Stack 1 Emissions Testing Report September 2016

Pharmaceutical Waste and Illicit Substance Destruction Trial

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			Name/Position	Signature
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1.0 Introduction

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

Testing was conducted on 28 September 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 12197-0-P, 12197-0-M:
  - Moisture;
  - Fine Particulate (PM_{10}); and
  - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1603502:
  - 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_060 and DAU16-225:

  - Polycyclic Aromatic Hydrocarbons; and
  - Dioxins and Furans.

· SGS Leeder Consulting, NATA accreditation number 14429, performed the following analysis detailed in report number M161982:

  - 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 Approved Methods	USEPA Methods	Parameter Measured
NSW EPA TM-15 (AS 4323.2-1995)	USEPA (2000) Method 5 under approved circumstances	Solid particles (Total)
NSW EPA TM-22	USEPA (2000) Method 4	Moisture content in stack gases
NSW EPA TM-23	USEPA (2000) Method 3	Dry gas density or molecular weight of stack gases
NSW EPA TM-34	USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate)	Volatile organic compounds
NSW EPA OM-5	USEPA (1997) Method 201 or 201A (as appropriate)	'Fine' particulates (PM_{10})
NSW EPA OM-6	California EPA Air Resources Board (1997) Method 429	Polycyclic aromatic hydrocarbons (PAHs)
NSW EPA TM-32	USEPA Method 10	Determination of Carbon Monoxide emissions from stationary sources
NSW EPA TM-25	USEPA (1990) Method 3A	Determination of Oxygen concentrations from stationary sources
NSW EPA TM-24	USEPA (1990) Method 3A	Carbon dioxide (CO_2) in stack gases
NSW EPA TM-11	USEPA(2000) Method 7C	Determination of Nitrogen dioxide or nitric oxide emissions from stationary sources
NSW EPA TM-18	USEPA (1995) Method 23	Dioxins and Furans

3.2 Deviations from NATA Accredited Methods

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

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

Table 3 NATA Method Deviations

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

4.0 Sampling Location

4.1 Sampling Location Summary

Table 4 provides a summary of the location sampled by AECOM on 28 September 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 September 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 28 September 2016

Parameter	Stack 1 EPL Point 1
Carbon Monoxide (CO) (ppm)	28 *(100)*
Chlorine (mg/m^3)	<4.6
Cyanide	0.25 *(0.5)*
Fine Particulate (PM_{10}) (mg/m^3)	2.0
Gaseous Fluoride (mg/m^3)	0.095 *(2)*
Hydrogen Chloride (mg/m^3)	<9.3 *(400)*
Oxides of Nitrogen (as Equivalent NO_2) (mg/m^3)	12 *(2500)*
Oxygen (%)	20.1
Carbon Dioxide (%)	0.2
Particulate Fluoride (mg/m^3)	0.11
Sulfur Dioxide (SO_2 as SO_3) (mg/m^3)	<1.7
Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	<8.5 *(100)*
Total Particulate (mg/m^3)	4.9 *(25)*
Total Polycyclic Aromatic Hydrocarbons (mg/m^3)	0.015
Dioxins and Furans Lower Bound	0.000017
Dioxins and Furans Middle Bound	0.00055
Type 1 and 2 Substances in Aggregate (Metals) (mg/m^3)	0.017 *(10)*
Volatile Organic Compounds (VOC) (mg/m^3)	<0.36

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 9.0mm and 11.0mm. 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	10.1

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

Table 7 Calculated Gas Concentrations Data Summary, 28 September 2016

Parameter	Stack 1
Time Period	10:20-11:20
Nitrogen Oxide (NO) (mg/m^3)	6
Nitrogen Dioxide (NO_2) (mg/m^3)	2
Nitrogen Oxides (NO_x) (mg/m^3)	8
Oxides of Nitrogen as Equivalent NO_2 (mg/m^3)	12 *(2500)*
Carbon Monoxide (ppm)	28 *(100)*
Carbon Monoxide (mg/m^3)	35
Carbon Dioxide (%)	0.2
Oxygen (%)	20.1

Note – EPL Limits are provided in parenthesis.

Table 8 Gas Mass Emission Rates Summary, 28 September 2016

Parameter	Stack 1
Time Period	10:20-11:20
Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure)	26
Nitrogen Oxide (NO) (mg/s)	156
Nitrogen Dioxide (NO_2) (mg/s)	52
Nitrogen Oxides (NO_x) (mg/s)	208
Oxides of Nitrogen as Equivalent NO_2 (mg/s)	312
Carbon Monoxide (mg/s)	910

Table 9 Stack 1 Fine Particulate (PM_{10}), Total Particulate, and Cyanide, 28 September 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	80.7	°C	353.9	K
Stack pressure (average)	1009	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	9:55	-	11:39	
Fine Particulate (PM_{10}) Mass	2.5	mg		
Gas Volume Sampled	1.23	m^3		
Fine Particulate (PM_{10}) Emission*[1]	2.0	mg/m^3		
Fine Particulate (PM_{10}) Mass Emission Rate*[2]	52	mg/s		
Regulatory Limit	NA	mg/m^3		
Total Particulate Testing				
Test Period	9:55	-	11:39	
Total Particulate Mass	6.1	mg		
Gas Volume Sampled	1.25	m^3		
Total Particulate Emission*[1]	4.9	mg/m^3		
Total Particulate Mass Emission Rate*[2]	130	mg/s		
Regulatory Limit	25	mg/m^3		
Cyanide Testing				
Test Period	9:55	-	11:39	
Cyanide Mass	0.4	mg		
Gas Volume Sampled	1.59	m^3		
Cyanide Emission*[1]	0.25	mg/m^3		
Cyanide Mass Emission Rate*[2]	6.5	mg/s		
Regulatory Limit	0.5	mg/m^3		
Moisture Content (%)	**2.2**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m3**		
Dry Molecular Weight	**28.8**	**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 Sulfuric Acid Mist (H_2SO_4 as SO_3), Sulfur Dioxide (SO_2 as SO_3), Hydrogen Chloride and Chlorine Results, 28 September 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	76.1	°C	349.3	K
Stack pressure (average)	1009	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 (H_2SO_4 as SO_3) Testing				
Test Period	11:58	-	13:40	
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 (SO_2 as SO_3) Testing				
Test Period	11:58	-	13:40	
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	11:58	-	13:40	
Hydrogen Chloride Mass	<10	mg		
Gas Volume Sampled	1.08	m^3		
Hydrogen Chloride Emission*[1]	<9.3	mg/m^3		
Hydrogen Chloride Mass Emission Rate*[2]	<240	mg/s		
Regulatory Limit	400	mg/m^3		
Chlorine Testing				
Test Period	11:58	-	13:40	
Chlorine Mass	<5	mg		
Gas Volume Sampled	1.08	m^3		
Chlorine Emission*[1]	<4.6	mg/m^3		
Chlorine Mass Emission Rate*[2]	<120	mg/s		
Regulatory Limit	NA	mg/m^3		
Moisture Content (%)	**1.4**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

Table 11 Stack 1 Hazardous Substances (Metals), Particulate Fluoride and Gaseous Fluoride Results, 28 September 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	71.9	^{o}C	345.1	K
Stack pressure (average)	1009	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		
Hazardous Substances (Metals) Testing				
Test Period	14:05	-	15:49	
Hazardous Substances (Metals) Mass	0.023	mg		
Gas Volume Sampled	1.34	m^3		
Hazardous Substances (Metals) Emission*[1]	0.017	mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*[2]	0.44	mg/s		
Regulatory Limit	10	mg/m^3		
Particulate Fluoride Testing				
Test Period	14:05	-	15:49	
Particulate Fluoride Mass	0.142	mg		
Gas Volume Sampled	1.27	m^3		
Particulate Fluoride Emission*[1]	0.11	mg/m^3		
Particulate Fluoride Mass Emission Rate*[2]	2.8	mg/s		
Regulatory Limit	NA	mg/m^3		
Gaseous Fluoride Testing				
Test Period	14:05	-	15:49	
Gaseous Fluoride Mass	0.12	mg		
Gas Volume Sampled	1.27	m^3		
Gaseous Fluoride Emission*[1]	0.095	mg/m^3		
Gaseous Fluoride Mass Emission Rate*[2]	2.4	mg/s		
Regulatory Limit	2	mg/m^3		
Moisture Content (%)	**2.7**			
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**		
Dry Molecular Weight	**28.9**	**g/g-mole**		

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

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

Table 12 Stack 1 Polycyclic Aromatic Hydrocarbon (PAH), Dioxins and Furans Results, 28 September 2016

Sampling Conditions:				
Stack internal diameter at test location	1650	mm		
Stack gas temperature (average)	76.5	^{o}C	349.7	K
Stack pressure (average)	1009	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		
Polycyclic Aromatic Hydrocarbons Testing				
Test Period	9:55	-	15:59	
Polycyclic Aromatic Hydrocarbons Mass	0.064733	mg		
Gas Volume Sampled	4.36	m^3		
Polycyclic Aromatic Hydrocarbons Emission*[1]	0.015	mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*[2]	0.39	mg/s		
Regulatory Limit	NA	mg/m^3		
Dioxins and Furans Lower Bound Testing				
Test Period	9:55	-	15:59	
Dioxins and Furans Lower Bound Mass	0.000074	ng		
Gas Volume Sampled	4.36	m^3		
Dioxins and Furans Lower Bound Emission*[1]	0.000017	ng/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*[2]	0.00044	ng/s		
Regulatory Limit	NA	ng/m^3		
Dioxins and Furans Middle Bound Testing				
Test Period	9:55	-	15:59	
Dioxins and Furans Middle Bound Mass	0.0024	ng		
Gas Volume Sampled	4.36	m^3		
Dioxins and Furans Middle Bound Emission*[1]	0.00055	ng/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*[2]	0.014	ng/s		
Regulatory Limit	NA	ng/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 13 Stack 1 Speciated Volatile Organic Compounds Results, 28 September 2016

Analyte	Sample mg	Blank mg	Sample Blank Corrected mg	(mg/m^3)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.7
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.7
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.7
Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.7
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.7
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.7
MIBK	<1.0	<1.0	<1.0	<0.18	<4.7
Toluene	<1.0	<1.0	<1.0	<0.18	<4.7
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
m- & p-xylene	<2.0	<2.0	<2.0	<0.36	<9.4
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.7
Styrene	<1.0	<1.0	<1.0	<0.18	<4.7
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-decane	<1.0	<1.0	<1.0	<0.18	<4.7
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.18	<4.7
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.7
Total	**<1**		**<1**	**<0.36**	**<9.4**

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, 28 September 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	<0.001	0.1	0.00005	<0.00023	0.000011
Total TCDF isomers	0.011				
2,3,7,8-TCDD	<0.002	1	0.001	<0.00046	0.00023
Total TCDD isomers	0.0055				
1,2,3,7,8-PeCDF	<0.001	0.05	0.000025	<0.00023	0.0000057
2,3,4,7,8-PeCDF	<0.001	0.5	0.00025	<0.00023	0.000057
Total PeCDF isomers	<0.007				
1,2,3,7,8-PeCDD	<0.002	0.5	0.0005	<0.00046	0.00011
Total PeCDD isomers	<0.01				
1,2,3,4,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
2,3,4,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
Total HxCDF isomers	<0.006				
1,2,3,4,7,8-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
1,2,3,6,7,8-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
1,2,3,7,8,9-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
Total HxCDD isomers	<0.007				
1,2,3,4,6,7,8-HpCDF	<0.001	0.01	0.000005	<0.00023	0.0000011
1,2,3,4,7,8,9-Hp CDF	<0.002	0.01	0.00001	<0.00046	0.0000023
Total HpCDF isomers	<0.003				
1,2,3,4,6,7,8-HpCDD	0.0028	0.01	0.000028	0.00064	0.0000064
Total HpCDD isomers	0.0071				
OCDF	<0.003	0.001	0.0000015	<0.00069	0.00000034
OCDD	0.046	0.001	0.000046	0.011	0.000011

I-TEQ$_{DF}$		
Lower Bound (excluding LOD Values)	0.000074	ng
Middle Bound (including half LOD Values)	0.0024	ng

Table 15 Stack 1 Elemental Metals Results, 28 September 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	<0.000075			<0.0002	<0.00015	<0.0038
Arsenic	<0.0005	<0.00037	0.000048	0.000036			0.000048	0.000036	0.00092
Beryllium	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Cadmium	<0.0006	<0.00045	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Chromium	<0.0022	<0.0016	0.011	0.0082			0.011	0.0082	0.21
Cobalt	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Copper	<0.0019	<0.0014	0.0014	0.001			0.0014	0.001	0.026
Lead	<0.0011	<0.00082	0.0018	0.0013			0.0018	0.0013	0.033
Magnesium	<0.18	<0.13	0.00035	0.00026			0.00035	0.00026	0.0067
Manganese	<0.0017	<0.0013	0.0075	0.0056			0.0075	0.0056	0.14
Mercury	<0.0002	<0.00015	<0.0001	<0.000075	<0.0005	<0.00037	<0.0005	<0.00037	<0.0095
Nickel	<0.0017	<0.0013	0.0021	0.0016			0.0021	0.0016	0.041
Selenium	<0.0002	<0.00015	0.00065	0.00048			0.00065	0.00048	0.012
Thallium	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Tin	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Vanadium	<0.0004	<0.0003	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Zinc	<3.1	<2.3	0.001	0.00075			0.001	0.00075	0.019
Total Hazardous Metals*	**<0.0002**	**<0.00015**	**0.023**	**0.017**	**<0.0005**	**<0.00037**	**0.023**	**0.017**	**0.44**
Total Metals	**<0.0002**	**<0.00015**	**0.026**	**0.019**			**0.026**	**0.019**	**0.49**

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

Table 16 Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 28 September 2016

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m^3)	(mg/m^3)	(µg/s)	(mg/s)
Naphthalene	45000	45	0.045	10	0.01	270	0.27
2 - Methylnaphthalene	7000	7	0.007	1.6	0.0016	41	0.041
Acenaphthylene	7100	7.1	0.0071	1.6	0.0016	42	0.042
Acenaphthene	470	0.47	0.00047	0.11	0.00011	2.8	0.0028
Fluorene	1600	1.6	0.0016	0.37	0.00037	9.4	0.0094
Phenanthrene	2000	2	0.002	0.46	0.00046	12	0.012
Anthracene	120	0.12	0.00012	0.028	0.000028	0.71	0.00071
Fluoranthene	550	0.55	0.00055	0.13	0.00013	3.2	0.0032
Pyrene	440	0.44	0.00044	0.1	0.0001	2.6	0.0026
Benz(a)anthracene	62	0.062	0.000062	0.014	0.000014	0.37	0.00037
Chrysene	85	0.085	0.000085	0.02	0.00002	0.5	0.0005
Benzo(b)fluoranthene	100	0.1	0.0001	0.023	0.000023	0.59	0.00059
Benzo(k)fluoranthene	46	0.046	0.000046	0.011	0.000011	0.27	0.00027
Benzo(e)pyrene	48	0.048	0.000048	0.011	0.000011	0.28	0.00028
Benzo(a)pyrene	39	0.039	0.000039	0.009	0.000009	0.23	0.00023
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	73	0.073	0.000073	0.017	0.000017	0.43	0.00043
Sum of reported PAH's	**65000**	**65**	**0.065**	**15**	**0.015**	**390**	**0.39**

Appendix A

Field Sheets and Final Calculations (71 pages)

Appendix A Field Sheets and Final Calculations (71 pages)

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 28-Sep-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:

James Lang

Colin Clarke

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 28-Sep-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	B S-type Pitot distances	PM10/2.5 A Distance from wall	PM2.5/10 B S-Type Pitot distances
1	111	81	73	43
2	195	165	241	211
3	292	262	488	458
4	413	383	1162	1132
5	584	554	1409	1379
6	1066	1036	1577	1547
7	1238	1208		
8	1358	1328		
9	1455	1425		
10	1539	1509		
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

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

General Comments:

Signed: .....

