0		Yes
2/10	1:40:00	1539	12.8	31.0	29.0		Yes
Averages				29.0	26.9	no result	

Meter Finish: 322.8770 Time Finish: 10:13
Total Condensate collected: 0 ml Silica gel No(s) used: FA9

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFUR DIOXIDE (SO2 AS SO3)

Date: 18-Mar-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): 1.49 x 10^{-5} m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 321.5796 Meter finish: 321.5796
Time start: 8:28 Time finish: 8:29

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 322.8802 Meter finish: 322.8802
Time start: 10:14 Time finish: 10:15

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 321.5822 Time start: 8:33
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	13.3	25.0	24.0		Yes
1/2	0:10:00	195	13.9	25.0	24.0		Yes
1/3	0:15:00	292	12.6	26.0	25.0		Yes
1/4	0:20:00	413	12.1	27.0	25.0		Yes
1/5	0:25:00	584	13.4	27.0	25.0		Yes
1/6	0:30:00	1066	13.2	28.0	26.0		Yes
1/7	0:35:00	1238	13.1	28.0	26.0		Yes
1/8	0:40:00	1358	12.5	29.0	26.0		Yes
1/9	0:45:00	1455	12.3	29.0	26.0		Yes
1/10	0:50:00	1539	12.9	29.0	27.0		Yes
2/1	0:55:00	111	12.7	30.0	27.0		Yes
2/2	1:00:00	195	13.2	30.0	27.0		Yes
2/3	1:05:00	292	13.6	30.0	28.0		Yes
2/4	1:10:00	413	12.6	31.0	28.0		Yes
2/5	1:15:00	584	12.3	31.0	29.0		Yes
2/6	1:20:00	1066	13.0	31.0	29.0		Yes
2/7	1:25:00	1238	11.8	31.0	29.0		Yes
2/8	1:30:00	1358	11.6	31.0	29.0		Yes
2/9	1:35:00	1455	12.6	31.0	29.0		Yes
2/10	1:40:00	1539	12.8	31.0	29.0		Yes
Averages				29.0	26.9	no result	

Meter Finish: 322.8770 Time Finish: 10:13
Total Condensate collected: 0 ml Silica gel No(s) used: FA9

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HYDROGEN CHLORIDE AND CHLORINE

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 4
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.36 x 10^{-5} m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 29.2332 Meter finish: 29.2332
Time start: 8:30 Time finish: 8:31

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 40.4576 Meter finish: 40.4576
Time start: 10:16 Time finish: 10:17

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 29.2360 Time start: 8:33
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	12.0	32.0	23.0		Yes
1/2	0:10:00	195	12.5	33.0	23.0		Yes
1/3	0:15:00	292	11.4	34.0	24.0		Yes
1/4	0:20:00	413	10.9	35.0	24.0		Yes
1/5	0:25:00	584	12.1	36.0	24.0		Yes
1/6	0:30:00	1066	11.9	37.0	25.0		Yes
1/7	0:35:00	1238	11.8	38.0	25.0		Yes
1/8	0:40:00	1358	11.3	39.0	25.0		Yes
1/9	0:45:00	1455	11.1	39.0	25.0		Yes
1/10	0:50:00	1539	11.7	39.0	25.0		Yes
2/1	0:55:00	111	11.5	40.0	26.0		Yes
2/2	1:00:00	195	11.9	40.0	26.0		Yes
2/3	1:05:00	292	12.3	40.0	27.0		Yes
2/4	1:10:00	413	11.4	41.0	27.0		Yes
2/5	1:15:00	584	11.1	41.0	28.0		Yes
2/6	1:20:00	1066	11.8	41.0	28.0		Yes
2/7	1:25:00	1238	10.7	41.0	28.0		Yes
2/8	1:30:00	1358	10.5	41.0	28.0		Yes
2/9	1:35:00	1455	11.4	41.0	29.0		Yes
2/10	1:40:00	1539	11.5	41.0	29.0		Yes
Averages				38.5	26.0	no result	

Meter Finish: 40.4544 Time Finish: 10:13
Total Condensate collected: 3 ml Silica gel No(s) used: P38

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-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 :	10:17	Barometric Pressure :	1005	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	0.169	73.0	346.2	15.4
1/2	165	0.148	73.0	346.2	14.5
1/3	262	0.135	73.0	346.2	13.8
1/4	383	0.134	73.0	346.2	13.8
1/5	554	0.189	73.0	346.2	16.4
1/6	1036	0.208	73.0	346.2	17.1
1/7	1208	0.159	73.0	346.2	15.0
1/8	1328	0.219	73.0	346.2	17.6
1/9	1425	0.213	73.0	346.2	17.3
1/10	1509	0.222	73.0	346.2	17.7
2/1	81	0.185	73.0	346.2	16.2
2/2	165	0.211	73.0	346.2	17.3
2/3	262	0.191	73.0	346.2	16.4
2/4	383	0.193	73.0	346.2	16.5
2/5	554	0.164	73.0	346.2	15.2
2/6	1036	0.131	73.0	346.2	13.6
2/7	1208	0.153	73.0	346.2	14.7
2/8	1328	0.170	73.0	346.2	15.5
2/9	1425	0.182	73.0	346.2	16.1
2/10	1509	0.177	73.0	346.2	15.8
Average			73.0	346.2	15.8

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -8 mm
Absolute pressure in stack (hPa) : 1004.22 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Sulfuric Acid Mist (H2SO4 as SO3)

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

Date: 18-Mar-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): 1.3077 m^3

Average gas meter temp. ($T_{M,2}$): 28.0 °C

301.2 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1765 m^3

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

H2SO4 as SO3 Weight <0.002 g

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

H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0017 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <1.7 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.1 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <100 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.059 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <59 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: FA9

V_v = 34.4 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 ($V_{wsg(std)}$) = 0.0459

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

B_{ws} = 3.76 %

ANZ

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): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

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

= 1.019 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.10 m/s

(ii) Average of post-sampling velocities: 15.80 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.95 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 = 34.11 m^3/s (stack conditions)

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

Qstd = 25.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.044	g/s (0°C, dry gas, 1 atm pressure)		
	=	<44	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<2.6	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<2600	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<1.5	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<1500	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Sulfur Dioxide (SO2 as SO3)

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

Date: 18-Mar-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): 1.3077 m^3

Average gas meter temp. ($T_{M,2}$): 28.0 °C

301.2 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1765 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): $=M_{p1}/MV_4=$ <0.0085 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <8.5 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.51 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <510 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.29 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <290 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: FA9

V_v = 34.4 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 ($V_{wsg(std)}$) = 0.0459

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

B_{ws} = 3.76 %

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): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

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

= 1.019 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.10 m/s

(ii) Average of post-sampling velocities: 15.80 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.95 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 = 34.11 m^3/s (stack conditions)

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

Qstd = 25.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.22	g/s (0°C, dry gas, 1 atm pressure)		
	=	<220	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<13	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<13000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<7.6	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<7600	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: 18-Mar-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): 11.2184 m^3

Average gas meter temp. ($T_{M,2}$): 32.2 °C

305.4 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 9.9539 m^3

(B) Hydrogen Chloride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Hydrogen Chloride Weight <0.01 g

Final Hydrogen Chloride Weight (Mp1): <0.01 g

Hydrogen Chloride Concentration (C1): $=M_{p1}/MV_4=$ <0.001 g/m^3 (0°C, dry gas, 1atm pressure)

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

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.06 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <60 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.034 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <34 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P38

V_v = 17.9 g (from laboratory report) V_w = 3 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0239

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

B_{ws} = 0.28 %

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): 1.26 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 $\frac{(Ps)}{(1013.25)}$

= 0.995 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.10 m/s

(ii) Average of post-sampling velocities: 15.80 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.95 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 = 34.11 m^3/s (stack conditions)

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

Qstd = 26.9 m^3/s (0^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.027	g/s (0^oC, dry gas, 1 atm pressure)		
	=	<27	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<1.6	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	<1600	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<0.93	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	<930	mg/s (0^oC, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Chlorine

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

Date: 18-Mar-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): 11.2184 m^3

Average gas meter temp. ($T_{M,2}$): 32.2 °C

305.4 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 9.9539 m^3

(B) Chlorine concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Chlorine Weight <0.005 g

Final Chlorine Weight (Mp1): <0.005 g

Chlorine Concentration (C1): $=M_{p1}/MV_4=$ <0.0005 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <0.5 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.03 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <30 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.017 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <17 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P38

V_v = 17.9 g (from laboratory report) V_w = 3 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0239

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

B_{ws} = 0.28 %

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Chlorine

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

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.26 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 $\frac{(Ps)}{(1013.25)}$

= 0.995 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.10 m/s

(ii) Average of post-sampling velocities: 15.80 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.95 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 = 34.11 m^3/s (stack conditions)

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

Qstd = 26.9 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	<0.013	g/s (0°C, dry gas, 1 atm pressure)		
	=	<13	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<0.81	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<810	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<0.46	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<460	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
18-Mar-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)	69.5 °C		342.7 K
Stack pressure (average)	1004 hPa		
Stack gas velocity (average, stack conditions)	16 m/s		
Stack gas flowrate (stack conditions)	34 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	26 m^3/s		
Sulfuric Acid Mist (H2SO4 as SO3) Testing			
Test Period	8:33	-	10:13
Sulfuric Acid Mist (H2SO4 as SO3) Mass	<2 mg		
Gas Volume Sampled	1.18 m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Emission*1	<1.7 mg/m^3		
Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2	<44 mg/s		
Regulatory Limit	100 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Testing			
Test Period	8:33	-	10:13
Sulfur Dioxide (SO2 as SO3) Mass	<10 mg		
Gas Volume Sampled	1.18 m^3		
Sulfur Dioxide (SO2 as SO3) Emission*1	<8.5 mg/m^3		
Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2	<220 mg/s		
Regulatory Limit	NA mg/m^3		
Hydrogen Chloride Testing			
Test Period	8:33	-	10:13
Hydrogen Chloride Mass	<10 mg		
Gas Volume Sampled	9.95 m^3		
Hydrogen Chloride Emission*1	<1 mg/m^3		
Hydrogen Chloride Mass Emission Rate*2	<27 mg/s		
Regulatory Limit	400 mg/m^3		
Chlorine Testing			
Test Period	8:33	-	10:13
Chlorine Mass	<5 mg		
Gas Volume Sampled	9.95 m^3		
Chlorine Emission*1	<0.5 mg/m^3		
Chlorine Mass Emission Rate*2	<13 mg/s		
Regulatory Limit	NA mg/m^3		
Moisture Content (%)	2.6		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.9 g/g-mole		

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

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 18-Mar-16

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

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

for Dylan Turnbull

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Polycyclic Aromatic Hydrocarbons
Test 2: Dioxins and Furans Lower Bound
Test 3: Dioxins and Furans Middle Bound

Measurement/Observations

Stack Internal Dimensions:

Diameter 1650 mm
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: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Polycyclic Aromatic Hydrocarbons
Test 2: Dioxins and Furans Lower Bound
Test 3: Dioxins and Furans Middle Bound