Checked: .....

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 28-Sep-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: 9:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:45	3	20.8	0.1
2	9:46	4	20.8	0.1
3	9:47	4	20.8	0.1
4	9:48	4	20.7	0.1
5	9:49	4	20.7	0.1
6	9:50	5	20.7	0.1
7	9:51	5	20.7	0.1
8	9:52	5	20.7	0.1
	Averages:	4.3 ppm	20.7 %	0.1 %

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

Measurements

CO:	0.0004 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0004 %,(wet)	N_2:	77.3 %,(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°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0°C, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 28-Sep-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: 11:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	11:30	3	20.6	0.2
2	11:31	3	20.6	0.2
3	11:32	3	20.7	0.1
4	11:33	4	20.7	0.1
5	11:34	4	20.7	0.1
6	11:35	4	20.7	0.1
7	11:36	4	20.7	0.1
8	11:37	4	20.7	0.1
	Averages:	3.6 ppm	20.7 %	0.1 %

Moisture content (M3): 0.98
Moisture percentage (M2): 2.06 %

Measurements

CO:	0.0004 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0004 %,(wet)	N_2:	77.6 %,(wet)
CO_2:	0.1 %,(wet)	O_2:	20.2 %,(wet)
H_2O:	2.06 %(=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
Fine Particulates

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

Time :	9:45	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	43	0.181	83.0	356.2	16.2
1/2	211	0.199	83.0	356.2	17.0
1/3	458	0.175	83.0	356.2	15.9
1/4	1132	0.165	83.0	356.2	15.4
1/5	1379	0.151	83.0	356.2	14.8
1/6	1547	0.171	83.0	356.2	15.7
2/1	43	0.176	83.0	356.2	15.9
2/2	211	0.181	83.0	356.2	16.2
2/3	458	0.188	83.0	356.2	16.5
2/4	1132	0.183	83.0	356.2	16.3
2/5	1379	0.173	83.0	356.2	15.8
2/6	1547	0.192	83.0	356.2	16.7
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) : 1009.26 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Cyanide

Time :	9:45	Barometric Pressure :		1010	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	15.3
1/2	165	0.136	83.0	356.2	14.0
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	15.4
1/7	1208	0.151	83.0	356.2	14.8
1/8	1328	0.171	83.0	356.2	15.7
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	15.3
2/3	262	0.176	83.0	356.2	15.9
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	16.1
Average			83.0	356.2	15.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -7.5 mm
Absolute pressure in stack (hPa) : 1009.26 hPa

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 28-Sep-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: T455
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 182.4447 Meter finish: 182.4447
Time start: 9:50 Time finish: 9:51

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 183.7829 Meter finish: 183.7829
Time start: 11:41 Time finish: 11:42

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 182.4459 Time start: 9:55
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	0:08:30	73	13.5	22.0	18.0		Yes
1/2	0:08:45	241	13.5	23.0	20.0		Yes
1/3	0:08:15	488	13.5	25.0	21.0		Yes
1/4	0:08:00	1162	13.5	25.0	22.0		Yes
1/5	0:07:45	1409	13.5	25.0	22.0		Yes
1/6	0:08:15	1577	13.5	25.0	22.0		Yes
2/1	0:08:15	73	13.5	25.0	23.0		Yes
2/2	0:08:30	241	13.5	25.0	23.0		Yes
2/3	0:08:30	488	13.5	26.0	23.0		Yes
2/4	0:08:30	1162	13.5	26.0	23.0		Yes
2/5	0:08:15	1409	13.5	26.0	23.0		Yes
2/6	0:08:45	1577	13.5	26.0	23.0		Yes
Averages				24.9	21.9	no result	

Meter Finish: 183.7821 Time Finish: 11:39
Total Condensate collected: 8 ml Silica gel No(s) used: L16

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF TOTAL PARTICULATE

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.6 x $10^{-5}m^2$
Thimble No: T458
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 62.8503 Meter finish: 62.8503
Time start: 9:51 Time finish: 9:52

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 64.2112 Meter finish: 64.2112
Time start: 11:42 Time finish: 11:43

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 62.8533 Time start: 9:55
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	12.4	23.0	18.0		Yes
1/2	0:10:00	195	11.4	25.0	19.0		Yes
1/3	0:15:00	292	13.1	26.0	19.0		Yes
1/4	0:20:00	413	13.8	28.0	20.0		Yes
1/5	0:25:00	584	12.9	28.0	21.0		Yes
1/6	0:30:00	1066	12.5	28.0	22.0		Yes
1/7	0:35:00	1238	12.0	29.0	22.0		Yes
1/8	0:40:00	1358	12.7	29.0	22.0		Yes
1/9	0:45:00	1455	13.1	30.0	22.0		Yes
1/10	0:50:00	1539	13.7	30.0	22.0		Yes
2/1	0:55:00	111	12.5	30.0	23.0		Yes
2/2	1:00:00	195	12.4	30.0	23.0		Yes
2/3	1:05:00	292	12.9	30.0	23.0		Yes
2/4	1:10:00	413	13.1	30.0	23.0		Yes
2/5	1:15:00	584	13.4	30.0	23.0		Yes
2/6	1:20:00	1066	13.2	30.0	23.0		Yes
2/7	1:25:00	1238	12.8	30.0	23.0		Yes
2/8	1:30:00	1358	13.6	30.0	23.0		Yes
2/9	1:35:00	1455	13.9	30.0	23.0		Yes
2/10	1:40:00	1539	13.1	30.0	23.0		Yes
Averages				28.8	21.9	no result	

Meter Finish: 64.2101 Time Finish: 11:39
Total Condensate collected: 15 ml Silica gel No(s) used: 166

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS
SAMPLING OF CYANIDE

Date: 28-Sep-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: 256.5211 Meter finish: 256.5211
Time start: 9:52 Time finish: 9:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 258.2632 Meter finish: 258.2632
Time start: 11:45 Time finish: 11:44

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 256.5231 Time start: 9:55
Meter correction factor (GMf) : 0.9900

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	16.1	18.0	16.0		Yes
1/2	0:10:00	195	14.8	20.0	17.0		Yes
1/3	0:15:00	292	17.1	21.0	18.0		Yes
1/4	0:20:00	413	17.9	21.0	19.0		Yes
1/5	0:25:00	584	16.8	22.0	19.0		Yes
1/6	0:30:00	1066	16.2	22.0	20.0		Yes
1/7	0:35:00	1238	15.6	22.0	20.0		Yes
1/8	0:40:00	1358	16.5	22.0	20.0		Yes
1/9	0:45:00	1455	17.0	23.0	20.0		Yes
1/10	0:50:00	1539	17.8	23.0	20.0		Yes
2/1	0:55:00	111	16.2	24.0	20.0		Yes
2/2	1:00:00	195	16.1	24.0	20.0		Yes
2/3	1:05:00	292	16.8	25.0	20.0		Yes
2/4	1:10:00	413	17.1	25.0	20.0		Yes
2/5	1:15:00	584	17.4	25.0	21.0		Yes
2/6	1:20:00	1066	17.2	25.0	21.0		Yes
2/7	1:25:00	1238	16.7	25.0	21.0		Yes
2/8	1:30:00	1358	17.6	25.0	21.0		Yes
2/9	1:35:00	1455	18.0	25.0	21.0		Yes
2/10	1:40:00	1539	17.0	25.0	21.0		Yes
Averages				23.1	19.8	no result	

Meter Finish: 258.2625 Time Finish: 11:39
Total Condensate collected: 15 ml Silica gel No(s) used: Z7

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

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

Time :	11:30	Barometric Pressure :		1010	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	S				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	43	0.161	78.0	351.2	15.1
1/2	211	0.179	78.0	351.2	16.0
1/3	458	0.207	78.0	351.2	17.2
1/4	1132	0.206	78.0	351.2	17.1
1/5	1379	0.204	78.0	351.2	17.1
1/6	1547	0.188	79.0	352.2	16.4
2/1	43	0.206	78.0	351.2	17.1
2/2	211	0.187	78.0	351.2	16.3
2/3	458	0.179	79.0	352.2	16.0
2/4	1132	0.191	79.0	352.2	16.5
2/5	1379	0.167	79.0	352.2	15.4
2/6	1547	0.159	79.0	352.2	15.1
Average			78.4	351.6	16.3

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.3 mm
Absolute pressure in stack (hPa) : 1009.26 hPa

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Cyanide

Time :	11:30	Barometric Pressure :		1010	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	0.196	78.0	351.2	16.7
1/2	165	0.213	78.0	351.2	17.4
1/3	262	0.161	78.0	351.2	15.1
1/4	383	0.179	78.0	351.2	16.0
1/5	554	0.207	78.0	351.2	17.2
1/6	1036	0.206	78.0	351.2	17.1
1/7	1208	0.204	78.0	351.2	17.1
1/8	1328	0.188	79.0	352.2	16.4
1/9	1425	0.167	79.0	352.2	15.4
1/10	1509	0.166	79.0	352.2	15.4
2/1	81	0.181	78.0	351.2	16.1
2/2	165	0.186	78.0	351.2	16.3
2/3	262	0.206	78.0	351.2	17.1
2/4	383	0.187	78.0	351.2	16.3
2/5	554	0.179	79.0	352.2	16.0
2/6	1036	0.191	79.0	352.2	16.5
2/7	1208	0.167	79.0	352.2	15.4
2/8	1328	0.159	79.0	352.2	15.1
2/9	1425	0.176	79.0	352.2	15.8
2/10	1509	0.181	79.0	352.2	16.1
Average			78.5	351.7	16.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.3 mm
Absolute pressure in stack (hPa) : 1009.09 hPa

STACK ANALYSIS - PM10 CALCULATIONS

Date: 28-Sep-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

1. Gas Analysis

	%		
$\%CO_2$	0.1		
$\%O_2$	20.7		
$\%N_2+\%CO$	79.2		
Fraction Moisture Content, Bws	0.02	M_s=	0.98

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.85
Mol. Wt. of Stack Gas (wet)	28.59

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	101000	29.82
Stack Static Pressure (Pg)	100909	29.79
Absolute Stack Pressure		29.79

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	78.4	173.2
Average Meter Temperature:	23.4	
Stack Gas Viscosity		207.2

5. Cyclone Flow Rate

	ft^3/min	m^3/min	L/min	L/s
Cyclone Flow Rate	0.54	0.0190	19.02	0.32

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	111.23	36.61	0.769	1.222	85.49	28.05	135.93	44.59
1	0.132	94.07	30.96	0.759	1.228	71.43	23.43	115.54	37.91
2	0.146	76.74	25.26	0.744	1.238	57.10	18.73	95.01	31.17
3	0.159	65.39	21.52	0.728	1.248	47.59	15.61	81.61	26.78
4	0.178	52.21	17.19	0.695	1.267	36.31	11.91	66.13	21.70
5	0.202	40.51	13.34	0.638	1.296	25.84	8.48	52.49	17.22
6	0.217	34.98	11.51	0.586	1.318	20.50	6.73	46.09	15.12
7	0.235	29.90	9.84	0.501	1.346	14.97	4.91	40.25	13.21
8	0.256	25.06	8.25	#NUM!	1.386	12.53	4.11	34.74	11.40
9	0.291	19.45	6.40	#NUM!	1.461	9.72	3.19	28.41	9.32
10	0.341	14.19	4.67	#NUM!	1.590	7.10	2.33	21.29	6.98
11	0.392	10.73	3.53	#NUM!	1.748	5.36	1.76	16.09	5.28

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: 28-Sep-16 Client: Weston Aluminium
AECOM's Project No: 60489919 Stack/Duct Description: Stack 1

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

Velocity Head (pitot) Pa	Vel Head in H20	Sqr Root	Dwell time mins
160.88	0.65	0.80	7.8
178.54	0.72	0.85	8.2
206.99	0.83	0.91	8.8
206.01	0.83	0.91	8.8
204.05	0.82	0.90	8.7
188.35	0.76	0.87	8.4
206.01	0.83	0.91	8.8
187.37	0.75	0.87	8.4
178.54	0.72	0.85	8.2
191.30	0.77	0.88	8.5
166.77	0.67	0.82	7.9
158.92	0.64	0.80	7.7
	Average	0.86	100.00
	Square	0.75	

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})
207.3

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

Actual D_{50}
10.1

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: 28-Sep-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):	1.3362	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	23.4	°C		
	296.6	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.2268	m^3		

(B) PM10 concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	T455		PM10 Weight	0.0025 g
Final PM10 Weight (Mp1):	0.00250	g		
PM10 Concentration (C1):		$=M_{p1}/MV_4=$	0.002	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	2.0	mg/m^3 (0°C, dry gas, 1atm pressure)
CO_2 Basis	12 %			
Average CO_2%:	0.1 %			
Therefore, C_c:		$= C_a \times 12/CO_2\% =$	0.21	g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
		;and C_{c1} =	210	mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
O_2 Basis	7 %			
Average O_2%:	20.7 %			
Therefore, C_b:		$=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$	0.095	g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)
		;and C_{b1} =	95	mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: L16

V_v = 9.2 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 ($V_{wsg(std)}$) = 0.0123

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

B_{ws} = 1.84 %

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Fine Particulate (PM10)

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

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

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

= 0.976 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.03 m/s

(ii) Average of post-sampling velocities: 16.28 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 16.15 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 = 34.53 m^3/s (stack conditions)

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

Qstd = 26.1 m^3/s (0^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.052	g/s (0^oC, dry gas, 1 atm pressure)		
	=	52	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	5.6	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	5600	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	2.5	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	2500	mg/s (0^oC, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

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

Date: 28-Sep-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): 1.3704 m^3

Average gas meter temp. ($T_{M,2}$): 25.3 °C

298.5 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.2502 m^3

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T458

Blank weight: g

Total Particulate Weight 0.0061 g

Final Total Particulate Weight (Mp1): 0.00610 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0049 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 4.9 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.1 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.52 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 520 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.23 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 230 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 166

V_v = 6.2 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 ($V_{wsg(std)}$) = 0.0083

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

B_{ws} = 2.21 %

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

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

= 0.984 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.93 m/s

(ii) Average of post-sampling velocities: 16.23 m/s

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

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

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

Qstack = Vs x A = 34.38 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^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.13	g/s (0^oC, dry gas, 1 atm pressure)		
	=	130	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	14	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	14000	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	6	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	6000	mg/s (0^oC, 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: 28-Sep-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):	1.7220	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	21.4	°C		
	294.6	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.5918	m^3		

(B) Cyanide concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Cyanide Weight	0.0004 g
Final Cyanide Weight (Mp1):	0.00040	g		
Cyanide Concentration (C1):		$=M_{p1}/MV_4=$	0.00025	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.25	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.1 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.027 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 27 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.012 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 12 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z7

V_v = 11.1 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 ($V_{wsg(std)}$) = 0.0148

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

B_{ws} = 2.14 %

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

= 0.976 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.93 m/s

(ii) Average of post-sampling velocities: 16.23 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 16.08 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 = 34.38 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 =	0.0065	g/s (0°C, dry gas, 1 atm pressure)		
	=	6.5	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.69	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	690	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.31	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	310	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

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

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	80.7 °C		353.9 K
Stack pressure (average)	1009 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	9:55	-	11:39
Fine Particulate (PM10) Mass	2.5 mg		
Gas Volume Sampled	1.23 m^3		
Fine Particulate (PM10) Emission*1	2.0 mg/m^3		
Fine Particulate (PM10) Mass Emission Rate*2	52 mg/s		
Regulatory Limit	NA mg/m^3		
Total Particulate Testing			
Test Period	9:55	-	11:39
Total Particulate Mass	6.1 mg		
Gas Volume Sampled	1.25 m^3		
Total Particulate Emission*1	4.9 mg/m^3		
Total Particulate Mass Emission Rate*2	130 mg/s		
Regulatory Limit	25 mg/m^3		
Cyanide Testing			
Test Period	9:55	-	11:39
Cyanide Mass	0.4 mg		
Gas Volume Sampled	1.59 m^3		
Cyanide Emission*1	0.25 mg/m^3		
Cyanide Mass Emission Rate*2	6.5 mg/s		
Regulatory Limit	0.5 mg/m^3		
Moisture Content (%)	2.2		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

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

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

Emission Measurement Calculations Spreadsheet

Weston Aluminium

AECOM's Project Number: 60489919

Emission Source: Stack 1

Date Sampled: 28-Sep-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:

James Lang

Colin Clarke

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 28-Sep-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: .....

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 28-Sep-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: 11:30		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	11:30	3	20.6	0.2
2	11:31	3	20.6	0.2
3	11:32	3	20.7	0.1
4	11:33	4	20.7	0.1
5	11:34	4	20.7	0.1
6	11:35	4	20.7	0.1
7	11:36	4	20.7	0.1
8	11:37	4	20.7	0.1
	Averages:	3.6 ppm	20.7 %	0.1 %

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

Measurements

CO:	0.0004 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0004 %,(wet)	N_2:	77.3 %,(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: 28-Sep-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: 13:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	13:45	0	20.6	0.2
2	13:46	0	20.6	0.2
3	13:47	1	20.6	0.2
4	13:48	1	20.6	0.2
5	13:49	1	20.7	0.1
6	13:50	0	20.7	0.1
7	13:51	0	20.6	0.2
8	13:52	0	20.6	0.2
	Averages:	0.4 ppm	20.6 %	0.2 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.42 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	78.1 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.3 %,(wet)
H_2O:	1.42 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-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 :	11:30	Barometric Pressure :	1010	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	0.196	78.0	351.2	16.7
1/2	165	0.213	78.0	351.2	17.4
1/3	262	0.161	78.0	351.2	15.2
1/4	383	0.179	78.0	351.2	16.0
1/5	554	0.207	78.0	351.2	17.2
1/6	1036	0.206	78.0	351.2	17.1
1/7	1208	0.204	78.0	351.2	17.1
1/8	1328	0.188	79.0	352.2	16.4
1/9	1425	0.167	79.0	352.2	15.4
1/10	1509	0.166	79.0	352.2	15.4
2/1	81	0.181	78.0	351.2	16.1
2/2	165	0.186	78.0	351.2	16.3
2/3	262	0.206	78.0	351.2	17.1
2/4	383	0.187	78.0	351.2	16.4
2/5	554	0.179	79.0	352.2	16.0
2/6	1036	0.191	79.0	352.2	16.5
2/7	1208	0.167	79.0	352.2	15.4
2/8	1328	0.159	79.0	352.2	15.1
2/9	1425	0.176	79.0	352.2	15.9
2/10	1509	0.181	79.0	352.2	16.1
Average			78.5	351.7	16.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.3 mm
Absolute pressure in stack (hPa) : 1009.09 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)

Date: 28-Sep-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: 183.7895 Meter finish: 183.7895
Time start: 11:52 Time finish: 11:53
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 185.0729 Meter finish: 185.0729
Time start: 13:45 Time finish: 13:46
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 183.7904 Time start: 11:58
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	12.7	23.0	19.0		Yes
1/2	0:10:00	195	13.2	24.0	20.0		Yes
1/3	0:15:00	292	11.5	24.0	21.0		Yes
1/4	0:20:00	413	12.1	24.0	21.0		Yes
1/5	0:25:00	584	13.1	24.0	21.0		Yes
1/6	0:30:00	1066	13.0	24.0	21.0		Yes
1/7	0:35:00	1238	13.0	25.0	22.0		Yes
1/8	0:40:00	1358	12.4	25.0	22.0		Yes
1/9	0:45:00	1455	11.7	25.0	22.0		Yes
1/10	0:50:00	1539	11.7	25.0	22.0		Yes
2/1	0:55:00	111	12.2	25.0	22.0		Yes
2/2	1:00:00	195	12.4	25.0	22.0		Yes
2/3	1:05:00	292	13.0	26.0	23.0		Yes
2/4	1:10:00	413	12.4	26.0	23.0		Yes
2/5	1:15:00	584	12.1	26.0	23.0		Yes
2/6	1:20:00	1066	12.5	26.0	23.0		Yes
2/7	1:25:00	1238	11.7	26.0	23.0		Yes
2/8	1:30:00	1358	11.4	26.0	23.0		Yes
2/9	1:35:00	1455	12.0	26.0	23.0		Yes
2/10	1:40:00	1539	12.2	26.0	23.0		Yes
Averages				25.1	22.0	no result	

Meter Finish: 185.0721 Time Finish: 13:40
Total Condensate collected: 0 ml Silica gel No(s) used: Z17

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFUR DIOXIDE (SO2 AS SO3)

Date: 28-Sep-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: 183.7895 Meter finish: 183.7895
Time start: 11:52 Time finish: 11:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 185.0729 Meter finish: 185.0729
Time start: 13:45 Time finish: 13:46

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 183.7904 Time start: 11:58
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	12.7	23.0	19.0		Yes
1/2	0:10:00	195	13.2	24.0	20.0		Yes
1/3	0:15:00	292	11.5	24.0	21.0		Yes
1/4	0:20:00	413	12.1	24.0	21.0		Yes
1/5	0:25:00	584	13.1	24.0	21.0		Yes
1/6	0:30:00	1066	13.0	24.0	21.0		Yes
1/7	0:35:00	1238	13.0	25.0	22.0		Yes
1/8	0:40:00	1358	12.4	25.0	22.0		Yes
1/9	0:45:00	1455	11.7	25.0	22.0		Yes
1/10	0:50:00	1539	11.7	25.0	22.0		Yes
2/1	0:55:00	111	12.2	25.0	22.0		Yes
2/2	1:00:00	195	12.4	25.0	22.0		Yes
2/3	1:05:00	292	13.0	26.0	23.0		Yes
2/4	1:10:00	413	12.4	26.0	23.0		Yes
2/5	1:15:00	584	12.1	26.0	23.0		Yes
2/6	1:20:00	1066	12.5	26.0	23.0		Yes
2/7	1:25:00	1238	11.7	26.0	23.0		Yes
2/8	1:30:00	1358	11.4	26.0	23.0		Yes
2/9	1:35:00	1455	12.0	26.0	23.0		Yes
2/10	1:40:00	1539	12.2	26.0	23.0		Yes
Averages				25.1	22.0	no result	

Meter Finish: 185.0721 Time Finish: 13:40
Total Condensate collected: 0 ml Silica gel No(s) used: Z17

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HYDROGEN CHLORIDE AND CHLORINE

Date: 28-Sep-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: 64.2203 Meter finish: 64.2203
Time start: 11:54 Time finish: 11:55
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 65.3913 Meter finish: 65.3913
Time start: 13:46 Time finish: 13:47
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 64.2214 Time start: 11:58
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	11.7	24.0	21.0		Yes
1/2	0:10:00	195	12.2	24.0	21.0		Yes
1/3	0:15:00	292	10.6	24.0	22.0		Yes
1/4	0:20:00	413	11.2	25.0	22.0		Yes
1/5	0:25:00	584	12.0	25.0	22.0		Yes
1/6	0:30:00	1066	12.0	26.0	22.0		Yes
1/7	0:35:00	1238	12.0	26.0	23.0		Yes
1/8	0:40:00	1358	11.4	26.0	23.0		Yes
1/9	0:45:00	1455	10.7	26.0	23.0		Yes
1/10	0:50:00	1539	10.7	26.0	23.0		Yes
2/1	0:55:00	111	11.3	26.0	23.0		Yes
2/2	1:00:00	195	11.4	26.0	23.0		Yes
2/3	1:05:00	292	12.0	27.0	24.0		Yes
2/4	1:10:00	413	11.5	27.0	24.0		Yes
2/5	1:15:00	584	11.2	27.0	24.0		Yes
2/6	1:20:00	1066	11.5	27.0	24.0		Yes
2/7	1:25:00	1238	10.7	27.0	24.0		Yes
2/8	1:30:00	1358	10.5	27.0	24.0		Yes
2/9	1:35:00	1455	11.1	27.0	24.0		Yes
2/10	1:40:00	1539	11.2	27.0	24.0		Yes
Averages				26.0	23.0	no result	

Meter Finish: 65.3901 Time Finish: 13:40
Total Condensate collected: 3 ml Silica gel No(s) used: 135

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-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 :	13:45	Barometric Pressure :	1010	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	0.172	73.0	346.2	15.5
1/2	165	0.147	73.0	346.2	14.4
1/3	262	0.143	74.0	347.2	14.2
1/4	383	0.132	74.0	347.2	13.6
1/5	554	0.180	74.0	347.2	15.9
1/6	1036	0.197	74.0	347.2	16.6
1/7	1208	0.162	74.0	347.2	15.1
1/8	1328	0.200	74.0	347.2	16.8
1/9	1425	0.217	74.0	347.2	17.5
1/10	1509	0.207	74.0	347.2	17.1
2/1	81	0.172	73.0	346.2	15.5
2/2	165	0.188	73.0	346.2	16.2
2/3	262	0.191	74.0	347.2	16.4
2/4	383	0.194	74.0	347.2	16.5
2/5	554	0.167	74.0	347.2	15.3
2/6	1036	0.149	74.0	347.2	14.5
2/7	1208	0.153	74.0	347.2	14.7
2/8	1328	0.174	74.0	347.2	15.6
2/9	1425	0.167	74.0	347.2	15.3
2/10	1509	0.159	73.0	346.2	14.9
Average			73.8	347.0	15.6

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -8 mm
Absolute pressure in stack (hPa) : 1009.22 hPa

STACK ANALYSIS - FINAL CALCULATIONS

Sulfuric Acid Mist (H2SO4 as SO3)

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

Date: 28-Sep-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):	1.2817	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	23.5	°C		
	296.7	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.1764	m^3		

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA Blank weight: g

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

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

H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0017 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: $= C_a \times 12/CO_2\% =$ <0.14 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

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

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.068 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = <68 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z17

V_v = 13.3 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 ($V_{wsg(std)}$) = 0.0178

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

B_{ws} = 1.49 %

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): 1.27 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: 16.24 m/s

(ii) Average of post-sampling velocities: 15.58 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 34.02 m^3/s (stack conditions)

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

Qstd = 26.1 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 =	<3.6	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<3600	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<1.8	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<1800	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Sulfur Dioxide (SO2 as SO3)

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

Date: 28-Sep-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): 1.2817 m^3
Average gas meter temp. ($T_{M,2}$): 23.5 °C
296.7 K
Average barometric pressure (P_{BARO}) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.1764 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: $= C_a \times 12/CO_2\% =$ <0.68 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
;and C_{c1} = <680 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %
Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.34 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)
;and C_{b1} = <340 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z17
V_v = 13.3 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 ($V_{wsg(std)}$) = 0.0178
Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.49 %

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): 1.27 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: 16.24 m/s

(ii) Average of post-sampling velocities: 15.58 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 34.02 m^3/s (stack conditions)