Sampling time start: 6:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	6:00	7	20.4	0.3
2	6:01	8	20.4	0.3
3	6:02	10	20.4	0.3
4	6:03	14	20.5	0.2
5	6:04	15	20.5	0.2
6	6:05	11	20.5	0.2
7	6:06	10	20.5	0.2
8	6:07	13	20.5	0.2
	Averages:	11.0 ppm	20.5 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.40 %

Measurements

CO:	0.0011 %,(dry)	N_2:	79.3 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.5 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0011 %,(wet)	N_2:	77.4 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.0 %,(wet)
H_2O:	2.40 %(=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: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1: Polycyclic Aromatic Hydrocarbons
Test 2: Dioxins and Furans Lower Bound
Test 3: Dioxins and Furans Middle Bound

Sampling time start: 12:06		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	12:06	1	20.3	0.3
2	12:07	1	20.3	0.3
3	12:08	2	20.3	0.3
4	12:09	2	20.3	0.3
5	12:10	2	20.3	0.3
6	12:11	2	20.3	0.3
7	12:12	1	20.3	0.3
8	12:13	1	20.3	0.3
	Averages:	1.5 ppm	20.3 %	0.3 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.94 %

Measurements

CO:	0.0002 %,(dry)	N_2:	79.4 %,(dry)
CO_2:	0.3 %,(dry)	O_2:	20.3 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0001 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.3 %,(wet)	O_2:	19.9 %,(wet)
H_2O:	1.94 %(=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 - Pre Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Polycyclic Aromatic Hydrocarbons
Test 2:Dioxins and Furans Lower Bound
Test 3:Dioxins and Furans Middle Bound

Time :	6:00	Barometric Pressure :		1005	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	0.163	83.0	356.2	15.4
1/2	165	0.136	83.0	356.2	14.1
1/3	262	0.181	83.0	356.2	16.2
1/4	383	0.199	83.0	356.2	17.0
1/5	554	0.175	83.0	356.2	15.9
1/6	1036	0.165	83.0	356.2	15.5
1/7	1208	0.151	83.0	356.2	14.8
1/8	1328	0.171	83.0	356.2	15.8
1/9	1425	0.179	83.0	356.2	16.1
1/10	1509	0.197	83.0	356.2	16.9
2/1	81	0.164	83.0	356.2	15.4
2/2	165	0.163	83.0	356.2	15.4
2/3	262	0.176	83.0	356.2	16.0
2/4	383	0.181	83.0	356.2	16.2
2/5	554	0.188	83.0	356.2	16.5
2/6	1036	0.183	83.0	356.2	16.3
2/7	1208	0.173	83.0	356.2	15.8
2/8	1328	0.192	83.0	356.2	16.7
2/9	1425	0.201	83.0	356.2	17.1
2/10	1509	0.180	83.0	356.2	16.2
Average			83.0	356.2	16.0

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -7.5 mm
Absolute pressure in stack (hPa) : 1004.26 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 5
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.76 x $10^{-5}m^2$
Thimble No: DAU140316A
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 5210.3222 Meter finish: 5210.3222
Time start: 6:05 Time finish: 6:06
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5215.3152 Meter finish: 5215.3152
Time start: 12:08 Time finish: 12:09
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 5210.3276 Time start: 6:07
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	0:18:00	111	13.6	35.0	23.0		Yes
1/2	0:36:00	195	12.5	36.0	24.0		Yes
1/3	0:54:00	292	14.3	37.0	26.0		Yes
1/4	1:12:00	413	15.0	37.0	26.0		Yes
1/5	1:30:00	584	14.1	38.0	27.0		Yes
1/6	1:48:00	1066	13.7	39.0	28.0		Yes
1/7	2:06:00	1238	13.1	39.0	29.0		Yes
1/8	2:24:00	1358	14.0	40.0	29.0		Yes
1/9	2:42:00	1455	14.2	40.0	30.0		Yes
1/10	3:00:00	1539	14.9	41.0	31.0		Yes
2/1	3:18:00	111	13.6	41.0	31.0		Yes
2/2	3:36:00	195	13.6	42.0	32.0		Yes
2/3	3:54:00	292	14.1	42.0	32.0		Yes
2/4	4:12:00	413	14.3	43.0	32.0		Yes
2/5	4:30:00	584	14.6	44.0	33.0		Yes
2/6	4:48:00	1066	14.4	44.0	34.0		Yes
2/7	5:06:00	1238	14.0	45.0	35.0		Yes
2/8	5:24:00	1358	14.8	44.0	36.0		Yes
2/9	5:42:00	1455	15.1	45.0	36.0		Yes
2/10	6:00:00	1539	14.3	45.0	36.0		Yes
Averages				40.9	30.5	no result	

Meter Finish: 5215.3120 Time Finish: 12:07
Total Condensate collected: 35 ml Silica gel No(s) used: F99

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF DIOXINS AND FURANS

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: 5
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.76 x 10^{-5} m^2
Thimble No: DAU140316A
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 5210.3222 Meter finish: 5210.3222
Time start: 6:05 Time finish: 6:06
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5215.3152 Meter finish: 5215.3152
Time start: 12:08 Time finish: 12:09
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 5210.3276 Time start: 6:07
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	0:18:00	111	13.6	35.0	23.0		Yes
1/2	0:36:00	195	12.5	36.0	24.0		Yes
1/3	0:54:00	292	14.3	37.0	26.0		Yes
1/4	1:12:00	413	15.0	37.0	26.0		Yes
1/5	1:30:00	584	14.1	38.0	27.0		Yes
1/6	1:48:00	1066	13.7	39.0	28.0		Yes
1/7	2:06:00	1238	13.1	39.0	29.0		Yes
1/8	2:24:00	1358	14.0	40.0	29.0		Yes
1/9	2:42:00	1455	14.2	40.0	30.0		Yes
1/10	3:00:00	1539	14.9	41.0	31.0		Yes
2/1	3:18:00	111	13.6	41.0	31.0		Yes
2/2	3:36:00	195	13.6	42.0	32.0		Yes
2/3	3:54:00	292	14.1	42.0	32.0		Yes
2/4	4:12:00	413	14.3	43.0	32.0		Yes
2/5	4:30:00	584	14.6	44.0	33.0		Yes
2/6	4:48:00	1066	14.4	44.0	34.0		Yes
2/7	5:06:00	1238	14.0	45.0	35.0		Yes
2/8	5:24:00	1358	14.8	44.0	36.0		Yes
2/9	5:42:00	1455	15.1	45.0	36.0		Yes
2/10	6:00:00	1539	14.3	45.0	36.0		Yes
Averages				40.9	30.5	no result	

Meter Finish: 5215.3120 Time Finish: 12:07
Total Condensate collected: 35 ml Silica gel No(s) used: F99

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 18-Mar-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Polycyclic Aromatic Hydrocarbons
Test 2:Dioxins and Furans Lower Bound
Test 3:Dioxins and Furans Middle Bound

Time :	12:10	Barometric Pressure :		1005	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	0.171	69.0	342.2	15.4
1/2	165	0.168	69.0	342.2	15.3
1/3	262	0.192	69.0	342.2	16.4
1/4	383	0.164	69.0	342.2	15.1
1/5	554	0.128	69.0	342.2	13.3
1/6	1036	0.170	69.0	342.2	15.4
1/7	1208	0.213	69.0	342.2	17.2
1/8	1328	0.113	69.0	342.2	12.5
1/9	1425	0.163	69.0	342.2	15.1
1/10	1509	0.173	69.0	342.2	15.5
2/1	81	0.181	69.0	342.2	15.9
2/2	165	0.189	69.0	342.2	16.2
2/3	262	0.208	69.0	342.2	17.0
2/4	383	0.193	69.0	342.2	16.4
2/5	554	0.169	69.0	342.2	15.3
2/6	1036	0.175	69.0	342.2	15.6
2/7	1208	0.181	69.0	342.2	15.9
2/8	1328	0.152	69.0	342.2	14.6
2/9	1425	0.140	69.0	342.2	14.0
2/10	1509	0.166	69.0	342.2	15.2
Average			69.0	342.2	15.4

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.5 mm
Absolute pressure in stack (hPa) : 1004.07 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results

Date: 18-Mar-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	42000	42	0.042	9.6	0.0096	240	0.24
2 - Methylnapthalene	46000	46	0.046	11	0.011	270	0.27
Acenaphthylene	120000	120	0.12	27	0.027	700	0.7
Acenaphthene	11000	11	0.011	2.5	0.0025	64	0.064
Fluorene	43000	43	0.043	9.8	0.0098	250	0.25
Phenanthrene	64000	64	0.064	15	0.015	370	0.37
Anthracene	2200	2.2	0.0022	0.5	0.0005	13	0.013
Fluoranthene	19000	19	0.019	4.3	0.0043	110	0.11
Pyrene	9900	9.9	0.0099	2.3	0.0023	58	0.058
Benz(a)anthracene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Chrysene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(b)fluoranthene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Perylene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Benzo(ghi)perylene	<20	<0.02	<0.00002	<0.0046	<0.0000046	<0.12	<0.00012
Sum of reported PAH's	360000	360	0.36	82	0.082	2100	2.1

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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	0.014	0.1	0.0014	0.0032	0.00032
Total TCDF isomers	0.27				
2,3,7,8-TCDD	<0.001	1	0.0005	<0.00023	0.00011
Total TCDD isomers	0.01				
1,2,3,7,8-PeCDF	0.023	0.05	0.00115	0.0053	0.00026
2,3,4,7,8-PeCDF	0.0026	0.5	0.0013	0.00059	0.0003
Total PeCDF isomers	0.084				
1,2,3,7,8-PeCDD	<0.0008	0.5	0.0002	<0.00018	0.000046
Total PeCDD isomers	<0.005				
1,2,3,4,7,8-HxCDF	0.0092	0.1	0.00092	0.0021	0.00021
1,2,3,6,7,8-HxCDF	0.008	0.1	0.0008	0.0018	0.00018
2,3,4,6,7,8-HxCDF	0.0019	0.1	0.00019	0.00043	0.000043
1,2,3,7,8,9-HxCDF	<0.002	0.1	0.0001	<0.00046	0.000023
Total HxCDF isomers	0.056				
1,2,3,4,7,8-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,6,7,8-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,7,8,9-HxCDD	<0.001	0.1	0.00005	<0.00023	0.000011
Total HxCDD isomers	0.0028				
1,2,3,4,6,7,8-HpCDF	0.017	0.01	0.00017	0.0039	0.000039
1,2,3,4,7,8,9-Hp CDF	0.011	0.01	0.00011	0.0025	0.000025
Total HpCDF isomers	0.038				
1,2,3,4,6,7,8-HpCDD	0.0049	0.01	0.000049	0.0011	0.000011
Total HpCDD isomers	0.0091				
OCDF	0.028	0.001	0.000028	0.0064	0.0000064
OCDD	0.018	0.001	0.000018	0.0041	0.0000041

I-TEQ$_{DF}$

Lower Bound (excluding LOD Values)	0.0061 ng
Middle Bound (including half LOD Values)	0.0071 ng
Date Tested **18-Mar-16**	