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

Qstd = 26.1 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 =	<18	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<18000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<8.9	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<8900	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Hydrogen Chloride

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

Date: 28-Sep-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): 1.1804 m^3

Average gas meter temp. ($T_{M,2}$): 24.5 °C

297.7 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 1.0798 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): $=M_{p1}/MV_4=$ <0.0093 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = <9.3 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ <0.74 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = <740 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

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: 135

V_v = 7.5 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 ($V_{wsg(std)}$) = 0.0100

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

B_{ws} = 1.28 %

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): 1.27 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: 16.24 m/s

(ii) Average of post-sampling velocities: 15.58 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 34.02 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 =	<0.24	g/s (0°C, dry gas, 1 atm pressure)		
	=	<240	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<19	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<19000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<9.7	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<9700	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Chlorine

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

Date: 28-Sep-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):	1.1804	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	24.5	°C		
	297.7	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0798	m^3		

(B) Chlorine concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Chlorine Weight	<0.005 g
Final Chlorine Weight (Mp1):	<0.005	g		
Chlorine Concentration (C1):		$=M_{p1}/MV_4=$	<0.0046	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	<4.6	mg/m^3 (0°C, dry gas, 1atm pressure)
CO_2 Basis	12 %			
Average CO_2%:	0.2 %			
Therefore, C_c:		$= C_a \times 12/CO_2\% =$	<0.37	g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
		;and C_{c1} =	<370	mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
O_2 Basis	7 %			
Average O_2%:	20.7 %			
Therefore, C_b:		$=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$	<0.18	g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)
		;and C_{b1} =	<180	mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 135

V_v =	7.5 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 ($V_{wsg(std)}$) =	0.0100			

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

B_{ws} = 1.28 %

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): 1.27 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: 16.24 m/s

(ii) Average of post-sampling velocities: 15.58 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 34.02 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 =	<0.12	g/s (0°C, dry gas, 1 atm pressure)		
	=	<120	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	<9.6	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	<9600	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	<4.8	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	<4800	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1
WESTON ALUMINIUM
28-Sep-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)	76.1 °C		349.3 K
Stack pressure (average)	1009 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	11:58	-	13:40
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	11:58	-	13:40
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	11:58	-	13:40
Hydrogen Chloride Mass	<10 mg		
Gas Volume Sampled	1.08 m^3		
Hydrogen Chloride Emission*1	<9.3 mg/m^3		
Hydrogen Chloride Mass Emission Rate*2	<240 mg/s		
Regulatory Limit	400 mg/m^3		
Chlorine Testing			
Test Period	11:58	-	13:40
Chlorine Mass	<5 mg		
Gas Volume Sampled	1.08 m^3		
Chlorine Emission*1	<4.6 mg/m^3		
Chlorine Mass Emission Rate*2	<120 mg/s		
Regulatory Limit	NA mg/m^3		
Moisture Content (%)	1.4		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.9 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: 28-Sep-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:

Sampling Performed By:

James Lang

Colin Clarke

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 28-Sep-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	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: 28-Sep-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: 13:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	13:45	0	20.6	0.2
2	13:46	0	20.6	0.2
3	13:47	1	20.6	0.2
4	13:48	1	20.6	0.2
5	13:49	1	20.7	0.1
6	13:50	0	20.7	0.1
7	13:51	0	20.6	0.2
8	13:52	0	20.6	0.2
	Averages:	0.4 ppm	20.6 %	0.2 %

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

Measurements

CO:	0.0000 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(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
SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 28-Sep-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: 185.0545 Meter finish: 185.0545
Time start: 13:58 Time finish: 13:59

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 186.5552 Meter finish: 186.5552
Time start: 15:52 Time finish: 15:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 185.0851 Time start: 14:05
Meter correction factor (GMf) : 1.0000

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	14.1	24.0	19.0		Yes
1/2	0:10:00	195	13.1	25.0	21.0		Yes
1/3	0:15:00	292	12.9	25.0	22.0		Yes
1/4	0:20:00	413	12.4	26.0	23.0		Yes
1/5	0:25:00	584	14.4	26.0	23.0		Yes
1/6	0:30:00	1066	15.1	26.0	23.0		Yes
1/7	0:35:00	1238	13.7	26.0	23.0		Yes
1/8	0:40:00	1358	15.2	26.0	23.0		Yes
1/9	0:45:00	1455	15.9	26.0	23.0		Yes
1/10	0:50:00	1539	15.5	26.0	24.0		Yes
2/1	0:55:00	111	14.1	26.0	24.0		Yes
2/2	1:00:00	195	14.8	27.0	24.0		Yes
2/3	1:05:00	292	14.9	27.0	24.0		Yes
2/4	1:10:00	413	15.0	27.0	25.0		Yes
2/5	1:15:00	584	13.9	27.0	25.0		Yes
2/6	1:20:00	1066	13.1	28.0	25.0		Yes
2/7	1:25:00	1238	13.3	28.0	25.0		Yes
2/8	1:30:00	1358	14.1	28.0	25.0		Yes
2/9	1:35:00	1455	13.9	28.0	26.0		Yes
2/10	1:40:00	1539	13.5	28.0	26.0		Yes
Averages				26.5	23.7	no result	

Meter Finish: 186.5544 Time Finish: 15:49
Total Condensate collected: 15 ml Silica gel No(s) used: F28

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF PARTICULATE FLUORIDE

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.6 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 65.4028 Meter finish: 65.4028
Time start: 14:00 Time finish: 14:01
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 66.7855 Meter finish: 66.7855
Time start: 15:53 Time finish: 15:54
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 65.4040 Time start: 14:05
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	12.9	25.0	22.0		Yes
1/2	0:10:00	195	12.0	25.0	22.0		Yes
1/3	0:15:00	292	11.8	26.0	23.0		Yes
1/4	0:20:00	413	11.4	26.0	23.0		Yes
1/5	0:25:00	584	13.2	26.0	23.0		Yes
1/6	0:30:00	1066	13.9	27.0	23.0		Yes
1/7	0:35:00	1238	12.6	27.0	24.0		Yes
1/8	0:40:00	1358	14.0	27.0	24.0		Yes
1/9	0:45:00	1455	14.6	27.0	24.0		Yes
1/10	0:50:00	1539	14.2	28.0	24.0		Yes
2/1	0:55:00	111	12.9	28.0	24.0		Yes
2/2	1:00:00	195	13.6	28.0	25.0		Yes
2/3	1:05:00	292	13.7	28.0	25.0		Yes
2/4	1:10:00	413	13.7	28.0	25.0		Yes
2/5	1:15:00	584	12.7	29.0	26.0		Yes
2/6	1:20:00	1066	12.1	29.0	26.0		Yes
2/7	1:25:00	1238	12.2	29.0	26.0		Yes
2/8	1:30:00	1358	13.0	29.0	26.0		Yes
2/9	1:35:00	1455	12.7	29.0	26.0		Yes
2/10	1:40:00	1539	12.4	29.0	26.0		Yes
Averages				27.5	24.4	no result	

Meter Finish: 66.7844 Time Finish: 15:49
Total Condensate collected: 13 ml Silica gel No(s) used: K9

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF GASEOUS FLUORIDE

Date: 28-Sep-16
Client: Weston Aluminium
AECOM's Project No: 60489919
Stack Description No.: Stack 1
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.6 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)
Meter start: 65.4028 Meter finish: 65.4028
Time start: 14:00 Time finish: 14:01
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 66.7855 Meter finish: 66.7855
Time start: 15:53 Time finish: 15:54
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 65.4040 Time start: 14:05
Meter correction factor (GMf) : 1.0100

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:05:00	111	12.9	25.0	22.0		Yes
1/2	0:10:00	195	12.0	25.0	22.0		Yes
1/3	0:15:00	292	11.8	26.0	23.0		Yes
1/4	0:20:00	413	11.4	26.0	23.0		Yes
1/5	0:25:00	584	13.2	26.0	23.0		Yes
1/6	0:30:00	1066	13.9	27.0	23.0		Yes
1/7	0:35:00	1238	12.6	27.0	24.0		Yes
1/8	0:40:00	1358	14.0	27.0	24.0		Yes
1/9	0:45:00	1455	14.6	27.0	24.0		Yes
1/10	0:50:00	1539	14.2	28.0	24.0		Yes
2/1	0:55:00	111	12.9	28.0	24.0		Yes
2/2	1:00:00	195	13.6	28.0	25.0		Yes
2/3	1:05:00	292	13.7	28.0	25.0		Yes
2/4	1:10:00	413	13.7	28.0	25.0		Yes
2/5	1:15:00	584	12.7	29.0	26.0		Yes
2/6	1:20:00	1066	12.1	29.0	26.0		Yes
2/7	1:25:00	1238	12.2	29.0	26.0		Yes
2/8	1:30:00	1358	13.0	29.0	26.0		Yes
2/9	1:35:00	1455	12.7	29.0	26.0		Yes
2/10	1:40:00	1539	12.4	29.0	26.0		Yes
Averages				27.5	24.4	no result	

Meter Finish: 66.7844 Time Finish: 15:49
Total Condensate collected: 13 ml Silica gel No(s) used: K9

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-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 :	16:10	Barometric Pressure :		1010	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	0.158	69.0	342.2	14.8
1/2	165	0.172	70.0	343.2	15.5
1/3	262	0.179	70.0	343.2	15.8
1/4	383	0.151	70.0	343.2	14.5
1/5	554	0.159	70.0	343.2	14.9
1/6	1036	0.181	71.0	344.2	15.9
1/7	1208	0.203	71.0	344.2	16.9
1/8	1328	0.205	70.0	343.2	16.9
1/9	1425	0.163	70.0	343.2	15.1
1/10	1509	0.147	70.0	343.2	14.3
2/1	81	0.177	69.0	342.2	15.7
2/2	165	0.197	69.0	342.2	16.6
2/3	262	0.217	69.0	342.2	17.4
2/4	383	0.196	70.0	343.2	16.5
2/5	554	0.185	70.0	343.2	16.1
2/6	1036	0.181	70.0	343.2	15.9
2/7	1208	0.166	70.0	343.2	15.2
2/8	1328	0.169	70.0	343.2	15.3
2/9	1425	0.147	71.0	344.2	14.4
2/10	1509	0.140	71.0	344.2	14.0
Average			70.0	343.2	15.6

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.5 mm
Absolute pressure in stack (hPa) : 1009.07 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 28-Sep-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	<0.0005	0.000048			
Beryllium	<0.0002	<0.0001			
Cadmium	<0.0006	<0.0001			
Chromium	<0.0022	0.011			
Cobalt	<0.0002	<0.0001			
Copper	<0.0019	0.0014			
Lead	<0.0011	0.0018			
Magnesium	<0.18	0.00035			
Manganese	<0.0017	0.0075			
Mercury	<0.0002	<0.0001	<0.0001	<0.0005	<0.0001
Nickel	<0.0017	0.0021			
Selenium	<0.0002	0.00065			
Thallium	<0.0002	<0.0001			
Tin	<0.0002	<0.0001			
Vanadium	<0.0004	<0.0001			
Zinc	<3.1	0.001			

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: 28-Sep-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	<0.000075			<0.0002	<0.00015	<0.0038
Arsenic	<0.0005	<0.00037	0.000048	0.000036			0.000048	0.000036	0.00092
Beryllium	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Cadmium	<0.0006	<0.00045	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Chromium	<0.0022	<0.0016	0.011	0.0082			0.011	0.0082	0.21
Cobalt	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Copper	<0.0019	<0.0014	0.0014	0.001			0.0014	0.001	0.026
Lead	<0.0011	<0.00082	0.0018	0.0013			0.0018	0.0013	0.033
Magnesium	<0.18	<0.13	0.00035	0.00026			0.00035	0.00026	0.0067
Manganese	<0.0017	<0.0013	0.0075	0.0056			0.0075	0.0056	0.14
Mercury	<0.0002	<0.00015	<0.0001	<0.000075	<0.0005	<0.00037	<0.0005	<0.00037	<0.0095
Nickel	<0.0017	<0.0013	0.0021	0.0016			0.0021	0.0016	0.041
Selenium	<0.0002	<0.00015	0.00065	0.00048			0.00065	0.00048	0.012
Thallium	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Tin	<0.0002	<0.00015	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Vanadium	<0.0004	<0.0003	<0.0001	<0.000075			<0.0002	<0.00015	<0.0038
Zinc	<3.1	<2.3	0.001	0.00075			0.001	0.00075	0.019
Total Hazardous Metals*	#NUM!	#NUM!	0.023	0.017	<0.0005	<0.00037	0.023	0.017	0.44
Total Metals	#NUM!	#NUM!	0.026	0.019			0.026	0.019	0.49

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

STACK ANALYSIS - FINAL CALCULATIONS

Hazardous Substances (Metals)

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

Date: 28-Sep-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):	1.4693	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	25.1	°C		
	298.3	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.3414	m^3		

(B) Metals concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		Metals Weight	0.000023 g
Final Metals Weight (Mp1):	0.00002	g		
Metals Concentration (C1):		$=M_{p1}/MV_4=$	0.000017	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.017	mg/m^3 (0°C, dry gas, 1atm pressure)
CO_2 Basis	12 %			
Average CO_2%:	0.2 %			
Therefore, C_c:		$= C_a \times 12/CO_2\% =$	0.0011	g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
		;and C_{c1} =	1.1	mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)
O_2 Basis	7 %			
Average O_2%:	20.6 %			
Therefore, C_b:		$=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$	0.00059	g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)
		;and C_{b1} =	0.59	mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: F28

V_v = 16.8 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 ($V_{wsg(std)}$) = 0.0224

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

B_{ws} = 3.07 %

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

= 1.009 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.77 m/s

(ii) Average of post-sampling velocities: 15.59 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.68 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 = 33.53 m^3/s (stack conditions)

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

Qstd = 25.6 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00044	g/s (0°C, dry gas, 1 atm pressure)		
	=	0.44	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.028	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	28	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.015	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	15	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: 28-Sep-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):	1.3942 m^3	Average barometric pressure (P_{BARO})	1010	hPa
Average gas meter temp. ($T_{M,2}$):	25.9 °C			
	299.1 K	Average pressure at meter ($P_{M,2}$)	1010.00	hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.2694 m^3			

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: NA Particulate Fluoride Weight 0.000142 g

Final Particulate Fluoride Weight (Mp1): 0.00014 g

Particulate Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00011 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.11 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.007 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 7 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0038 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 3.8 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: K9

V_v = 11.6 g (from laboratory report) V_w = 13 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0173

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0155

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

B_{ws} = 2.52 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Particulate Fluoride

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

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

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

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

= 1.009 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.77 m/s

(ii) Average of post-sampling velocities: 15.59 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.68 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 = 33.53 m^3/s (stack conditions)

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

Qstd = 25.8 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0028	g/s (0°C, dry gas, 1 atm pressure)		
	=	2.8	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.18	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	180	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.098	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	98	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: 28-Sep-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):	1.3942	m^3	Average barometric pressure (P_{BARO})	1010	hPa
Average gas meter temp. ($T_{M,2}$):	25.9	°C			
	299.1	K	Average pressure at meter ($P_{M,2}$)	1010.00	hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.2694	m^3			

(B) Gaseous Fluoride concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: NA Gaseous Fluoride Weight 0.00012 g

Final Gaseous Fluoride Weight (Mp1): 0.00012 g

Gaseous Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.000095 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.095 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0061 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 6.1 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.6 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0033 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 3.3 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: K9

V_v = 11.6 g (from laboratory report) V_w = 13 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0173

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0155

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

B_{ws} = 2.52 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Gaseous Fluoride

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

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

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

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

= 1.009 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.77 m/s

(ii) Average of post-sampling velocities: 15.59 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.68 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 = 33.53 m^3/s (stack conditions)

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

Qstd = 25.8 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.0024	g/s (0°C, dry gas, 1 atm pressure)		
	=	2.4	mg/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.16	g/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	160	mg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.084	g/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	84	mg/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

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

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	71.9 °C		345.1 K
Stack pressure (average)	1009 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		
Hazardous Substances (Metals) Testing			
Test Period	14:05	-	15:49
Hazardous Substances (Metals) Mass	0.023 mg		
Gas Volume Sampled	1.34 m^3		
Hazardous Substances (Metals) Emission*1	0.017 mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.44 mg/s		
Regulatory Limit	10 mg/m^3		
Particulate Fluoride Testing			
Test Period	14:05	-	15:49
Particulate Fluoride Mass	0.142 mg		
Gas Volume Sampled	1.27 m^3		
Particulate Fluoride Emission*1	0.11 mg/m^3		
Particulate Fluoride Mass Emission Rate*2	2.8 mg/s		
Regulatory Limit	NA mg/m^3		
Gaseous Fluoride Testing			
Test Period	14:05	-	15:49
Gaseous Fluoride Mass	0.12 mg		
Gas Volume Sampled	1.27 m^3		
Gaseous Fluoride Emission*1	0.095 mg/m^3		
Gaseous Fluoride Mass Emission Rate*2	2.4 mg/s		
Regulatory Limit	2 mg/m^3		
Moisture Content (%)	2.7		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.9 g/g-mole		

Notes *1 Emission concentration at Standard conditions of 0^0C, 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: 28-Sep-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:

James Lang

for Colin Clarke

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - PRE-SAMPLING

Date: 28-Sep-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	B 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: 28-Sep-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: 9:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:45	3	20.8	0.1
2	9:46	4	20.8	0.1
3	9:47	4	20.8	0.1
4	9:48	4	20.7	0.1
5	9:49	4	20.7	0.1
6	9:50	5	20.7	0.1
7	9:51	5	20.7	0.1
8	9:52	5	20.7	0.1
	Averages:	4.3 ppm	20.7 %	0.1 %

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

Measurements

CO:	0.0004 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.1 %,(dry)	O_2:	20.7 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0004 %,(wet)	N_2:	77.3 %,(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: 28-Sep-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: 16:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	16:00	6	20.5	0.2
2	16:01	6	20.5	0.2
3	16:02	7	20.6	0.2
4	16:03	7	20.5	0.2
5	16:04	7	20.6	0.2
6	16:05	7	20.6	0.2
7	16:06	7	20.6	0.2
8	16:07	6	20.6	0.2
	Averages:	6.6 ppm	20.6 %	0.2 %

Moisture content (M3): 0.98
Moisture percentage (M2): 1.74 %

Measurements

CO:	0.0007 %,(dry)	N_2:	79.2 %,(dry)
CO_2:	0.2 %,(dry)	O_2:	20.6 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0007 %,(wet)	N_2:	77.9 %,(wet)
CO_2:	0.2 %,(wet)	O_2:	20.2 %,(wet)
H_2O:	1.74 %(=M2)		

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

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-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 :	9:45	Barometric Pressure :	1010	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	15.3
1/2	165	0.136	83.0	356.2	14.0
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	15.4
1/7	1208	0.151	83.0	356.2	14.8
1/8	1328	0.171	83.0	356.2	15.7
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	15.3
2/3	262	0.176	83.0	356.2	15.9
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	16.1
Average			83.0	356.2	15.9

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -7.5 mm
Absolute pressure in stack (hPa) : 1009.26 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS

Date: 28-Sep-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: 5312.2030 Meter finish: 5312.2030
Time start: 9:52 Time finish: 9:53
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5317.1054 Meter finish: 5317.1054
Time start: 16:01 Time finish: 16:02
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 5312.3046 Time start: 9:55
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	13.5	26.0	22.0		Yes
1/2	0:36:00	195	12.4	26.0	23.0		Yes
1/3	0:54:00	292	14.3	27.0	23.0		Yes
1/4	1:12:00	413	15.0	27.0	24.0		Yes
1/5	1:30:00	584	14.1	27.0	24.0		Yes
1/6	1:48:00	1066	13.6	28.0	24.0		Yes
1/7	2:06:00	1238	13.1	28.0	24.0		Yes
1/8	2:24:00	1358	13.9	29.0	24.0		Yes
1/9	2:42:00	1455	14.2	29.0	24.0		Yes
1/10	3:00:00	1539	14.9	29.0	25.0		Yes
2/1	3:18:00	111	13.6	30.0	25.0		Yes
2/2	3:36:00	195	13.5	30.0	25.0		Yes
2/3	3:54:00	292	14.1	31.0	25.0		Yes
2/4	4:12:00	413	14.3	31.0	25.0		Yes
2/5	4:30:00	584	14.6	31.0	25.0		Yes
2/6	4:48:00	1066	14.4	31.0	25.0		Yes
2/7	5:06:00	1238	14.0	31.0	25.0		Yes
2/8	5:24:00	1358	14.8	31.0	25.0		Yes
2/9	5:42:00	1455	15.1	31.0	25.0		Yes
2/10	6:00:00	1539	14.2	31.0	25.0		Yes
Averages				29.2	24.4	no result	

Meter Finish: 5317.1044 Time Finish: 15:59
Total Condensate collected: 35 ml Silica gel No(s) used: Z11

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF DIOXINS AND FURANS

Date: 28-Sep-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: 5312.2030 Meter finish: 5312.2030
Time start: 9:52 Time finish: 9:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5317.1054 Meter finish: 5317.1054
Time start: 16:01 Time finish: 16:02

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 5312.3046 Time start: 9:55
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	13.5	26.0	22.0		Yes
1/2	0:36:00	195	12.4	26.0	23.0		Yes
1/3	0:54:00	292	14.3	27.0	23.0		Yes
1/4	1:12:00	413	15.0	27.0	24.0		Yes
1/5	1:30:00	584	14.1	27.0	24.0		Yes
1/6	1:48:00	1066	13.6	28.0	24.0		Yes
1/7	2:06:00	1238	13.1	28.0	24.0		Yes
1/8	2:24:00	1358	13.9	29.0	24.0		Yes
1/9	2:42:00	1455	14.2	29.0	24.0		Yes
1/10	3:00:00	1539	14.9	29.0	25.0		Yes
2/1	3:18:00	111	13.6	30.0	25.0		Yes
2/2	3:36:00	195	13.5	30.0	25.0		Yes
2/3	3:54:00	292	14.1	31.0	25.0		Yes
2/4	4:12:00	413	14.3	31.0	25.0		Yes
2/5	4:30:00	584	14.6	31.0	25.0		Yes
2/6	4:48:00	1066	14.4	31.0	25.0		Yes
2/7	5:06:00	1238	14.0	31.0	25.0		Yes
2/8	5:24:00	1358	14.8	31.0	25.0		Yes
2/9	5:42:00	1455	15.1	31.0	25.0		Yes
2/10	6:00:00	1539	14.2	31.0	25.0		Yes
Averages				29.2	24.4	no result	

Meter Finish: 5317.1044 Time Finish: 15:59
Total Condensate collected: 35 ml Silica gel No(s) used: Z11

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 28-Sep-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 :	16:10	Barometric Pressure :		1010	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	0.158	69.0	342.2	14.8
1/2	165	0.172	70.0	343.2	15.5
1/3	262	0.179	70.0	343.2	15.8
1/4	383	0.151	70.0	343.2	14.5
1/5	554	0.159	70.0	343.2	14.9
1/6	1036	0.181	71.0	344.2	15.9
1/7	1208	0.203	71.0	344.2	16.8
1/8	1328	0.205	70.0	343.2	16.9
1/9	1425	0.163	70.0	343.2	15.0
1/10	1509	0.147	70.0	343.2	14.3
2/1	81	0.177	69.0	342.2	15.6
2/2	165	0.197	69.0	342.2	16.5
2/3	262	0.217	69.0	342.2	17.3
2/4	383	0.196	70.0	343.2	16.5
2/5	554	0.185	70.0	343.2	16.1
2/6	1036	0.181	70.0	343.2	15.8
2/7	1208	0.166	70.0	343.2	15.2
2/8	1328	0.169	70.0	343.2	15.3
2/9	1425	0.147	71.0	344.2	14.3
2/10	1509	0.140	71.0	344.2	14.0
Average			70.0	343.2	15.6

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -9.5 mm
Absolute pressure in stack (hPa) : 1009.07 hPa

Stack Analysis - Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results

Date: 28-Sep-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	45000	45	0.045	10	0.01	270	0.27
2 - Methylnapthalene	7000	7	0.007	1.6	0.0016	41	0.041
Acenaphthylene	7100	7.1	0.0071	1.6	0.0016	42	0.042
Acenaphthene	470	0.47	0.00047	0.11	0.00011	2.8	0.0028
Fluorene	1600	1.6	0.0016	0.37	0.00037	9.4	0.0094
Phenanthrene	2000	2	0.002	0.46	0.00046	12	0.012
Anthracene	120	0.12	0.00012	0.028	0.000028	0.71	0.00071
Fluoranthene	550	0.55	0.00055	0.13	0.00013	3.2	0.0032
Pyrene	440	0.44	0.00044	0.1	0.0001	2.6	0.0026
Benz(a)anthracene	62	0.062	0.000062	0.014	0.000014	0.37	0.00037
Chrysene	85	0.085	0.000085	0.02	0.00002	0.5	0.0005
Benzo(b)fluoranthene	100	0.1	0.0001	0.023	0.000023	0.59	0.00059
Benzo(k)fluoranthene	46	0.046	0.000046	0.011	0.000011	0.27	0.00027
Benzo(e)pyrene	48	0.048	0.000048	0.011	0.000011	0.28	0.00028
Benzo(a)pyrene	39	0.039	0.000039	0.009	0.000009	0.23	0.00023
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	73	0.073	0.000073	0.017	0.000017	0.43	0.00043
Sum of reported PAH's	65000	65	0.065	15	0.015	390	0.39

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	<0.001	0.1	0.00005	<0.00023	0.000011
Total TCDF isomers	0.011				
2,3,7,8-TCDD	<0.002	1	0.001	<0.00046	0.00023
Total TCDD isomers	0.0055				
1,2,3,7,8-PeCDF	<0.001	0.05	0.000025	<0.00023	0.0000057
2,3,4,7,8-PeCDF	<0.001	0.5	0.00025	<0.00023	0.000057
Total PeCDF isomers	<0.007				
1,2,3,7,8-PeCDD	<0.002	0.5	0.0005	<0.00046	0.00011
Total PeCDD isomers	<0.01				
1,2,3,4,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
2,3,4,6,7,8-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00023	0.000011
Total HxCDF isomers	<0.006				
1,2,3,4,7,8-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
1,2,3,6,7,8-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
1,2,3,7,8,9-HxCDD	<0.002	0.1	0.0001	<0.00046	0.000023
Total HxCDD isomers	<0.007				
1,2,3,4,6,7,8-HpCDF	<0.001	0.01	0.000005	<0.00023	0.0000011
1,2,3,4,7,8,9-Hp CDF	<0.002	0.01	0.00001	<0.00046	0.0000023
Total HpCDF isomers	<0.003				
1,2,3,4,6,7,8-HpCDD	0.0028	0.01	0.000028	0.00064	0.0000064
Total HpCDD isomers	0.0071				
OCDF	<0.003	0.001	0.0000015	<0.00069	0.00000034
OCDD	0.046	0.001	0.000046	0.011	0.000011

I-TEQ$_{DF}$

Lower Bound (excluding LOD Values)	0.000074 ng
Middle Bound (including half LOD Values)	0.0024 ng
Date Tested	**28-Sep-16**

STACK ANALYSIS - FINAL CALCULATIONS

Polycyclic Aromatic Hydrocarbons

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

Date: 28-Sep-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):	4.7998	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	26.8	°C		
	300.0	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	4.3570	m^3		

(B) PAH concentration at standard conditions

Blank thimble No.:	NA		Blank weight:	g
Thimble No. used:	NA		PAH Weight	6.47E-05 g
Final PAH Weight (Mp1):	0.00006	g		
PAH Concentration (C1):		$=M_{p1}/MV_4=$	0.000015	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.015	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0012 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 1.2 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0006 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.6 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z11

V_v = 23 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 ($V_{wsg(std)}$) = 0.0307

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

B_{ws} = 1.74 %

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

= 0.988 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.93 m/s

(ii) Average of post-sampling velocities: 15.55 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.74 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 = 33.66 m^3/s (stack conditions)

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

Qstd = 25.7 m^3/s (0^oC, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00039	g/s (0^oC, dry gas, 1 atm pressure)		
	=	0.39	mg/s (0^oC, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.031	g/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	=	31	mg/s (0^oC, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.015	g/s (0^oC, dry gas, 1 atm pressure	7%	O_2)
	=	15	mg/s (0^oC, dry gas, 1 atm pressure	7%	O_2)