STACK ANALYSIS - FINAL CALCULATIONS

Polycyclic Aromatic Hydrocarbons

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

Date: 18-Mar-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):	4.9844	m^3	Average barometric pressure (P_{BARO})	1005 hPa
Average gas meter temp. ($T_{M,2}$):	35.7	°C		
	308.9	K	Average pressure at meter ($P_{M,2}$)	1005.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	4.3725	m^3		

(B) PAH concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	DAU140316A		PAH Weight	0.000357 g
Final PAH Weight (Mp1):	0.00036	g		
PAH Concentration (C1):		$=M_{p1}/MV_4=$	0.000082	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.082	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0037 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 3.7 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.4 %

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: F99

V_v = 29.9 g (from laboratory report) V_w = 35 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0467

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0399

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

B_{ws} = 1.94 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Polycyclic Aromatic Hydrocarbons

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

(i) Initial gas density for sampling: 1.28 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.27 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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 0.985 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.97 m/s

(ii) Average of post-sampling velocities: 15.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.67 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 = 33.51 m^3/s (stack conditions)

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

Qstd = 25.5 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0021	g/s (0°C, dry gas, 1 atm pressure)		
	=	2.1	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.093	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	93	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.047	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	47	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Lower Bound

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

Date: 18-Mar-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): 4.9844 m^3

Average gas meter temp. ($T_{M,2}$): 35.7 °C / 308.9 K

Average barometric pressure (P_{BARO}) 1005 hPa

Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 4.3725 m^3

(B) Lower Bound concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: DAU140316A

Blank weight: µg

Lower Bound Weight 0.0000061 µg

Final Lower Bound Weight (Mp1): 0.00001 µg

Lower Bound Concentration (C1): $=M_{p1}/MV_4=$ 1.4E-06 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.0014 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.000063 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.063 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.4 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000032 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.032 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F99

V_v = 29.9 g (from laboratory report) V_w = 35 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0467

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0399

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

B_{ws} = 1.94 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

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

= 0.985 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.97 m/s

(ii) Average of post-sampling velocities: 15.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.67 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 = 33.51 m^3/s (stack conditions)

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

Qstd = 25.5 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.000036	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.036	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.0016	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1.6	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.00081	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	0.81	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: 18-Mar-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): 4.9844 m^3
Average gas meter temp. ($T_{M,2}$): 35.7 °C
308.9 K
Average barometric pressure (P_{BARO}) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 4.3725 m^3

(B) Middle Bound concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: DAU140316A
Blank weight: µg
Middle Bound Weight 0.0000071 µg
Final Middle Bound Weight (Mp1): 0.00001 µg
Middle Bound Concentration (C1): $=M_{p1}/MV_4=$ 0.0000016 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.0016 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %
Average CO_2%: 0.3 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.000071 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.071 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %
Average O_2%: 20.4 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000036 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.036 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F99
V_v = 29.9 g (from laboratory report) V_w = 35 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0467
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0399
Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.94 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Dioxins and Furans Middle 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): 1.27 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 $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 0.985 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.97 m/s

(ii) Average of post-sampling velocities: 15.37 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.67 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 = 33.51 m^3/s (stack conditions)

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

Qstd = 25.5 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.000041	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.041	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.0018	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1.8	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.00092	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	0.92	ng/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
18-Mar-16
POLYCYCLIC AROMATIC HYDROCARBONS
DIOXINS AND FURANS

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	76.0 °C		349.2 K
Stack pressure (average)	1004 hPa		
Stack gas velocity (average, stack conditions)	16 m/s		
Stack gas flowrate (stack conditions)	34 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	25 m^3/s		
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	6:07	-	12:07
Polycyclic Aromatic Hydrocarbons Mass	0.3571 mg		
Gas Volume Sampled	4.37 m^3		
Polycyclic Aromatic Hydrocarbons Emission*1	0.082 mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	2.1 mg/s		
Regulatory Limit	NA mg/m^3		
Dioxins and Furans Lower Bound Testing			
Test Period	6:07	-	12:07
Dioxins and Furans Lower Bound Mass	0.0061 ng		
Gas Volume Sampled	4.37 m^3		
Dioxins and Furans Lower Bound Emission*1	0.0014 ng/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.036 ng/s		
Regulatory Limit	NA ng/m^3		
Dioxins and Furans Middle Bound Testing			
Test Period	6:07	-	12:07
Dioxins and Furans Middle Bound Mass	0.0071 ng		
Gas Volume Sampled	4.37 m^3		
Dioxins and Furans Middle Bound Emission*1	0.0016 ng/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.041 ng/s		
Regulatory Limit	NA ng/m^3		
Moisture Content (%)	1.9		
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.

STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

AECOM

Client:	Weston Aluminium	
Project Number:	60489919	
Stack Description:	Stack 1	
Date:	18-Mar-16	
Rotameter Correction Factor:	1.01	
Time Start:	10:48	
Time Finish:	11:48	
Sample Flow Rate:	0.2	L/min
Sample Time:	60	min
Sampled Volume:	12.12	litres
	0.01212	m^3
Ambient Temperature:	25	°C
Barometric Pressure:	1005	hPa
Stack Gas Moisture:	3.5	%
Corrected Volume:	0.0106	m^3 (0°C, dry gas, 1 atmosphere pressure)
Stack Flow Rate	25	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	<0.094	<2.4
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.094	<2.4
2-Butanone	<1.0	<1.0	<1.0	<0.094	<2.4
Chloroform	<1.0	<1.0	<1.0	<0.094	<2.4
Benzene	16.1	<1.0	15.6	1.5	38
1-heptene	<1.0	<1.0	<1.0	<0.094	<2.4
n-heptane	<1.0	<1.0	<1.0	<0.094	<2.4
Trichloroethene	<1.0	<1.0	<1.0	<0.094	<2.4
MIBK	<1.0	<1.0	<1.0	<0.094	<2.4
Toluene	39.9	<1.0	39.4	3.7	93
2-hexanone	<1.0	<1.0	<1.0	<0.094	<2.4
Chlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
Ethyl Benzene	<1.0	<1.0	<1.0	<0.094	<2.4
m- & p-xylene	<2.0	<0.2	<2.0	<0.19	<4.8
o-xylene	<1.0	<1.0	<1.0	<0.094	<2.4
Styrene	<1.0	<1.0	<1.0	<0.094	<2.4
Cyclohexanone	<1.0	<1.0	<1.0	<0.094	<2.4
Isopropylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
2-chlorotoluene	<1.0	<1.0	<1.0	<0.094	<2.4
4-chlorotoluene	<1.0	<1.0	<1.0	<0.094	<2.4
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
n-decane	<1.0	<1.0	<1.0	<0.094	<2.4
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.094	<2.4
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.094	<2.4
n-butylbenzene	<1.0	<1.0	<1.0	<0.094	<2.4
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.094	<2.4
Total	56.0		55.0	5.2	131

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)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EN1601130**	Page	: 1 of 12
Client	: **AECOM Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR JAMES LANG	Contact	: Loren Schiavon
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 8784 8503
Project	: 60489919 Task 1.4	Date Samples Received	: 23-Mar-2016 13:25
Order number	: 60489919 Task 1.4	Date Analysis Commenced	: 24-Mar-2016
C-O-C number	: ----	Issue Date	: 01-Apr-2016 17:47
Sampler	: D TURNBULL, VILAI KELEMETE-MANUA		
Site	: ----		
Quote number	: ----		
No. of samples received	: 14		
No. of samples analysed	: 14		

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*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Daniel Junek	Senior Air Analyst	Newcastle - Organics, Mayfield West, NSW
Dianne Blane	Laboratory Coordinator (2IC)	Newcastle - Inorganics, Mayfield West, NSW
Justin Houghton	Senior Analyst - Organic	Newcastle - Organics, 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.

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.

- **Filters were supplied by the client. Filter preparation may not meet ALS method requirements.**
- **ED009-X: LOR raised on various samples due to matrix interference.**
- **ED009-X: Spike for Fluoride failed due to matrix interference (confirmed by re-analysis).**
- **EP091: The LOR values for EP091 have been raised due to increased charcoal sample size (400/200 mg) over the standard charcoal sample size (100/50mg) requiring greater extraction volume of solvent.**
- **EP091: Sample analysed outside recommended holding time for EP091 analysis. Results should be scrutinised accordingly.**

Analytical Results

Sub-Matrix: **EXTRACT** (Matrix: **WATER**)				Client sample ID	STACK 1_HCL(H2SO4)	STACK 1_CL2(NaOH)	HCL(H2SO4) BLANK	CL2(NaOH) BLANK	----
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	---
Compound	CAS Number	LOR	Unit		EN1601130-001	EN1601130-002	EN1601130-003	EN1601130-004	------
					Result	Result	Result	Result	Result
ED009: Anions									
Bromide	24959-67-9	0.01	mg/L		<1.00	<0.500	<1.00	<1.00	---
Chloride	16887-00-6	0.1	mg/L		<10.0	<5.00	<10.0	<10.0	---
Fluoride	16984-48-8	0.01	mg/L		**2.27**	**5.45**	<1.00	<1.00	---

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)

Compound	CAS Number	LOR	Unit	Client sample ID	STACK 1_HCL(H2SO4)	STACK 1_CL2(NaOH)	HCL(H2SO4) BLANK	CL2(NaOH) BLANK	STACK 1_H2SO4 AS SO3
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]
					EN1601130-001	EN1601130-002	EN1601130-003	EN1601130-004	EN1601130-005
					Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)									
Volume - Impinger	—	1	mL		—	—	—	—	158
Sulfuric Acid as SO3	—	2	mg/sample		—	—	—	—	<2
Volume - Impinger	—	1	mL		—	—	—	—	—
Sulfur Dioxide as SO3	—	10	mg/sample		—	—	—	—	—
EA144C: Gaseous and Particulate Fluorides									
Fluoride (as HF)	—	0.01	mg/sample		—	—	—	—	—
Volume - Impinger	—	1	mL		—	—	—	—	—
Fluoride (Particulate) as HF	—	1	µg/filter		—	—	—	—	—
EA147: Acid Gases									
Hydrogen Bromide	—	0.01	mg		<1.00	—	<1.00	—	—
Hydrogen Chloride	7647-01-0	0.1	mg		<10.0	—	<10.0	—	—
Hydrogen Fluoride	73602-61-6	0.01	mg		<1.00	—	<1.00	—	—
EA147: Halogens									
Bromine	7726-95-6	0.01	mg		—	<0.500	—	<1.00	—
Chlorine	7782-50-5	0.1	mg		—	<5.00	—	<10.0	—
Fluorine	7782-41-4	0.01	mg		—	1.35	—	<1.00	—
Sampling Method									
ø Volume - Impinger	—	0.01	mL		249	248	223	238	—

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)

Compound	CAS Number	LOR	Unit	Client sample ID	STACK 1_SO2 AS SO3	H2SO4 AS SO3 BLANK	SO2 AS SO3	STACK 1_GASEOUS FLUORIDE	STACK 1_PARTICULATE FLUORIDE
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]
					EN1601130-006	EN1601130-007	EN1601130-008	EN1601130-009	EN1601130-010
					Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)									
Volume - Impinger	---	1	mL		---	223	---	---	---
Sulfuric Acid as SO3	---	2	mg/sample		---	<2	---	---	---
Volume - Impinger	---	1	mL		295	---	194	---	---
Sulfur Dioxide as SO3	---	10	mg/sample		<10	---	<10	---	---
EA144C: Gaseous and Particulate Fluorides									
Fluoride (as HF)	---	0.01	mg/sample		---	---	---	0.02	---
Volume - Impinger	---	1	mL		---	---	---	270	---
Fluoride (Particulate) as HF	---	1	µg/filter		---	---	---	---	61
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		---	---	---	---	---
Sampling Method									
ø Volume - Impinger	---	0.01	mL		---	---	---	---	---