STACK ANALYSIS - FINAL CALCULATIONS

Dioxins and Furans Lower Bound

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

Date: 28-Sep-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): 4.7998 m^3

Average gas meter temp. ($T_{M,2}$): 26.8 °C

300.0 K

Average barometric pressure (P_{BARO}) 1010 hPa

Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure): 4.3570 m^3

(B) Lower Bound concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: µg

Lower Bound Weight 7.4E-08 µg

Final Lower Bound Weight (Mp1): 0.00000 µg

Lower Bound Concentration (C1): $=M_{p1}/MV_4=$ 1.7E-08 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.000017 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0000014 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.0014 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00000068 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.00068 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z11

V_v = 23 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 ($V_{wsg(std)}$) = 0.0307

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

B_{ws} = 1.74 %

Emission Measurement Calculations Spreadsheet

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

= 0.988 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.93 m/s

(ii) Average of post-sampling velocities: 15.55 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.74 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 = 33.66 m^3/s (stack conditions)

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

Qstd = 25.7 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.00000044	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.00044	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.000035	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	0.035	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.000017	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	0.017	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: 28-Sep-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):	4.7998	m^3	Average barometric pressure (P_{BARO})	1010 hPa
Average gas meter temp. ($T_{M,2}$):	26.8	°C		
	300.0	K	Average pressure at meter ($P_{M,2}$)	1010.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	4.3570	m^3		

(B) Middle Bound concentration at standard conditions

Blank thimble No.: NA Blank weight: µg

Thimble No. used: NA Middle Bound Weight 0.0000024 µg

Final Middle Bound Weight (Mp1): 0.00000 µg

Middle Bound Concentration (C1): $=M_{p1}/MV_4=$ 5.5E-07 µg/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 0.00055 ng/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.2 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.000044 µg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.044 ng/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.7 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000022 µg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 0.022 ng/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: Z11

V_v = 23 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 ($V_{wsg(std)}$) = 0.0307

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

B_{ws} = 1.74 %

ANZ

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

= 0.988 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 15.93 m/s

(ii) Average of post-sampling velocities: 15.55 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 15.74 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 = 33.66 m^3/s (stack conditions)

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

Qstd = 25.7 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C_{1a} x Qstd =	0.000014	µg/s (0°C, dry gas, 1 atm pressure)		
	=	0.014	ng/s (0°C, dry gas, 1 atm pressure)		
	C_{1a} x Qstd =	0.0011	µg/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	=	1.1	ng/s (0°C, dry gas, 1 atm pressure	12%	CO_2)
	C_{1a} x Qstd =	0.00057	µg/s (0°C, dry gas, 1 atm pressure	7%	O_2)
	=	0.57	ng/s (0°C, dry gas, 1 atm pressure	7%	O_2)

Emission Measurement Calculations Spreadsheet

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

Sampling Conditions:			
Stack internal diameter at test location	1650 mm		
Stack gas temperature (average)	76.5 °C		349.7 K
Stack pressure (average)	1009 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		
Polycyclic Aromatic Hydrocarbons Testing			
Test Period	9:55	-	15:59
Polycyclic Aromatic Hydrocarbons Mass	0.0647 mg		
Gas Volume Sampled	4.36 m^3		
Polycyclic Aromatic Hydrocarbons Emission*1	0.015 mg/m^3		
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	0.39 mg/s		
Regulatory Limit	NA mg/m^3		
Dioxins and Furans Lower Bound Testing			
Test Period	9:55	-	15:59
Dioxins and Furans Lower Bound Mass	0.000074 ng		
Gas Volume Sampled	4.36 m^3		
Dioxins and Furans Lower Bound Emission*1	0.000017 ng/m^3		
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.00044 ng/s		
Regulatory Limit	NA ng/m^3		
Dioxins and Furans Middle Bound Testing			
Test Period	9:55	-	15:59
Dioxins and Furans Middle Bound Mass	0.0024 ng		
Gas Volume Sampled	4.36 m^3		
Dioxins and Furans Middle Bound Emission*1	0.00055 ng/m^3		
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.014 ng/s		
Regulatory Limit	NA ng/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.

STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

AECOM

Client:	Weston Aluminium	
Project Number:	60489919	
Stack Description:	Stack 1	
Date:	28-Sep-16	
Rotameter Correction Factor:	1.01	
Time Start:	11:35	
Time Finish:	12:05	
Sample Flow Rate:	0.2	L/min
Sample Time:	30	min
Sampled Volume:	6.06	litres
	0.00606	m^3
Ambient Temperature:	20	°C
Barometric Pressure:	1010	hPa
Stack Gas Moisture:	2.2	%
Corrected Volume:	0.0055	m^3 (0°C, dry gas, 1 atmosphere pressure)
Stack Flow Rate	26	m^3/s (0°C, dry gas, 1 atmosphere pressure)

VOC AIR EMISSION TEST RESULTS

Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m^3)	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.7
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.7
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.7
Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.7
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.7
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.7
MIBK	<1.0	<1.0	<1.0	<0.18	<4.7
Toluene	<1.0	<1.0	<1.0	<0.18	<4.7
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.7
m- & p-xylene	<2.0	<0.2	<2.0	<0.36	<9.4
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.7
Styrene	<1.0	<1.0	<1.0	<0.18	<4.7
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.7
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
n-decane	<1.0	<1.0	<1.0	<0.18	<4.7
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.7
1,2-dichlorobenzne	<1.0	<1.0	<1.0	<0.18	<4.7
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.7
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.7
Total	<1		<1	<0.36	<9.4

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 (32 pages)

Appendix B Laboratory Analytical Reports (32 pages)

Steel River Testing

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

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: **60489919 / 1.9**

Report : 12197-0-P

Description : Stack Emission Samples
Received: 30-Sep-16

Date : 06-Oct-16

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

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
T455	Filter	-	0.0025
T458	Filter	-	0.0061

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

Note : Sampled by Client

Reported By: M. Campbell
Michael Campbell

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

Steel River Testing

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

STACK EMISSION - MOISTURE REPORT

Origin: AECOM - Newcastle
Project: **60489919 / 1.9**

Report : 12197-0-M

Description : Stack Emission Samples
Received: 30-Sep-16

Date : 06-Oct-16

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

Copy to: FILE

Jar ID	Moisture (g)
135	7.5
166	6.2
F28	16.8
K9	11.6
L16	9.2
Z11	23.0
Z17	13.3
Z7	11.1

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

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: M. Campbell
Michael Campbell

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

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EN1603502**	Page	: 1 of 14
Client	: **AECOM Australia Pty Ltd**	Laboratory	: Environmental Division Newcastle
Contact	: MR JAMES LANG	Contact	: Hayley Worthington
Address	: 17 WARABROOK BOULEVARDE WARABROOK NSW 2304	Address	: 5/585 Maitland Road Mayfield West NSW Australia 2304
Telephone	: +61 02 4911 4900	Telephone	: +612 4014 2500
Project	: 60489919 Task 1.9	Date Samples Received	: 30-Sep-2016 14:12
Order number	: 60489919 Task 1.9	Date Analysis Commenced	: 06-Oct-2016
C-O-C number	: ----	Issue Date	: 13-Oct-2016 20:00
Sampler	: JL CC		
Site	: ----		
Quote number	: ----		
No. of samples received	: 17		
No. of samples analysed	: 17		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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

Signatories

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

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

General Comments

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

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

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED009X : LOR was raised for Fluoride, Bromide and Chloride due to sample matrix.
- Filters were supplied by the client. Filter preparation may not meet ALS method requirements.
- EK026SF: LOR raised for Total Cyanide on sample 14 due to sample matrix.
- EP091: ALS quality procedures (QWI-EN/38) permit, for organic trace analysis, that the recoveries of 20% of target compounds may lie outside of established control limits as long as these remain within acceptable ranges defined within referenced USEPA methods.
- EP091: The LOR values for EP091 have been raised due to increased charcoal sample size (350/350/350 mg) over the standard charcoal sample size (100/50mg) requiring greater extraction volume of solvent.
- EK026-I: Cyanide was analysed as a preserved water sample by ALS Environmental, Sydney under NATA accreditation no. 825, site no 10911

Analytical Results

Sub-Matrix: **EMISSION** (Matrix: **AIR**)			Client sample ID	ST1_SOX(IPA)	ST1_SOX(H2O2)	ST1_SOX(IPA) Blank	ST1_SOX(H2O2) Blank	ST1_HCL(H2SO4)
			Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]
Compound	CAS Number	LOR	Unit	EN1603502-001	EN1603502-002	EN1603502-003	EN1603502-004	EN1603502-005
				Result	Result	Result	Result	Result
EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)								
Volume - Impinger	----	1	mL	**229**	----	**227**	----	----
Sulfuric Acid as SO3	----	2	mg/sample	<2	----	<2	----	----
Volume - Impinger	----	1	mL	----	**300**	----	**263**	----
Sulfur Dioxide as SO3	----	10	mg/sample	----	<10	----	<10	----
EA144C: Gaseous and Particulate Fluorides								
Fluoride (as HF)	----	0.01	mg/sample	----	----	----	----	----
Volume - Impinger	----	1	mL	----	----	----	----	----
EA147: Acid Gases								
Hydrogen Bromide	----	0.01	mg	----	----	----	----	<1.00
Hydrogen Chloride	7647-01-0	0.1	mg	----	----	----	----	<10.0
Hydrogen Fluoride	73602-61-6	0.01	mg	----	----	----	----	<1.00
EA147: Halogens								
Bromine	7726-95-6	0.01	mg	----	----	----	----	----
Chlorine	7782-50-5	0.1	mg	----	----	----	----	----
Fluorine	7782-41-4	0.01	mg	----	----	----	----	----
EK026-I: Cyanide in Air Impinger Solutions								
ø Cyanide	57-12-5	0.01	mg	----	----	----	----	----
ø Volume - Impinger	----	1	mL	----	----	----	----	----
Sampling Method								
ø Volume - Impinger	----	0.01	mL	----	----	----	----	**382**

Analytical Results

Sub-Matrix: **EMISSION** (Matrix: **AIR**)				Client sample ID	ST1_HCL(H2SO4) Blank	ST1_CL2(NaOH)	ST1_CL2(NaOH) Blank	ST1_GASEOUS FLUORIDE	ST1_GASEOUS FLUORIDE Blank
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]
Compound	CAS Number	LOR	Unit		EN1603502-006	EN1603502-007	EN1603502-008	EN1603502-009	EN1603502-010
					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		----	----	----	0.12	<0.01
Volume - Impinger	----	1	mL		----	----	----	230	250
EA147: Acid Gases									
Hydrogen Bromide	----	0.01	mg		<1.00	----	----	----	----
Hydrogen Chloride	7647-01-0	0.1	mg		<10.0	----	----	----	----
Hydrogen Fluoride	73602-61-6	0.01	mg		<1.00	----	----	----	----
EA147: Halogens									
Bromine	7726-95-6	0.01	mg		----	<0.500	<0.500	----	----
Chlorine	7782-50-5	0.1	mg		----	<5.00	<5.00	----	----
Fluorine	7782-41-4	0.01	mg		----	<0.500	<0.500	----	----
EK026-I: Cyanide in Air Impinger Solutions									
ø Cyanide	57-12-5	0.01	mg		----	----	----	----	----
ø Volume - Impinger	----	1	mL		----	----	----	----	----
Sampling Method									
ø Volume - Impinger	----	0.01	mL		454	336	373	----	----

Analytical Results

Sub-Matrix: EMISSION (Matrix: AIR)				Client sample ID	ST1_CN A	ST1_CN B	CN Blank	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	----	----
Compound	CAS Number	LOR	Unit		EN1603502-013	EN1603502-014	EN1603502-015	--------	--------
					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		----	----	----	----	----
Volume - Impinger	----	1	mL		----	----	----	----	----
EA147: Acid Gases									
Hydrogen Bromide	----	0.01	mg		----	----	----	----	----
Hydrogen Chloride	7647-01-0	0.1	mg		----	----	----	----	----
Hydrogen Fluoride	73602-61-6	0.01	mg		----	----	----	----	----
EA147: Halogens									
Bromine	7726-95-6	0.01	mg		----	----	----	----	----
Chlorine	7782-50-5	0.1	mg		----	----	----	----	----
Fluorine	7782-41-4	0.01	mg		----	----	----	----	----
EK026-I: Cyanide in Air Impinger Solutions									
ø Cyanide	57-12-5	0.01	mg		0.40	<0.05	<0.01	----	----
ø Volume - Impinger	----	1	mL		356	182	392	----	----
Sampling Method									
ø Volume - Impinger	----	0.01	mL		----	----	----	----	----

Analytical Results

Sub-Matrix: **FILTER** (Matrix: **AIR**)			Client sample ID	**ST1_PARTICULATE FLUORIDE**	**ST1_PARTICULATE FLUORIDE Blank**	----	----	----
			Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EN1603502-011**	**EN1603502-012**	--------	--------	--------
				Result	Result	----	----	----
EA144C: Gaseous and Particulate Fluorides								
Fluoride (Particulate) as HF	----	1	µg/filter	**142**	**7**	----	----	----

Analytical Results

Sub-Matrix: SORBENT TUBE (Matrix: AIR)				Client sample ID	ST1_VOC	VOC Blank	----	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1603502-016	EN1603502-017	--------	--------	--------
					Result	Result	----	----	----
EP091A: Aliphatic Hydrocarbons - Total									
1-heptene	592-76-7	0.5	µg/sample		<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg/sample		<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg/sample		<1.0	<1.0	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons - Total									
Benzene	71-43-2	0.5	µg/sample		<1.0	<1.0	----	----	----
Toluene	108-88-3	0.5	µg/sample		<1.0	<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	ST1_VOC	VOC Blank	----	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1603502-016	EN1603502-017	--------	--------	--------
					Result	Result	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)									
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	----	----	----
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	ST1_VOC	VOC Blank	----	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1603502-016	EN1603502-017	--------	--------	--------
					Result	Result	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued									
meta- & para-Xylene	108-38-3 106-42-3	1	µg		<2	<2	----	----	----
Styrene	100-42-5	0.5	µg		<1.0	<1.0	----	----	----
ortho-Xylene	95-47-6	0.5	µg		<1.0	<1.0	----	----	----
1.3.5-Trimethylbenzene	108-67-8	0.5	µg		<1.0	<1.0	----	----	----
1.2.4-Trimethylbenzene	95-63-6	0.5	µg		<1.0	<1.0	----	----	----
n-Butylbenzene	104-51-8	0.5	µg		<1.0	<1.0	----	----	----
Isopropylbenzene	98-82-8	0.5	µg		<1.0	<1.0	----	----	----
EP091C: Oxygenated Compounds (Section 2)									
2-Propanone (Acetone)	67-64-1	0.5	µg		<1.0	<1.0	----	----	----
2-Butanone (MEK)	78-93-3	0.5	µg		<1.0	<1.0	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	µg		<1.0	<1.0	----	----	----
2-Hexanone (MBK)	591-78-6	0.5	µg		<1.0	<1.0	----	----	----
EP091D: Halogenated Compounds (Section 2)									
1.1-Dichloroethane	75-34-3	0.5	µg		<1.0	<1.0	----	----	----
Chloroform	67-66-3	0.5	µg		<1.0	<1.0	----	----	----
Trichloroethene	79-01-6	0.5	µg		<1.0	<1.0	----	----	----
Chlorobenzene	108-90-7	0.5	µg		<1.0	<1.0	----	----	----
2-Chlorotoluene	95-49-8	0.5	µg		<1.0	<1.0	----	----	----
4-Chlorotoluene	106-43-4	0.5	µg		<1.0	<1.0	----	----	----
1.3-Dichlorobenzene	541-73-1	0.5	µg		<1.0	<1.0	----	----	----
1.4-Dichlorobenzene	106-46-7	0.5	µg		<1.0	<1.0	----	----	----
1.2-Dichlorobenzene	95-50-1	0.5	µg		<1.0	<1.0	----	----	----
Hexachlorobutadiene	87-68-3	0.5	µg		<1.0	<1.0	----	----	----
EP091A: Aliphatic Hydrocarbons (Section 3)									
1-heptene	592-76-7	0.5	µg		<1.0	<1.0	----	----	----
Heptane	142-82-5	0.5	µg		<1.0	<1.0	----	----	----
Decane	124-18-5	0.5	µg		<1.0	<1.0	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)									
Benzene	71-43-2	0.5	µg		<1.0	<1.0	----	----	----
Toluene	108-88-3	0.5	µg		<1.0	<1.0	----	----	----
Ethylbenzene	100-41-4	0.5	µg		<1.0	<1.0	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	1	µg		<2	<2	----	----	----
Styrene	100-42-5	0.5	µg		<1.0	<1.0	----	----	----
ortho-Xylene	95-47-6	0.5	µg		<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: SORBENT TUBE (Matrix: AIR)				Client sample ID	ST1_VOC	VOC Blank	----	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1603502-016	EN1603502-017	--------	--------	--------
					Result	Result	----	----	----
EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued									
1.3.5-Trimethylbenzene	108-67-8	0.5	µg		<1.0	<1.0	----	----	----
1.2.4-Trimethylbenzene	95-63-6	0.5	µg		<1.0	<1.0	----	----	----
n-Butylbenzene	104-51-8	0.5	µg		<1.0	<1.0	----	----	----
Isopropylbenzene	98-82-8	0.5	µg		<1.0	<1.0	----	----	----
EP091C: Oxygenated Compounds (Section 3)									
2-Propanone (Acetone)	67-64-1	0.5	µg		<1.0	<1.0	----	----	----
2-Butanone (MEK)	78-93-3	0.5	µg		<1.0	<1.0	----	----	----
4-Methyl-2-pentanone (MIBK)	108-10-1	0.5	µg		<1.0	<1.0	----	----	----
2-Hexanone (MBK)	591-78-6	0.5	µg		<1.0	<1.0	----	----	----
EP091D: Halogenated Compounds (Section 3)									
1.1-Dichloroethane	75-34-3	0.5	µg		<1.0	<1.0	----	----	----
Chloroform	67-66-3	0.5	µg		<1.0	<1.0	----	----	----
Trichloroethene	79-01-6	0.5	µg		<1.0	<1.0	----	----	----
Chlorobenzene	108-90-7	0.5	µg		<1.0	<1.0	----	----	----
2-Chlorotoluene	95-49-8	0.5	µg		<1.0	<1.0	----	----	----
4-Chlorotoluene	106-43-4	0.5	µg		<1.0	<1.0	----	----	----
1.3-Dichlorobenzene	541-73-1	0.5	µg		<1.0	<1.0	----	----	----
1.4-Dichlorobenzene	106-46-7	0.5	µg		<1.0	<1.0	----	----	----
1.2-Dichlorobenzene	95-50-1	0.5	µg		<1.0	<1.0	----	----	----
Hexachlorobutadiene	87-68-3	0.5	µg		<1.0	<1.0	----	----	----
EP091: Chlorinated Organic Surrogates (Section 1)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		89.3	110	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		62.5	77.6	----	----	----
EP091: Chlorinated Organic Surrogates (Section 2)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		98.5	109	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		64.9	84.7	----	----	----
EP091: Chlorinated Organic Surrogates (Section 3)									
1.2-Dichloroethane-D4	17060-07-0	0.5	%		106	107	----	----	----
4-Bromofluorobenzene	460-00-4	0.5	%		84.4	86.8	----	----	----
EP091: MAH Surrogates (Section 1)									
Toluene-D8	2037-26-5	0.5	%		83.1	105	----	----	----
EP091: MAH Surrogates (Section 2)									
Toluene-D8	2037-26-5	0.5	%		87.9	107	----	----	----
EP091: MAH Surrogates (Section 3)									

Analytical Results

Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**)				Client sample ID	ST1_VOC	VOC Blank	----	----	----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	CAS Number	LOR	Unit		EN1603502-016	EN1603502-017	--------	--------	--------
					Result	Result	----	----	----
EP091: MAH Surrogates (Section 3) - Continued									
Toluene-D8	2037-26-5	0.5	%		**108**	**115**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	ST1_HCL(H2SO4)	ST1_HCL(H2SO4) Blank	ST1_CL2(NaOH)	ST1_CL2(NaOH) Blank	ST1_CN A
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]	[29-Sep-2016]
Compound	CAS Number	LOR	Unit		EN1603502-005	EN1603502-006	EN1603502-007	EN1603502-008	EN1603502-013
					Result	Result	Result	Result	Result
ED009: Anions									
Bromide	24959-67-9	0.01	mg/L		<1.00	<1.00	<0.500	<0.500	----
Chloride	16887-00-6	0.1	mg/L		<10.0	<10.0	<5.00	<5.00	----
Fluoride	16984-48-8	0.01	mg/L		<1.00	<1.00	<0.500	<0.500	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		----	----	----	----	**1.13**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	ST1_CN B	CN Blank	-----	-----	-----
				Client sampling date / time	[29-Sep-2016]	[29-Sep-2016]	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EN1603502-014**	**EN1603502-015**	--------	--------	--------
					Result	Result	----	----	----
ED009: Anions									
Bromide	24959-67-9	0.01	mg/L		----	----	----	----	----
Chloride	16887-00-6	0.1	mg/L		----	----	----	----	----
Fluoride	16984-48-8	0.01	mg/L		----	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.020	<0.004	----	----	----

Surrogate Control Limits

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

A.B.N. 44 000 964 278
10 / 585 Blackburn Road
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Chartered Chemists

14-Oct-2016

REPORT NUMBER: M161982
Site/Client Ref: 60489919/1.9
Order No: 60489919/1.9

AECOM
17 Warabrook Bvde
Warabrook

NSW 2304
Attention: James Lang

CERTIFICATE OF ANALYSIS

SAMPLES:	Twelve samples were received for analysis
DATE RECEIVED:	**6-Oct-2016**
DATE COMMENCED:	**6-Oct-2016**
METHODS:	See Attached Results
RESULTS:	Please refer to attached pages for results.

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

REPORTED BY:

Ming

Ming Dai
Senior Chemist

NATA 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: 11/10/2016

	Leeder ID	2016025098	2016025099	2016025100
	Client ID	ST1_Metals 1	Metals 12 Blank	Method
Analyte Name	**Sampled Date**	29/09/2016	29/09/2016	
	PQL			Blank
Sb	0.2	nd	nd	nd
As	0.2	nd	0.5	nd
Be	0.2	nd	nd	nd
Cd	0.2	nd	0.6	nd
Cr	0.2	1.9	2.2	nd
Co	0.2	nd	nd	nd
Cu	0.2	1.1	1.9	nd
Pb	0.2	nd	1.1	nd
Mg	2	nd	180	nd
Mn	0.2	0.2	1.7	nd
Hg	0.2	nd	nd	nd
Ni	0.2	0.9	1.7	nd
Se	0.2	nd	nd	nd
Tl	0.2	nd	nd	nd
Sn	0.2	nd	0.2	nd
V	0.2	nd	0.4	nd
Zn	0.2	0.9	3100	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: 11/10/2016

	Leeder ID	2016025101	2016025102	2016025103
	Client ID	ST1_Metals 3	ST1_Metals 4	Metals 8A Blank
Analyte Name	**Sampled Date**	29/09/2016	29/09/2016	29/09/2016
	PQL			
Sb	0.1	nd	nd	nd
As	0.1	nd	0.1	nd
Be	0.1	nd	nd	nd
Cd	0.1	nd	nd	nd
Cr	0.1	nd	11	nd
Co	0.1	nd	nd	nd
Cu	0.1	nd	1.5	nd
Pb	0.1	0.1	1.9	nd
Mg	0.1	0.8	0.4	nd
Mn	0.1	nd	7.6	nd
Hg	0.1	nd	nd	nd
Ni	0.1	0.1	2.2	nd
Se	0.1	nd	0.7	nd
Tl	0.1	nd	nd	nd
Sn	0.1	nd	nd	nd
V	0.1	nd	nd	nd
Zn	0.1	0.5	1.1	nd
Sample Volume (mL)		100	310	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: 11/10/2016

	Leeder ID	2016025104	2016025105	2016025106	2016025107	2016025108	2016025109
	Client ID	Metals 9 Blank	ST1_Metals 5A	ST1_Metals 5C	Metals 8B Blank	Metals 11 Blank	Method
Analyte Name	**Sampled Date**	29/09/2016	29/09/2016	29/09/2016	29/09/2016	29/09/2016	29/09/2016
	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	nd					nd
Pb	0.1	nd					nd
Mg	0.1	nd					nd
Mn	0.1	nd					nd
Hg	0.1	nd	nd	nd	nd	nd	nd
Ni	0.1	nd					nd
Se	0.1	nd					nd
Tl	0.1	nd					nd
Sn	0.1	nd					nd
V	0.1	nd					nd
Zn	0.1	nd					nd
Sample Volume (mL)		99	98	250	100	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: 11/10/2016

	Leeder ID	2016025110	2016025111	2016025112
	Client ID	ST1_Metals 5B	Metals 10 Blank	Matrix
Analyte Name	**Sampled Date**		29/09/2016	29/09/2016
	PQL			Blank
Hg	0.5	nd	nd	nd
Sample Volume (mL)		400	110	

QA/QC RESULTS

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

Test Started: 11/10/2016

	Leeder ID	2016025113	2016025114
	Client ID	Matrix	Matrix
Analyte Name	**Sampled Date**		
	PQL	Spike	Spike Dup
Sb		103	104
As		101	101
Be		105	107
Cd		99	100
Cr		97	99
Co		96	98
Cu		97	98
Pb		87	90
Mg		94	103
Mn		98	98
Hg		106	111
Ni		96	98
Se		92	96
Tl		86	89
Sn		104	105
V		117	119
Zn		95	91

QA/QC RESULTS

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

Test Started: 11/10/2016

	Leeder ID	2016025115	2016025116
	Client ID	Matrix	Matrix
Analyte Name	**Sampled Date**		
	PQL	Spike	Spike Dup
Sb		102	103
As		98	102
Be		101	92
Cd		99	99
Cr		98	100
Co		97	99
Cu		99	100
Pb		94	97
Mg		110	110
Mn		98	100
Hg		115	119
Ni		97	99
Se		91	94
Tl		93	96
Sn		96	100
V		101	104
Zn		98	98

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

Test Started: 11/10/2016

	Leeder ID	2016025117	2016025118
	Client ID	Matrix	Matrix
Analyte Name	**Sampled Date**		
	PQL	Spike	Spike Dup
Hg		120	118

QUALIFIERS / NOTES FOR REPORTED RESULTS

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

APPENDIX ONE.

CHAIN OF CUSTODY DOCUMENT

Chain of Custody Record - SGS Leeder Consulting

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

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

Sheet 1 of 1

CLIENT NAME: AECOM
CLIENT ADDRESS: 17 Warabrook Blvd
Warabrook NSW 2304
CONTACT: James Lang
SAMPLED BY: JL CC
PROJECT REF. / ORDER No: 60489919/1.9

CONTACT PHONE No: 02 4911 4900
CONTACT FAX No: 02 4911 4999
RESULTS REQUIRED BY: JAMES LANG
EMAIL REPORT TO: ntlair.labs@aecom.com+james.lang@aecom.com
LAB QUOTE NUMBER:

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

Client Sample ID	Date Sampled	Matrix			Containers/Preservation (please tick) (G=glass, P=plastic)										Analyses Required (Analyte + Method Code)	
		Filter	Impinger	KMnO4	0.1-1L Jar(G) n.a.	0.1-1.0 litre(G) Nat.	0.1-1.0 litre(P) Nat.	40ml Vial(G) Nat.	40ml Vial(G) H2SO4	0.1-1L (P) H2SO4	125mL (P) HCl acid washed	125mL (P) Zn Ace. NaOH	125mL (P) Filtered Yes/No HNO3	125mL (P) NaOH	Metals -USEPA Method 29*	Mercury
ST1_Metals 1	29/09/16	X			X										X	
ST1_Metals 3	29/09/16		X				X								X	
ST1_Metals 4	29/09/16		X				X								X	
ST1_Metals 5A	29/09/16		X				X									X
ST1_Metals 5B	29/09/16			X		X										X
ST1_Metals 5C	29/09/16		X				X									X
Metals 8A Blank	29/09/16		X				X								X	
Metals 8B Blank	29/09/16		X				X									X
Metals 9 Blank	29/09/16		X				X								X	
Metals 10 Blank	29/09/16			X		X										X
Metals 11 Blank	29/09/16		X				X									X
Metals 12 Blank	29/09/16	X			X										X	
----------	**Totals:**	2	8	2	2	2	8								6	6

CHAIN OF CUSTODY RECORD

	(Name)	(Signature)	(Date / Time)
RELEASED BY:	Vila. Velemete		4/10/16
RECEIVED BY:	Benedict Robinson		4/10/16 9:50 am

Custody Seals Intact? (Yes) / No

Samples Received Chilled? Yes (No)

Please Note: Dissolved metals require filtering in the field.
Please indicate whether the HNO3 acidified sample has been filtered.