Analytical Results

Sub-Matrix: **IMPINGER SOLUTION** (Matrix: **AIR**)

Compound	CAS Number	LOR	Unit	Client sample ID	GASEOUS FLUORIDE	PARTICULATE FLUORIDE	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
					EN1601130-011	EN1601130-012	-----	-----	-----
					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		216	---	---	---	---
Fluoride (Particulate) as HF	---	1	µg/filter		---	11	---	---	---
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		---	---	---	---	---
Sampling Method									
ø Volume - Impinger	---	0.01	mL		---	---	---	---	---

Analytical Results

Sub-Matrix: SORBENT TUBE (Matrix: AIR)				Client sample ID	STACK 1_VOC TEST	VOC BLANK	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
Compound	CAS Number	LOR	Unit		EN1601130-013	EN1601130-014	-----	-----	-----
					Result	Result	Result	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		**16.1**	<1.0	---	---	---
Toluene	108-88-3	0.5	µg/sample		**39.9**	<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	STACK 1_VOC TEST	VOC BLANK	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
Compound	CAS Number	LOR	Unit		EN1601130-013	EN1601130-014	-----	-----	-----
					Result	Result	Result	Result	Result
EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)									
Benzene	71-43-2	0.5	µg		16.1	<1.0	---	---	---
Toluene	108-88-3	0.5	µg		39.9	<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	STACK 1_VOC TEST	VOC BLANK	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
Compound	CAS Number	LOR	Unit		EN1601130-013	EN1601130-014	-----	-----	-----
					Result	Result	Result	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	STACK 1_VOC TEST	VOC BLANK	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
Compound	CAS Number	LOR	Unit		EN1601130-013	EN1601130-014	-----	-----	-----
					Result	Result	Result	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	%		88.2	86.4	---	---	---
4-Bromofluorobenzene	460-00-4	0.5	%		70.1	66.8	---	---	---
EP091: Chlorinated Organic Surrogates (Section 2)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		88.3	93.5	---	---	---
4-Bromofluorobenzene	460-00-4	0.5	%		63.9	73.1	---	---	---
EP091: Chlorinated Organic Surrogates (Section 3)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		91.6	90.0	---	---	---
4-Bromofluorobenzene	460-00-4	0.5	%		67.0	70.8	---	---	---
EP091: MAH Surrogates (Section 1)									
Toluene-D8	2037-26-5	0.5	%		90.1	89.2	---	---	---
EP091: MAH Surrogates (Section 2)									
Toluene-D8	2037-26-5	0.5	%		87.8	97.5	---	---	---
EP091: MAH Surrogates (Section 3)									

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	STACK 1_VOC TEST	VOC BLANK	---	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	---	---	---
Compound	CAS Number	LOR	Unit		EN1601130-013	EN1601130-014	------	------	------
					Result	Result	Result	Result	Result
EP091: MAH Surrogates (Section 3) - Continued									
Toluene-D8	2037-26-5	0.5	%		**91.5**	**90.0**	---	---	---

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

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EN1601220**	Page	: 1 of 4
Client	: **AECOM Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR JAMES LANG	Contact	: Loren Schiavon
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 8784 8503
Project	: 60489919 Task 1.1	Date Samples Received	: 31-Mar-2016 15:05
Order number	: 60489919 Task 1.1	Date Analysis Commenced	: 01-Apr-2016
C-O-C number	: ----	Issue Date	: 01-Apr-2016 16:32
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 3		
No. of samples analysed	: 3		

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

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

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.

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.

- **EK026SF: LOR raised for Total Cyanide on samples 2 and 3 due to sample matrix.**
- **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: **IMPINGER SOLUTION** (Matrix: **AIR**)			Client sample ID	**ST1 Cyanide A**	**ST1 Cyanide B**	**Cyanide Blank**	**----**	**----**
			Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1601220-001**	**EN1601220-002**	**EN1601220-003**	**-------**	**-------**
				Result	Result	Result	Result	Result
EK026-I: Cyanide in Air Impinger Solutions								
ø Cyanide	57-12-5	0.01	mg	**0.61**	<0.01	<0.01	----	----
ø Volume - Impinger	----	1	mL	**289**	**119**	**294**	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**ST1 Cyanide A**	**ST1 Cyanide B**	**Cyanide Blank**	---	---
				Client sampling date / time	[18-Mar-2016]	[18-Mar-2016]	[18-Mar-2016]	---	---
Compound	*CAS Number*	*LOR*	*Unit*		**EN1601220-001**	**EN1601220-002**	**EN1601220-003**	------	------
					Result	Result	Result	Result	Result
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		**2.11**	<0.020	<0.020	---	---

Steel River Testing

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

STACK EMISSION - PARTICULATES REPORT - Amended

Replacement for Report 10918-0

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

Report : 10918-1-P

Description : Stack Emission Samples
Received: 23-Mar-16

Date : 04-May-16

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

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
T405	Filter	-	0.0006
TP-ACETONE RINSE	Acetone Rinse	32	0.0010

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 - PARTICULATES REPORT

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

Report : 11046-0-P

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

Date : 15-Apr-16

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

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
SRT-74	Filter	-	0.0008

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
Project: **60489919**

Report : 10918-0-M

Description : Stack Emission Samples
Received: 23-Mar-16

Date : 31-Mar-16

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

Copy to: FILE

Jar ID	Moisture (g)
C15	12.8
C19	13.1
F23	9.0
F99	29.9
FA9	34.4
I01	7.3
P38	17.9

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

SGS LEEDER CONSULTING

A.B.N. 44 000 964 278
3 - 5, 18 Redland Drive
Mitcham, Vic, 3132
Telephone: (03) 9874 1988
Fax: (03) 9874 1933

Chartered Chemists

8-Apr-2016

REPORT NUMBER: M160684
Site/Client Ref: 60489919/1.4
Order No: 60489919/1.4

AECOM
17 Warabrook Bvde
Warabrook

NSW 2304
Attention: James Lang

CERTIFICATE OF ANALYSIS

SAMPLES:	Twelve samples were received for analysis
DATE RECEIVED:	**23-Mar-2016**
DATE COMMENCED:	**23-Mar-2016**
METHODS:	See Attached Results
RESULTS:	Please refer to attached pages for results.

Note: Results are based on samples as received at SGS Leeder Consulting's 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: 5/04/2016

	Leeder ID	2016009263	2016009264	2016009265
	Client ID	Stack 1_ Metals 1	Stack 1_Metals 12 Blank	Method
Analyte Name	Sampled Date	21/03/2016	21/03/2016	
	PQL			Blank
Sb	0.2	nd	nd	nd
As	0.2	nd	nd	nd
Be	0.2	nd	nd	nd
Cd	0.2	0.9	nd	nd
Cr	0.2	0.4	0.3	nd
Co	0.2	nd	nd	nd
Cu	0.2	0.4	1.2	nd
Pb	0.2	0.2	0.2	nd
Mg	2	31	49	nd
Mn	0.2	0.8	0.6	nd
Hg	0.2	nd	nd	nd
Ni	0.2	0.4	0.6	nd
Se	0.2	nd	nd	nd
Tl	0.2	nd	nd	nd
Sn	0.2	nd	nd	nd
V	0.2	nd	nd	nd
Zn	0.2	460	780	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: 5/04/2016

	Leeder ID	2016009266	2016009267	2016009268
	Client ID	Stack 1_Metals 3	Stack 1_Metals 4	Stack 1_Metals 8A Blank
Analyte Name	**Sampled Date**	21/03/2016	21/03/2016	21/03/2016
	PQL			
Sb	0.1	nd	nd	nd
As	0.1	nd	nd	nd
Be	0.1	nd	nd	nd
Cd	0.1	nd	0.8	nd
Cr	0.1	0.1	10	nd
Co	0.1	nd	nd	nd
Cu	0.1	nd	1.6	nd
Pb	0.1	nd	0.6	nd
Mg	0.1	nd	6.7	0.6
Mn	0.1	nd	2.6	0.5
Hg	0.1	nd	nd	nd
Ni	0.1	0.1	1.0	nd
Se	0.1	0.2	nd	0.9
Tl	0.1	nd	nd	nd
Sn	0.1	nd	nd	nd
V	0.1	nd	nd	nd
Zn	0.1	0.2	7.0	1.2
Sample Volume		96	320	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: 5/04/2016

	Leeder ID	2016009269	2016009270	2016009271	2016009272	2016009273	2016009274
	Client ID	Stack 1_Metals 9 Blank	Stack 1_Metals 5A	Stack 1_Metals 5C	Stack 1_Metals 8B Blank	Stack 1_Metals 11 Blank	Method
Analyte Name	**Sampled Date**	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016	
	PQL						Blank
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	0.2					nd
Pb	0.1	nd					nd
Mg	0.1	0.6					nd
Mn	0.1	0.3					nd
Hg	0.1	nd	nd	nd	nd	nd	nd
Ni	0.1	0.2					nd
Se	0.1	nd					nd
Tl	0.1	nd					nd
Sn	0.1	nd					nd
V	0.1	nd					nd
Zn	0.1	0.5					nd
Sample Volume		200	98	250	99	250	

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: 5/04/2016

	Leeder ID	2016009275	2016009276
	Client ID	Stack 1_Metals 5B	Stack 1_Metals 10 Blank
Analyte Name	**Sampled Date**	21/03/2016	21/03/2016
	PQL		
Hg	0.5	nd	nd
Sample Volume		390	90

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: 5/04/2016

	Leeder ID	2016009278	2016009279
	Client ID	Method	Method
Analyte Name	**Sampled Date**		
	PQL	Spike	Spike Dup
Sb		107	111
As		109	109
Be		87	92
Cd		103	102
Cr		111	112
Co		114	115
Cu		119	119
Pb		105	102
Mg		104	106
Mn		117	117
Hg		102	103
Ni		121	123
Se		107	110
Tl		104	103
Sn		111	111
V		116	117
Zn		101	101

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: 5/04/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016009280 Method Spike	2016009281 Method Spike Dup
Sb		111	113
As		106	106
Be		98	98
Cd		98	95
Cr		104	103
Co		107	104
Cu		111	109
Pb		95	95
Mg		99	96
Mn		108	107
Hg		100	100
Ni		114	111
Se		107	102
Tl		95	94
Sn		95	95
V		106	102
Zn		116	115

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: 5/04/2016

Analyte Name	Leeder ID / Client ID / Sampled Date / PQL	2016009282 Method Spike	2016009283 Method Spike Dup
Hg		105	107

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

SGS LEEDER CONSULTING

APPENDIX ONE.

CHAIN OF CUSTODY DOCUMENT

Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU16_070

Client	AECOM 17 Warabrook Boulevarde Warabrook NSW 2304	**Job No.**	AECO01/160323
		Sampled by	Client
		Date Sampled	22-Mar-2016
Contact	James Lang	**Date Received**	23-Mar-2016

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

Method AUTL_02 **Date Reported** 20-Apr-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

Robert Crough
Chemist
Dioxin Analysis Unit

Dr Alan Yates
Senior Analyst
Dioxin Analysis Unit

Accreditation

NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025.

Sample Details : Job No. AECO01/160323

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/007781X	60489919	Emission	Resin, Filter, Solvent Rinse

Project Details

Project Name	*Not Specified*
Project Number	*PO No. 60489919/14*

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
Pb	Laboratory surrogate recovery outside normal acceptance criteria: **40-130%** for Tetra/Penta/Hexa congeners - **25-130%** for Hepta/Octa congeners
Pb	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. AECO01/160323

Laboratory Reg. No. N16/007781X **Date Extracted** 08-Apr-16

Client Sample Ref. 60489919 **DB5 Analysis** 14-Apr-16
Matrix Emission **DB-Dioxin Analysis** 18-Apr-16
Description Resin, Filter, Solvent Rinse

PCDD/F Congeners	Level pg	I-TEF	I-TEQ middle bound contribution	Labelled Surrogate recovery	
2,3,7,8-TCDF	14	0.1	1.4	71	
2,3,7,8-TCDD	<1	1	0.5	70	
1,2,3,7,8-PeCDF	23	0.05	1.1	79	
2,3,4,7,8-PeCDF	2.6	0.5	1.3	**105**	
1,2,3,7,8-PeCDD	<0.8	0.5	0.2	81	
1,2,3,4,7,8-HxCDF	9.2	0.1	0.92	**96**	
1,2,3,6,7,8-HxCDF	8.0	0.1	0.80	81	
2,3,4,6,7,8-HxCDF	1.9	0.1	0.19		
1,2,3,7,8,9-HxCDF	<2	0.1	0.1		
1,2,3,4,7,8-HxCDD	<1	0.1	0.05	**100**	
1,2,3,6,7,8-HxCDD	<1	0.1	0.05	80	
1,2,3,7,8,9-HxCDD	<1	0.1	0.05		
1,2,3,4,6,7,8-HpCDF	17	0.01	0.17	70	
1,2,3,4,7,8,9-HpCDF	11	0.01	0.11	**90**	
1,2,3,4,6,7,8-HpCDD	4.9	0.01	0.049	73	
OCDF	28	0.001	0.028		
OCDD	18	0.001	0.018	70	

PCDD/F Homologue Groups	Level pg
Total TCDF isomers	270
Total TCDD isomers	10
Total PeCDF isomers	84
Total PeCDD isomers	<5
Total HxCDF isomers	56
Total HxCDD isomers	2.8
Total HpCDF isomers	38
Total HpCDD isomers	9.1

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values	520	pg

I-TEQ

Lower Bound [excluding LOD values]	**6.1**	pg
Middle Bound [including half LOD values]	**7.0**	pg
Upper Bound [including LOD values]	**8.0**	pg

Australian Government
National Measurement Institute

ANALYSIS REPORT # ORG16_014

Client	AECOM AUSTRALIA 17 WARABROOK BOULEVARDE WARABROOK NSW 2304	**Job No.**	AECO01/160323
		Sampled by	Client
		Date Sampled	22-Mar-2016
Contact	JAMES LANG	**Date Received**	23-Mar-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
April 26, 2016

Accreditation NATA Accreditation Number : 198

Accredited for compliance with ISO/IEC 17025.

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Sample Details : Job No. AECO01/160323

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/007781	DAU140316A	Emission	Cartridge, Rinses, Filter Stack1

Project Details

Project Name	*Not specified*
Project Number	*60489919/1.4*

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:

$$BaP\text{-}TEQ_{PAH} = \sum_{i=1}^{n} [PAH_i \times BaP\text{-}PEF_i] \qquad i = \text{toxic PAH analyte index (1 to n=7)}$$

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. AECO01/160323

Laboratory Reg. No.	N16/007781	**Date Reported**	26-Apr-2016
Client Sample Ref.	DAU140316A	**Date Extracted**	08-Apr-2016
Matrix	Emission		
Description	Cartridge, Rinses, Filter Stack1		

PAH	Conc. ng	Reporting Level (LOR, ng)	BaP-PEF Value	BaP-TEQ Contribution	Labelled Internal recovery (%)	Flags
Naphthalene	42000	450	-	-	18	*
2-Methylnaphthalene	46000	110	-	-		
Acenaphthylene	120000	20	-	-	15	*
Acenaphthene	11000	20	-	-	45	*
Fluorene	43000	130	-	-	47	*
Phenanthrene	64000	20	-	-	74	
Anthracene	2200	20	-	-		
Fluoranthene	19000	20	-	-	69	
Pyrene	9900	20	-	-		
Benz(a)anthracene	<20	20	0.1	1.0	83	
Chrysene	<20	20	0.01	0.1	90	
Benzo(b)fluoranthene	<20	20	0.1	1	80	
Benzo(k)fluoranthene	<20	20	0.1	1.0	86	
Benzo(e)pyrene	<20	20	-	-		
Benzo(a)pyrene	<20	20	1.0	10	50	*
Perylene	<20	20	-	-		
Indeno(1,2,3-cd)pyrene	<20	20	0.1	1.0	80	
Dibenz(ah)anthracene	<20	20	0.4	4.0	79	
Benzo(ghi)perylene	<20	20	-	-	72	

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

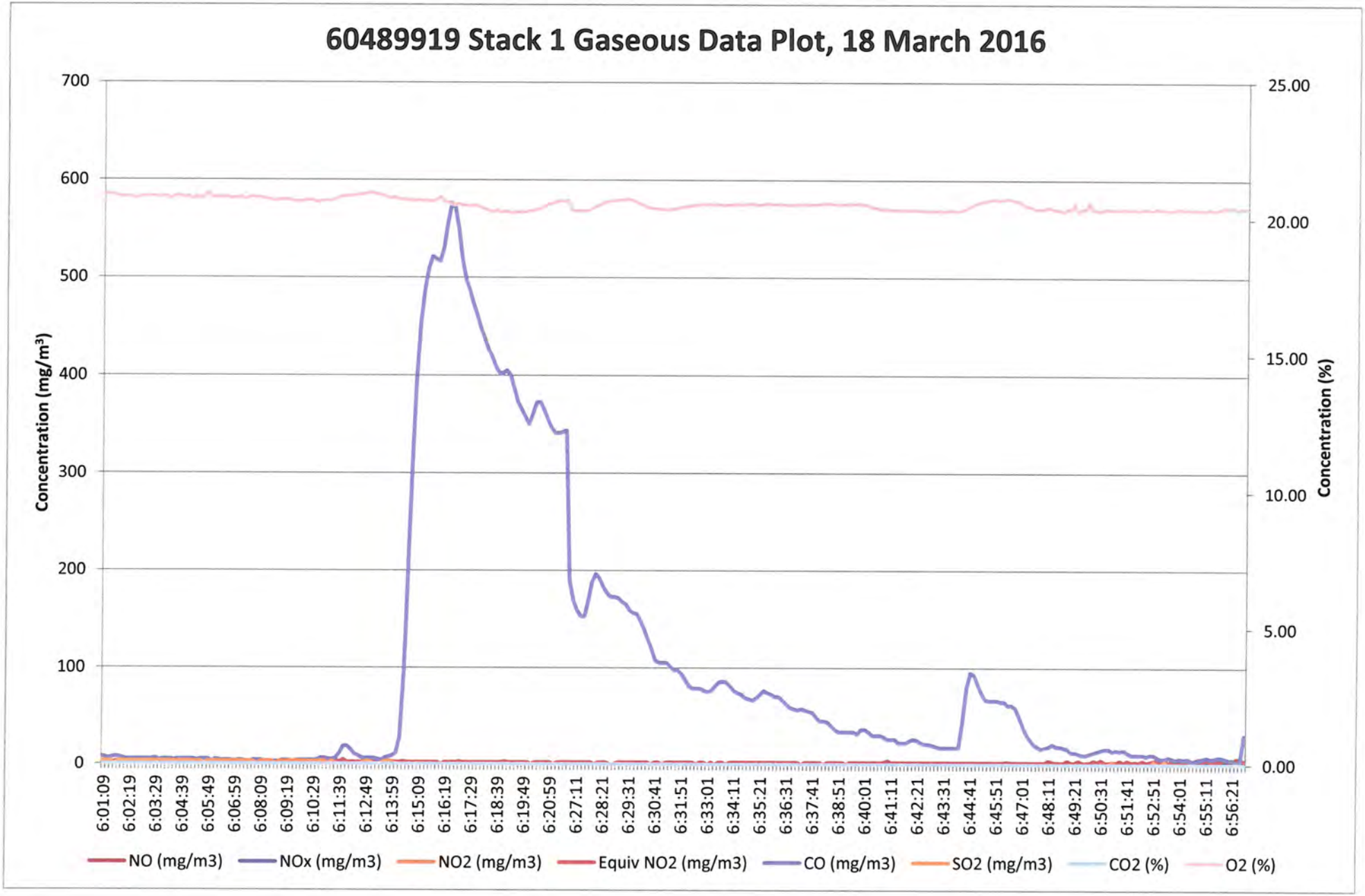
Surrogate Recovery	%
d14-Terphenyl	68

Summary Results		
BaP -TEQ$_{PAH}$		
Lower Bound [excluding LOD values]	**0**	ng
Middle Bound [including half LOD values]	**18**	ng
Upper Bound [including LOD values]	**36**	ng

Appendix C

Raw & Calculated Gas Data (4 pages)

Appendix C Raw & Calculated Gas Data (4 pages)


60489919 Stack 1 Gaseous Data Plot, 18 March 2016
Concentration (mg/m³)
Concentration (%)
700
600
500
400
300
200
100
0
25.00
20.00
15.00
10.00
5.00
0.00
6:01:09
6:02:19
6:03:29
6:04:39
6:05:49
6:06:59
6:08:09
6:09:19
6:10:29
6:11:39
6:12:49
6:13:59
6:15:09
6:16:19
6:17:29
6:18:39
6:19:49
6:20:59
6:27:11
6:28:21
6:29:31
6:30:41
6:31:51
6:33:01
6:34:11
6:35:21
6:36:31
6:37:41
6:38:51
6:40:01
6:41:11
6:42:21
6:43:31
6:44:41
6:45:51
6:47:01
6:48:11
6:49:21
6:50:31
6:51:41
6:52:51
6:54:01
6:55:11
6:56:21
NO (mg/m3)
NOx (mg/m3)
NO2 (mg/m3)
Equiv NO2 (mg/m3)
CO (mg/m3)
SO2 (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)	SO2 (ppm)	SO2 (mg/m^3)	CO2 (%)	O2 (%)
18-Mar-16	6:01:09	0	0	0	0	0.0	0	0	0	6	8	1	3	0.00	20.89
18-Mar-16	6:01:19	0	0	0	0	0.0	0	0	0	5	6	1	3	0.00	20.89
18-Mar-16	6:01:29	0	0	0	1	0.3	1	0	1	5	6	1	3	0.00	20.88
18-Mar-16	6:01:39	1	1	1	1	0.0	0	2	2	6	8	0	0	0.00	20.83
18-Mar-16	6:01:49	1	1	1	2	0.3	1	2	3	6	8	1	3	0.00	20.80
18-Mar-16	6:01:59	0	0	0	0	0.0	0	0	0	5	6	1	3	0.00	20.79
18-Mar-16	6:02:09	1	1	1	1	0.0	0	2	2	4	5	1	3	0.00	20.81
18-Mar-16	6:02:19	1	1	1	1	0.0	0	2	2	4	5	1	3	0.00	20.79
18-Mar-16	6:02:29	1	1	1	2	0.3	1	2	3	4	5	1	3	0.00	20.70
18-Mar-16	6:02:39	1	1	1	1	0.0	0	2	2	4	5	1	3	0.00	20.80
18-Mar-16	6:02:49	1	1	1	1	0.0	0	2	2	4	5	1	3	0.00	20.82
18-Mar-16	6:02:59	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.82
18-Mar-16	6:03:09	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.82
18-Mar-16	6:03:19	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.82
18-Mar-16	6:03:29	0	0	0	0	0.0	0	0	0	5	6	1	3	0.00	20.77
18-Mar-16	6:03:39	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.81
18-Mar-16	6:03:49	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.84
18-Mar-16	6:03:59	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.68
18-Mar-16	6:04:09	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.80
18-Mar-16	6:04:19	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.85
18-Mar-16	6:04:29	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.80
18-Mar-16	6:04:39	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.79
18-Mar-16	6:04:49	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.80
18-Mar-16	6:04:59	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.68
18-Mar-16	6:05:09	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.82
18-Mar-16	6:05:19	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.70
18-Mar-16	6:05:29	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.77
18-Mar-16	6:05:39	0	0	0	0	0.0	0	0	0	4	5	0	0	0.00	20.97
18-Mar-16	6:05:49	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.80
18-Mar-16	6:05:59	0	0	0	0	0.0	0	0	0	2	3	1	3	0.00	20.77
18-Mar-16	6:06:09	0	0	0	0	0.0	0	0	0	4	5	1	3	0.00	20.79
18-Mar-16	6:06:19	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.76
18-Mar-16	6:06:29	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.80
18-Mar-16	6:06:39	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.73
18-Mar-16	6:06:49	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.76
18-Mar-16	6:06:59	0	0	0	0	0.0	0	0	0	2	3	1	3	0.00	20.76
18-Mar-16	6:07:09	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.80
18-Mar-16	6:07:19	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.70
18-Mar-16	6:07:29	0	0	0	0	0.0	0	0	0	2	3	1	3	0.00	20.78
18-Mar-16	6:07:39	0	0	0	0	0.0	0	0	0	2	3	1	3	0.00	20.81
18-Mar-16	6:07:49	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.76
18-Mar-16	6:07:59	0	0	0	0	0.0	0	0	0	3	4	0	0	0.00	20.79
18-Mar-16	6:08:09	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.73
18-Mar-16	6:08:19	1	1	1	1	0.0	0	2	2	2	3	1	3	0.00	20.73
18-Mar-16	6:08:29	0	0	0	0	0.0	0	0	0	2	3	1	3	0.00	20.67
18-Mar-16	6:08:39	1	1	1	1	0.0	0	2	2	2	3	1	3	0.00	20.64
18-Mar-16	6:08:49	0	0	0	0	0.0	0	0	0	2	3	0	0	0.00	20.68
18-Mar-16	6:08:59	1	1	1	1	0.0	0	2	2	2	3	1	3	0.00	20.69
18-Mar-16	6:09:09	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.71
18-Mar-16	6:09:19	0	0	0	0	0.0	0	0	0	3	4	1	3	0.00	20.67
18-Mar-16	6:09:29	1	1	1	1	0.0	0	2	2	2	3	1	3	0.00	20.64
18-Mar-16	6:09:39	1	1	1	1	0.0	0	2	2	2	3	1	3	0.00	20.63
18-Mar-16	6:09:49	1	1	1	1	0.0	0	2	2	3	4	1	3	0.00	20.61
18-Mar-16	6:09:59	1	1	1	1	0.0	0	2	2	3	4	1	3	0.00	20.68
18-Mar-16	6:10:09	1	1	2	2	0.3	1	2	3	3	4	1	3	0.00	20.67
18-Mar-16	6:10:19	1	1	1	1	0.0	0	2	2	3	4	1	3	0.00	20.68
18-Mar-16	6:10:29	2	3	2	3	0.0	0	3	4	3	4	1	3	0.00	20.59
18-Mar-16	6:10:39	1	1	1	1	0.0	0	2	2	3	4	1	3	0.00	20.63
18-Mar-16	6:10:49	2	3	2	3	0.0	0	3	4	5	6	1	3	0.00	20.66
18-Mar-16	6:10:59	1	1	1	1	0.0	0	2	2	5	6	1	3	0.00	20.66
18-Mar-16	6:11:09	2	3	2	3	0.0	0	3	4	4	5	0	0	0.00	20.65
18-Mar-16	6:11:19	2	3	2	3	0.0	0	3	4	4	5	1	3	0.00	20.69
18-Mar-16	6:11:29	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.78
18-Mar-16	6:11:39	1	1	1	1	0.0	0	2	2	9	11	0	0	0.00	20.82
18-Mar-16	6:11:49	2	3	2	3	0.3	1	3	5	15	19	0	0	0.00	20.84
18-Mar-16	6:11:59	1	1	1	1	0.0	0	2	2	15	19	0	0	0.00	20.83
18-Mar-16	6:12:09	1	1	1	1	0.0	0	2	2	12	15	0	0	0.00	20.84
18-Mar-16	6:12:19	1	1	1	1	0.0	0	2	2	8	10	0	0	0.00	20.89
18-Mar-16	6:12:29	1	1	1	1	0.0	0	2	2	7	9	0	0	0.00	20.88
18-Mar-16	6:12:39	1	1	1	1	0.0	0	2	2	5	6	0	0	0.00	20.90
18-Mar-16	6:12:49	1	1	1	2	0.3	1	2	3	5	6	1	3	0.00	20.94
18-Mar-16	6:12:59	1	1	1	2	0.3	1	2	3	5	6	1	3	0.00	20.94
18-Mar-16	6:13:09	1	1	1	1	0.0	0	2	2	5	6	0	0	0.00	20.89
18-Mar-16	6:13:19	1	1	1	1	0.0	0	2	2	4	5	0	0	0.00	20.88
18-Mar-16	6:13:29	1	1	1	2	0.3	1	2	3	3	4	0	0	0.00	20.87
18-Mar-16	6:13:39	0	0	0	0	0.0	0	0	0	5	6	1	3	0.00	20.73
18-Mar-16	6:13:49	1	1	1	2	0.5	1	2	3	6	8	1	3	0.00	20.77
18-Mar-16	6:13:59	1	1	2	2	0.3	1	2	3	7	9	1	3	0.00	20.79
18-Mar-16	6:14:09	1	1	1	1	0.0	0	2	2	9	11	0	0	0.00	20.71
18-Mar-16	6:14:19	1	1	1	1	0.0	0	2	2	22	28	0	0	0.00	20.71
18-Mar-16	6:14:29	1	1	1	2	0.3	1	2	3	78	98	0	0	0.00	20.68
18-Mar-16	6:14:39	1	1	1	1	0.0	0	2	2	168	210	0	0	0.00	20.69
18-Mar-16	6:14:49	1	1	1	1	0.0	0	2	2	248	310	0	0	0.00	20.65
18-Mar-16	6:14:59	1	1	1	1	0.0	0	2	2	317	396	0	0	0.00	20.71
18-Mar-16	6:15:09	1	1	1	1	0.0	0	2	2	362	453	0	0	0.00	20.65
18-Mar-16	6:15:19	1	1	1	1	0.0	0	2	2	389	486	0	0	0.00	20.68
18-Mar-16	6:15:29	1	1	1	1	0.0	0	2	2	407	509	0	0	0.00	20.64
18-Mar-16	6:15:39	1	1	1	1	0.0	0	2	2	417	521	0	0	0.00	20.64
18-Mar-16	6:15:49	1	1	1	1	0.0	0	2	2	415	519	0	0	0.00	20.70
18-Mar-16	6:15:59	1	1	1	1	0.0	0	2	2	413	516	0	0	0.00	20.80
18-Mar-16	6:16:09	0	0	0	0	0.0	0	0	0	424	530	0	0	0.00	20.62
18-Mar-16	6:16:19	1	1	1	1	0.0	0	2	2	445	556	0	0	0.00	20.61
18-Mar-16	6:16:29	1	1	1	1	0.0	0	2	2	461	576	0	0	0.00	20.54
18-Mar-16	6:16:39	1	1	1	1	0.0	0	2	2	457	571	0	0	0.00	20.52
18-Mar-16	6:16:49	1	1	1	1	0.0	0	2	2	439	549	0	0	0.00	20.55
18-Mar-16	6:16:59	1	1	1	2	0.3	1	2	3	414	518	0	0	0.00	20.49
18-Mar-16	6:17:09	1	1	1	1	0.0	0	2	2	398	498	0	0	0.00	20.49
18-Mar-16	6:17:19	1	1	1	1	0.0	0	2	2	389	486	0	0	0.00	20.48
18-Mar-16	6:17:29	1	1	1	1	0.0	0	2	2	378	473	0	0	0.00	20.50
18-Mar-16	6:17:39	1	1	1	1	0.0	0	2	2	369	461	0	0	0.00	20.45
18-Mar-16	6:17:49	1	1	1	1	0.0	0	2	2	358	448	0	0	0.00	20.40
18-Mar-16	6:17:59	1	1	1	1	0.0	0	2	2	350	438	0	0	0.00	20.35
18-Mar-16	6:18:09	1	1	1	1	0.0	0	2	2	341	426	0	0	0.00	20.30
18-Mar-16	6:18:19	1	1	1	1	0.0	0	2	2	335	419	0	0	0.00	20.23
18-Mar-16	6:18:29	1	1	1	1	0.0	0	2	2	327	409	0	0	0.00	20.33
18-Mar-16	6:18:39	1	1	1	1	0.0	0	2	2	322	403	0	0	0.00	20.23
18-Mar-16	6:18:49	1	1	1	1	0.0	0	2	2	322	403	0	0	0.00	20.27
18-Mar-16	6:18:59	1	1	1	2	0.3	1	2	3	324	405	0	0	0.00	20.26
18-Mar-16	6:19:09	1	1	1	1	0.0	0	2	2	320	400	0	0	0.00	20.21
18-Mar-16	6:19:19	1	1	1	1	0.0	0	2	2	309	386	0	0	0.00	20.25
18-Mar-16	6:19:29	1	1	1	1	0.0	0	2	2	298	373	0	0	0.00	20.24
18-Mar-16	6:19:39	1	1	1	1	0.0	0	2	2	292	365	0	0	0.00	20.25
18-Mar-16	6:19:49	1	1	1	1	0.0	0	2	2	286	358	0	0	0.00	20.25
18-Mar-16	6:19:59	1	1	1	1	0.0	0	2	2	280	350	0	0	0.00	20.30
18-Mar-16	6:20:09	0	0	0	0	0.0	0	0	0	289	361	0	0	0.00	20.31
18-Mar-16	6:20:19	1	1	1	1	0.0	0	2	2	298	373	0	0	0.00	20.35
18-Mar-16	6:20:29	1	1	1	1	0.0	0	2	2	298	373	0	0	0.00	20.40

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)	SO2 (ppm)	SO2 (mg/m^3)	CO2 (%)	O2 (%)
18-Mar-16	6:20:39	1	1	1	1	0.0	0	2	2	292	365	0	0	0.00	20.48
18-Mar-16	6:20:49	1	1	1	1	0.0	0	2	2	284	355	0	0	0.00	20.52
18-Mar-16	6:20:59	1	1	1	1	0.0	0	2	2	277	346	0	0	0.00	20.57
18-Mar-16	6:21:09	0	0	0	0	0.0	0	0	0	273	341	0	0	0.00	20.64
18-Mar-16	6:21:19	1	1	1	1	0.0	0	2	2	273	341	0	0	0.00	20.65
18-Mar-16	6:21:29	1	1	1	1	0.0	0	2	2	274	343	0	0	0.00	20.64
18-Mar-16	6:21:39	1	1	1	1	0.0	0	2	2	275	344	0	0	0.00	20.68
18-Mar-16	6:26:51	1	1	1	1	0.0	0	2	2	151	189	0	0	0.00	20.32
18-Mar-16	6:27:01	1	1	1	1	0.0	0	2	2	135	169	0	0	0.00	20.30
18-Mar-16	6:27:11	1	1	1	1	0.0	0	2	2	127	159	0	0	0.00	20.29
18-Mar-16	6:27:21	1	1	1	1	0.0	0	2	2	122	153	0	0	0.00	20.29
18-Mar-16	6:27:31	1	1	1	1	0.0	0	2	2	122	153	0	0	0.00	20.28
18-Mar-16	6:27:41	1	1	1	1	0.0	0	2	2	135	169	0	0	0.00	20.32
18-Mar-16	6:27:51	1	1	1	1	0.0	0	2	2	150	188	0	0	0.00	20.43
18-Mar-16	6:28:01	0	0	0	0	0.0	0	0	0	157	196	0	0	0.00	20.47
18-Mar-16	6:28:11	1	1	1	1	0.0	0	2	2	153	191	0	0	0.00	20.55
18-Mar-16	6:28:21	1	1	1	1	0.0	0	2	2	146	183	0	0	0.00	20.63
18-Mar-16	6:28:31	1	1	1	1	0.0	0	2	2	141	176	0	0	0.00	20.65
18-Mar-16	6:28:41	0	0	0	0	0.0	0	0	0	138	173	0	0	0.00	20.65
18-Mar-16	6:28:51	0	0	0	0	0.0	0	0	0	138	173	0	0	0.00	20.67
18-Mar-16	6:29:01	1	1	1	1	0.0	0	2	2	137	171	0	0	0.00	20.71
18-Mar-16	6:29:11	1	1	1	1	0.0	0	2	2	134	168	0	0	0.00	20.71
18-Mar-16	6:29:21	1	1	1	1	0.0	0	2	2	132	165	0	0	0.00	20.72
18-Mar-16	6:29:31	1	1	1	1	0.0	0	2	2	127	159	0	0	0.00	20.69
18-Mar-16	6:29:41	1	1	1	1	0.0	0	2	2	125	156	0	0	0.00	20.63
18-Mar-16	6:29:51	1	1	1	1	0.0	0	2	2	124	155	0	0	0.00	20.56
18-Mar-16	6:30:01	1	1	1	1	0.0	0	2	2	118	148	0	0	0.00	20.51
18-Mar-16	6:30:11	1	1	1	1	0.0	0	2	2	111	139	0	0	0.00	20.42
18-Mar-16	6:30:21	1	1	1	1	0.0	0	2	2	103	129	0	0	0.00	20.40
18-Mar-16	6:30:31	0	0	0	0	0.0	0	0	0	95	119	0	0	0.00	20.39
18-Mar-16	6:30:41	1	1	1	1	0.0	0	2	2	86	108	0	0	0.00	20.37
18-Mar-16	6:30:51	1	1	1	1	0.0	0	2	2	84	105	0	0	0.00	20.36
18-Mar-16	6:31:01	0	0	0	0	0.0	0	0	0	84	105	0	0	0.00	20.34
18-Mar-16	6:31:11	1	1	1	1	0.0	0	2	2	84	105	0	0	0.00	20.34
18-Mar-16	6:31:21	1	1	1	1	0.0	0	2	2	81	101	0	0	0.00	20.37
18-Mar-16	6:31:31	1	1	1	1	0.0	0	2	2	78	98	0	0	0.00	20.37
18-Mar-16	6:31:41	1	1	1	1	0.0	0	2	2	78	98	0	0	0.00	20.41
18-Mar-16	6:31:51	1	1	1	1	0.0	0	2	2	75	94	0	0	0.00	20.45
18-Mar-16	6:32:01	1	1	1	1	0.0	0	2	2	70	88	0	0	0.00	20.46
18-Mar-16	6:32:11	1	1	1	1	0.0	0	2	2	65	81	0	0	0.00	20.49
18-Mar-16	6:32:21	1	1	1	1	0.0	0	2	2	63	79	0	0	0.00	20.52
18-Mar-16	6:32:31	0	0	0	0	0.0	0	0	0	63	79	0	0	0.00	20.49
18-Mar-16	6:32:41	1	1	1	1	0.0	0	2	2	63	79	0	0	0.00	20.56
18-Mar-16	6:32:51	1	1	1	1	0.0	0	2	2	61	76	0	0	0.00	20.52
18-Mar-16	6:33:01	0	0	0	0	0.0	0	0	0	60	75	0	0	0.00	20.56
18-Mar-16	6:33:11	1	1	1	1	0.0	0	2	2	61	76	0	0	0.00	20.49
18-Mar-16	6:33:21	0	0	0	0	0.0	0	0	0	65	81	0	0	0.00	20.56
18-Mar-16	6:33:31	1	1	1	1	0.0	0	2	2	68	85	0	0	0.00	20.51
18-Mar-16	6:33:41	1	1	1	1	0.0	0	2	2	69	86	0	0	0.00	20.51
18-Mar-16	6:33:51	0	0	0	0	0.0	0	0	0	68	85	0	0	0.00	20.52
18-Mar-16	6:34:01	1	1	1	1	0.0	0	2	2	65	81	0	0	0.00	20.52
18-Mar-16	6:34:11	1	1	1	1	0.0	0	2	2	61	76	0	0	0.00	20.56
18-Mar-16	6:34:21	1	1	1	1	0.0	0	2	2	59	74	0	0	0.00	20.50
18-Mar-16	6:34:31	1	1	1	1	0.0	0	2	2	58	73	0	0	0.00	20.53
18-Mar-16	6:34:41	1	1	1	1	0.0	0	2	2	55	69	0	0	0.00	20.56
18-Mar-16	6:34:51	1	1	1	1	0.0	0	2	2	54	68	0	0	0.00	20.55
18-Mar-16	6:35:01	1	1	1	1	0.0	0	2	2	53	66	0	0	0.00	20.54
18-Mar-16	6:35:11	1	1	1	1	0.0	0	2	2	55	69	0	0	0.00	20.51
18-Mar-16	6:35:21	1	1	1	1	0.0	0	2	2	58	73	0	0	0.00	20.54
18-Mar-16	6:35:31	1	1	1	1	0.0	0	2	2	61	76	0	0	0.00	20.56
18-Mar-16	6:35:41	1	1	1	1	0.0	0	2	2	59	74	0	0	0.00	20.55
18-Mar-16	6:35:51	1	1	1	1	0.0	0	2	2	58	73	0	0	0.00	20.54
18-Mar-16	6:36:01	1	1	1	1	0.0	0	2	2	56	70	0	0	0.00	20.54
18-Mar-16	6:36:11	1	1	1	1	0.0	0	2	2	56	70	0	0	0.00	20.54
18-Mar-16	6:36:21	1	1	1	1	0.0	0	2	2	53	66	0	0	0.00	20.53
18-Mar-16	6:36:31	1	1	1	1	0.0	0	2	2	50	63	0	0	0.00	20.52
18-Mar-16	6:36:41	1	1	1	1	0.0	0	2	2	47	59	0	0	0.00	20.52
18-Mar-16	6:36:51	1	1	1	1	0.0	0	2	2	46	58	0	0	0.00	20.55
18-Mar-16	6:37:01	1	1	1	1	0.0	0	2	2	45	56	0	0	0.00	20.53
18-Mar-16	6:37:11	0	0	0	0	0.0	0	0	0	46	58	0	0	0.00	20.55
18-Mar-16	6:37:21	1	1	1	1	0.0	0	2	2	45	56	0	0	0.00	20.53
18-Mar-16	6:37:31	1	1	1	1	0.0	0	2	2	44	55	0	0	0.00	20.54
18-Mar-16	6:37:41	1	1	1	1	0.0	0	2	2	43	54	0	0	0.00	20.54
18-Mar-16	6:37:51	1	1	1	1	0.0	0	2	2	39	49	0	0	0.00	20.54
18-Mar-16	6:38:01	1	1	1	1	0.0	0	2	2	36	45	0	0	0.00	20.56
18-Mar-16	6:38:11	0	0	0	0	0.0	0	0	0	36	45	0	0	0.00	20.58
18-Mar-16	6:38:21	1	1	1	1	0.0	0	2	2	35	44	0	0	0.00	20.56
18-Mar-16	6:38:31	1	1	1	1	0.0	0	2	2	32	40	0	0	0.00	20.54
18-Mar-16	6:38:41	1	1	1	1	0.0	0	2	2	29	36	0	0	0.00	20.55
18-Mar-16	6:38:51	1	1	1	1	0.0	0	2	2	27	34	0	0	0.00	20.53
18-Mar-16	6:39:01	1	1	1	1	0.0	0	2	2	27	34	0	0	0.00	20.55
18-Mar-16	6:39:11	0	0	0	0	0.0	0	0	0	27	34	0	0	0.00	20.57
18-Mar-16	6:39:21	1	1	1	1	0.0	0	2	2	27	34	0	0	0.00	20.55
18-Mar-16	6:39:31	1	1	1	1	0.0	0	2	2	27	34	0	0	0.00	20.54
18-Mar-16	6:39:41	1	1	1	1	0.0	0	2	2	25	31	0	0	0.00	20.58
18-Mar-16	6:39:51	1	1	1	1	0.0	0	2	2	29	36	0	0	0.00	20.53
18-Mar-16	6:40:01	1	1	1	1	0.0	0	2	2	29	36	0	0	0.00	20.51
18-Mar-16	6:40:11	1	1	1	1	0.0	0	2	2	27	34	0	0	0.00	20.44
18-Mar-16	6:40:21	1	1	1	1	0.0	0	2	2	24	30	0	0	0.00	20.42
18-Mar-16	6:40:31	1	1	1	1	0.0	0	2	2	24	30	0	0	0.00	20.37
18-Mar-16	6:40:41	1	1	1	1	0.0	0	2	2	24	30	0	0	0.00	20.37
18-Mar-16	6:40:51	1	1	1	1	0.0	0	2	2	23	29	0	0	0.00	20.37
18-Mar-16	6:41:01	2	3	2	3	0.0	0	3	4	21	26	0	0	0.00	20.34
18-Mar-16	6:41:11	1	1	1	1	0.0	0	2	2	21	26	0	0	0.00	20.34
18-Mar-16	6:41:21	1	1	1	1	0.0	0	2	2	21	26	0	0	0.00	20.34
18-Mar-16	6:41:31	1	1	1	1	0.0	0	2	2	18	23	0	0	0.00	20.33
18-Mar-16	6:41:41	1	1	1	1	0.0	0	2	2	18	23	0	0	0.00	20.34
18-Mar-16	6:41:51	1	1	1	1	0.0	0	2	2	18	23	0	0	0.00	20.32
18-Mar-16	6:42:01	1	1	1	1	0.0	0	2	2	20	25	0	0	0.00	20.34
18-Mar-16	6:42:11	1	1	1	1	0.0	0	2	2	21	26	0	0	0.00	20.33
18-Mar-16	6:42:21	1	1	1	1	0.0	0	2	2	20	25	0	0	0.00	20.32
18-Mar-16	6:42:31	1	1	1	1	0.0	0	2	2	18	23	0	0	0.00	20.32
18-Mar-16	6:42:41	1	1	1	1	0.0	0	2	2	17	21	0	0	0.00	20.30
18-Mar-16	6:42:51	1	1	1	1	0.0	0	2	2	17	21	0	0	0.00	20.32
18-Mar-16	6:43:01	1	1	1	1	0.0	0	2	2	16	20	0	0	0.00	20.29
18-Mar-16	6:43:11	1	1	1	1	0.0	0	2	2	15	19	0	0	0.00	20.35
18-Mar-16	6:43:21	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.29
18-Mar-16	6:43:31	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.30
18-Mar-16	6:43:41	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.33
18-Mar-16	6:43:51	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.32
18-Mar-16	6:44:01	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.31
18-Mar-16	6:44:11	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.32
18-Mar-16	6:44:21	1	1	1	1	0.0	0	2	2	36	45	0	0	0.00	20.37
18-Mar-16	6:44:31	1	1	1	1	0.0	0	2	2	64	80	0	0	0.00	20.45
18-Mar-16	6:44:41	1	1	1	1	0.0	0	2	2	76	95	0	0	0.00	20.52
18-Mar-16	6:44:51	1	1	1	1	0.0	0	2	2	74	93	0	0	0.00	20.59
18-Mar-16	6:45:01	1	1	1	1	0.0	0	2	2	66	83	0	0	0.00	20.65

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)	SO2 (ppm)	SO2 (mg/m^3)	CO2 (%)	O2 (%)
18-Mar-16	6:45:11	1	1	1	1	0.0	0	2	2	59	74	0	0	0.00	20.65
18-Mar-16	6:45:21	1	1	1	1	0.0	0	2	2	54	68	0	0	0.00	20.70
18-Mar-16	6:45:31	1	1	1	1	0.0	0	2	2	53	66	0	0	0.00	20.72
18-Mar-16	6:45:41	1	1	1	1	0.0	0	2	2	53	66	0	0	0.00	20.73
18-Mar-16	6:45:51	1	1	1	1	0.0	0	2	2	53	66	0	0	0.00	20.68
18-Mar-16	6:46:01	1	1	1	1	0.0	0	2	2	52	65	0	0	0.00	20.72
18-Mar-16	6:46:11	1	1	1	1	0.0	0	2	2	52	65	0	0	0.00	20.75
18-Mar-16	6:46:21	1	1	1	2	0.3	1	2	3	49	61	0	0	0.00	20.75
18-Mar-16	6:46:31	1	1	1	1	0.0	0	2	2	49	61	0	0	0.00	20.67
18-Mar-16	6:46:41	1	1	1	1	0.0	0	2	2	47	59	0	0	0.00	20.67
18-Mar-16	6:46:51	1	1	1	1	0.0	0	2	2	40	50	0	0	0.00	20.58
18-Mar-16	6:47:01	1	1	1	1	0.0	0	2	2	32	40	0	0	0.00	20.48
18-Mar-16	6:47:11	1	1	1	1	0.0	0	2	2	25	31	0	0	0.00	20.48
18-Mar-16	6:47:21	1	1	1	1	0.0	0	2	2	21	26	0	0	0.00	20.41
18-Mar-16	6:47:31	1	1	1	1	0.0	0	2	2	17	21	0	0	0.00	20.36
18-Mar-16	6:47:41	1	1	1	1	0.0	0	2	2	15	19	0	0	0.00	20.38
18-Mar-16	6:47:51	1	1	1	1	0.0	0	2	2	13	16	0	0	0.00	20.39
18-Mar-16	6:48:01	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.45
18-Mar-16	6:48:11	2	3	2	3	0.0	0	3	4	15	19	0	0	0.00	20.39
18-Mar-16	6:48:21	1	1	2	2	0.3	1	2	3	17	21	0	0	0.00	20.34
18-Mar-16	6:48:31	1	1	1	1	0.0	0	2	2	15	19	0	0	0.00	20.36
18-Mar-16	6:48:41	1	1	1	1	0.0	0	2	2	15	19	0	0	0.00	20.27
18-Mar-16	6:48:51	1	1	1	1	0.0	0	2	2	14	18	0	0	0.00	20.38
18-Mar-16	6:49:01	2	3	2	3	0.0	0	3	4	13	16	0	0	0.00	20.34
18-Mar-16	6:49:11	1	1	1	1	0.0	0	2	2	10	13	0	0	0.00	20.58
18-Mar-16	6:49:21	1	1	1	1	0.0	0	2	2	10	13	0	0	0.00	20.23
18-Mar-16	6:49:31	2	3	2	3	0.0	0	3	4	9	11	0	0	0.00	20.39
18-Mar-16	6:49:41	1	1	1	1	0.0	0	2	2	8	10	0	0	0.00	20.38
18-Mar-16	6:49:51	1	1	1	1	0.0	0	2	2	8	10	0	0	0.00	20.60
18-Mar-16	6:50:01	1	1	1	1	0.0	0	2	2	9	11	0	0	0.00	20.34
18-Mar-16	6:50:11	2	3	2	3	0.0	0	3	4	10	13	0	0	0.00	20.35
18-Mar-16	6:50:21	1	1	2	2	0.3	1	2	3	11	14	0	0	0.00	20.30
18-Mar-16	6:50:31	2	3	2	3	0.3	1	3	5	12	15	0	0	0.00	20.38
18-Mar-16	6:50:41	1	1	1	1	0.0	0	2	2	13	16	0	0	0.00	20.36
18-Mar-16	6:50:51	1	1	1	1	0.0	0	2	2	13	16	0	0	0.00	20.36
18-Mar-16	6:51:01	1	1	2	2	0.3	1	2	3	11	14	1	3	0.00	20.36
18-Mar-16	6:51:11	1	1	1	1	0.0	0	2	2	12	15	0	0	0.00	20.35
18-Mar-16	6:51:21	2	3	2	3	0.0	0	3	4	11	14	0	0	0.00	20.37
18-Mar-16	6:51:31	1	1	1	1	0.0	0	2	2	12	15	0	0	0.00	20.36
18-Mar-16	6:51:41	2	3	2	3	0.0	0	3	4	10	13	0	0	0.00	20.35
18-Mar-16	6:51:51	1	1	1	1	0.0	0	2	2	8	10	0	0	0.00	20.36
18-Mar-16	6:52:01	1	1	2	2	0.3	1	2	3	8	10	0	0	0.00	20.34
18-Mar-16	6:52:11	1	1	1	1	0.0	0	2	2	8	10	0	0	0.00	20.36
18-Mar-16	6:52:21	2	3	2	3	0.0	0	3	4	8	10	0	0	0.00	20.37
18-Mar-16	6:52:31	1	1	1	1	0.0	0	2	2	7	9	0	0	0.00	20.36
18-Mar-16	6:52:41	1	1	2	2	0.3	1	2	3	8	10	0	0	0.00	20.34
18-Mar-16	6:52:51	2	3	2	3	0.0	0	3	4	8	10	1	3	0.00	20.40
18-Mar-16	6:53:01	2	3	2	3	0.0	0	3	4	6	8	0	0	0.00	20.36
18-Mar-16	6:53:11	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.36
18-Mar-16	6:53:21	2	3	2	3	0.3	1	3	5	5	6	1	3	0.00	20.35
18-Mar-16	6:53:31	1	1	1	1	0.0	0	2	2	6	8	0	0	0.00	20.34
18-Mar-16	6:53:41	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.34
18-Mar-16	6:53:51	2	3	2	3	0.0	0	3	4	4	5	0	0	0.00	20.42
18-Mar-16	6:54:01	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.35
18-Mar-16	6:54:11	2	3	2	3	0.0	0	3	4	4	5	0	0	0.00	20.36
18-Mar-16	6:54:21	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.34
18-Mar-16	6:54:31	2	3	2	3	0.0	0	3	4	3	4	0	0	0.00	20.37
18-Mar-16	6:54:41	2	3	2	3	0.0	0	3	4	3	4	0	0	0.00	20.35
18-Mar-16	6:54:51	3	4	3	4	0.0	0	5	6	4	5	0	0	0.00	20.34
18-Mar-16	6:55:01	1	1	1	1	0.0	0	2	2	5	6	0	0	0.00	20.34
18-Mar-16	6:55:11	3	4	3	4	0.0	0	5	6	6	8	0	0	0.00	20.38
18-Mar-16	6:55:21	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.34
18-Mar-16	6:55:31	2	3	2	3	0.0	0	3	4	5	6	0	0	0.00	20.35
18-Mar-16	6:55:41	2	3	2	3	0.0	0	3	4	6	8	0	0	0.00	20.38
18-Mar-16	6:55:51	2	3	2	3	0.0	0	3	4	6	8	0	0	0.00	20.45
18-Mar-16	6:56:01	3	4	3	4	0.0	0	5	6	5	6	0	0	0.00	20.36
18-Mar-16	6:56:11	2	3	2	3	0.0	0	3	4	4	5	0	0	0.00	20.47
18-Mar-16	6:56:21	2	3	2	3	0.0	0	3	4	4	5	0	0	0.00	20.37
18-Mar-16	6:56:31	3	4	3	4	0.0	0	5	6	2	3	0	0	0.00	20.36
18-Mar-16	6:56:41	3	4	3	4	0.0	0	5	6	2	3	0	0	0.00	20.41
18-Mar-16	7:01:53	2	3	2	3	0.0	0	3	4	24	30	0	0	0.00	20.37
	Average	**1**	**1**	**1**	**1**	**0.0**	**0**	**1**	**2**	**76**	**95**	**0**	**1**	**0.0**	**20.5**
	Maximum	**3**	**4**	**3**	**4**	**0.5**	**1**	**5**	**6**	**461**	**576**	**1**	**3**	**0.0**	**21.0**
	Minimum	**0**	**0**	**0**	**0**	**0.0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0.0**	**20.2**

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