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

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

Australian Government
National Measurement Institute

CERTIFICATE OF ANALYSIS # DAU16_225

Client	AECOM 17 Warabrook Boulevarde Warabrook NSW 2304	**Job No.**	AECO01/161007
		Sampled by	Client
		Date Sampled	Not specified
Contact	James Lang	**Date Received**	7-Oct-16

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

Method AUTL_02 **Date Reported** 3-Nov-16

Details

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

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

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

Authorisation

Nino Piro
Senior Chemist
Dioxin Analysis Unit

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. AECO01/161007

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/027857X	Stack 1	Emission	Resin DAU280916C, Filter, Solvent Rinse

Project Details

Project Name	*Not specified*
Project Number	*PO No. 60489919 1.9*

Key

Analytes

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

Units & Abbreviations

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

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

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

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

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

Surrogate Recovery	percentage recovery for $^{13}C_{12}$ labelled surrogate standard
⚐	Laboratory surrogate recovery outside normal acceptance criteria: **40-130%** for Tetra/Penta/Hexa congeners - **25-130%** for Hepta/Octa congeners
⚑	Field surrogate recovery outside normal acceptance criteria (**70-130%**)

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

USEPA US Environmental Protection Agency

Results : Job No. AECO01/161007

Laboratory Reg. No. N16/027857X **Date Extracted** 24-Oct-16

Client Sample Ref. Stack 1 **DB5 Analysis** 28-Oct-16
Matrix Emission
Description Resin DAU280916C, Filter, Solvent Rinse

PCDD/F Congeners	Level pg	I-TEF	I-TEQ middle bound contribution	Labelled Surrogate recovery
2,3,7,8-TCDF	<1	0.1	0.05	69
2,3,7,8-TCDD	<2	1	1	60
1,2,3,7,8-PeCDF	<1	0.05	0.025	66
2,3,4,7,8-PeCDF	<1	0.5	0.25	**118**
1,2,3,7,8-PeCDD	<2	0.5	0.5	66
1,2,3,4,7,8-HxCDF	<1	0.1	0.05	**109**
1,2,3,6,7,8-HxCDF	<1	0.1	0.05	89
2,3,4,6,7,8-HxCDF	<1	0.1	0.05	
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	
1,2,3,4,7,8-HxCDD	<2	0.1	0.1	**108**
1,2,3,6,7,8-HxCDD	<2	0.1	0.1	82
1,2,3,7,8,9-HxCDD	<2	0.1	0.1	
1,2,3,4,6,7,8-HpCDF	<1	0.01	0.005	66
1,2,3,4,7,8,9-HpCDF	<2	0.01	0.01	**91**
1,2,3,4,6,7,8-HpCDD	2.8	0.01	0.028	61
OCDF	<3	0.001	0.0015	
OCDD	46	0.001	0.046	46

PCDD/F Homologue Groups	Level pg
Total TCDF isomers	11
Total TCDD isomers	5.5
Total PeCDF isomers	<7
Total PeCDD isomers	<10
Total HxCDF isomers	<6
Total HxCDD isomers	<7
Total HpCDF isomers	<3
Total HpCDD isomers	7.1

Summary Results

Sum of PCDD and PCDF congeners

Excluding LOD values	70	pg

I-TEQ

Lower Bound [excluding LOD values]	**0.074**	pg
Middle Bound [including half LOD values]	**2.4**	pg
Upper Bound [including LOD values]	**4.8**	pg

Australian Government
National Measurement Institute

ANALYSIS REPORT # ORG16_060

Client	AECOM Australia pty Ltd 17 Warabrook Boulevarde Warabrook NSW 2304	**Job No.**	AECO01/161007
		Sampled by	Client
		Date Sampled	Not specified
Contact	James Lang	**Date Received**	7-Oct-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
October 31, 2016

Accreditation NATA Accreditation Number : 198

Accredited for compliance with ISO/IEC 17025.

This report shall not be reproduced, except in full.

Sample Details : Job No. AECO01/161007

Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N16/027857	DAU0280916C	Emission	Cartridge+Filter+Solvent Rinses

Project Details

Project Name	*Not specified*
Project Number	*Not specified*

Key

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

Abbreviations & Definitions

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

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

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

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

CARB	California Air Resources Board
OEHHA	Office of Environmental Health Hazard Assessment (US)
Surrogate Standard	Known amount of deuterated standard added to the XAD resin prior to sampling. Surrogates are 'field spikes'. The surrogate recovery indicates how effectively the sample train retains PAHs collected on the resin. It is also a guide to matrix effects caused by time of storage and transportation.
Internal Standard	Known amount of deuterated PAHs added to field samples, blanks and QC samples prior to laboratory analysis. The internal standard is used to measure the concentration of native PAHs and surrogates. The internal standard recovery will determine the performance of the laboratory method. Usual recoveries are 50 to 150%. Lower recoveries can be accepted as long as the signal/noise ratio of the internal standard is >10.

Results : Job No. AECO01/161007

Laboratory Reg. No.	N16/027857	**Date Reported**	31-Oct-2016
Client Sample Ref.	DAU0280916C	**Date Extracted**	24-Oct-2016
Matrix	Emission		
Description	Cartridge+Filter+Solvent Rinses		

PAH	Conc. ng	Reporting Level (LOR, ng)	BaP-PEF Value	BaP-TEQ Contribution	Labelled Internal recovery (%)	Flags
Naphthalene	45000	240	-	-	142	
2-Methylnaphthalene	7000	30	-	-		
Acenaphthylene	7100	20	-	-	100	
Acenaphthene	470	20	-	-	132	
Fluorene	1600	20	-	-	130	
Phenanthrene	2000	20	-	-	135	
Anthracene	120	20	-	-		
Fluoranthene	550	20	-	-	81	
Pyrene	440	20	-	-		
Benz(a)anthracene	62	20	0.1	6.2	105	
Chrysene	85	20	0.01	0.9	99	
Benzo(b)fluoranthene	100	20	0.1	10	89	
Benzo(k)fluoranthene	46	20	0.1	4.6	92	
Benzo(e)pyrene	48	20	-	-		
Benzo(a)pyrene	39	20	1.0	39	92	
Perylene	<20	20	-	-		
Indeno(1,2,3-cd)pyrene	<20	20	0.1	1.0	85	
Dibenz(ah)anthracene	<20	20	0.4	4.0	84	
Benzo(ghi)perylene	73	20	-	-	76	

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

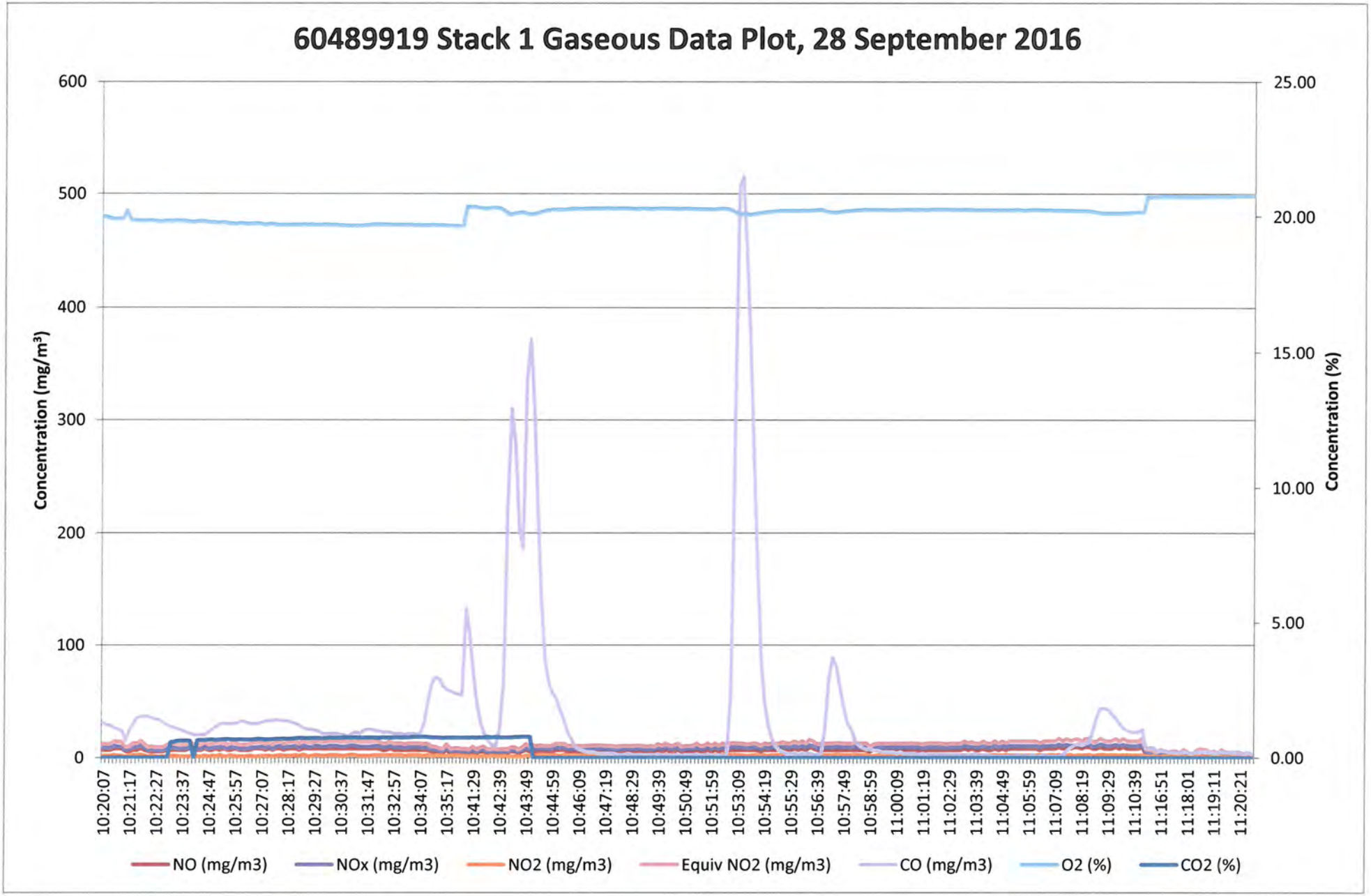
Surrogate Recovery	%
d14-Terphenyl	52

Summary Results		
BaP -TEQ$_{PAH}$		
Lower Bound [excluding LOD values]	**61**	ng
Middle Bound [including half LOD values]	**66**	ng
Upper Bound [including LOD values]	**71**	ng

Appendix C

Raw & Calculated Gas Data (5 pages)

Appendix C Raw & Calculated Gas Data (5 pages)


60489919 Stack 1 Gaseous Data Plot, 28 September 2016
Concentration (mg/m³)
Concentration (%)
600
500
400
300
200
100
0
25.00
20.00
15.00
10.00
5.00
0.00
10:20:07
10:21:17
10:22:27
10:23:37
10:24:47
10:25:57
10:27:07
10:28:17
10:29:27
10:30:37
10:31:47
10:32:57
10:34:07
10:35:17
10:41:29
10:42:39
10:43:49
10:44:59
10:46:09
10:47:19
10:48:29
10:49:39
10:50:49
10:51:59
10:53:09
10:54:19
10:55:29
10:56:39
10:57:49
10:58:59
11:00:09
11:01:19
11:02:29
11:03:39
11:04:49
11:05:59
11:07:09
11:08:19
11:09:29
11:10:39
11:16:51
11:18:01
11:19:11
11:20:21
NO (mg/m3)
NOx (mg/m3)
NO2 (mg/m3)
Equiv NO2 (mg/m3)
CO (mg/m3)
O2 (%)
CO2 (%)

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
29-Sep-16	10:20:07	5	7	6	8	0.8	2	8	12	25	31	0.0	19.99
29-Sep-16	10:20:17	5	7	6	8	0.8	2	8	12	23	29	0.0	19.95
29-Sep-16	10:20:27	5	7	6	8	0.8	2	8	12	23	29	0.0	19.91
29-Sep-16	10:20:37	6	8	7	10	1.1	2	10	15	21	26	0.0	19.90
29-Sep-16	10:20:47	6	8	7	10	0.8	2	10	14	20	25	0.0	19.90
29-Sep-16	10:20:57	6	8	7	10	0.8	2	10	14	19	24	0.0	19.91
29-Sep-16	10:21:07	4	5	5	6	0.5	1	7	9	12	15	0.0	20.19
29-Sep-16	10:21:17	4	5	5	7	0.8	2	7	10	19	24	0.0	19.86
29-Sep-16	10:21:27	5	7	6	9	1.1	2	9	13	24	30	0.0	19.85
29-Sep-16	10:21:37	5	7	6	9	1.1	2	9	13	28	35	0.0	19.85
29-Sep-16	10:21:47	6	8	7	11	1.3	3	11	15	29	36	0.0	19.83
29-Sep-16	10:21:57	5	7	6	8	0.8	2	8	12	29	36	0.0	19.84
29-Sep-16	10:22:07	4	5	5	6	0.5	1	7	9	29	36	0.0	19.85
29-Sep-16	10:22:17	4	5	5	7	0.8	2	7	10	28	35	0.0	19.83
29-Sep-16	10:22:27	4	5	5	6	0.5	1	7	9	27	34	0.0	19.82
29-Sep-16	10:22:37	4	5	5	6	0.5	1	7	9	27	34	0.0	19.80
29-Sep-16	10:22:47	4	5	5	6	0.5	1	7	9	25	31	0.0	19.82
29-Sep-16	10:22:57	5	7	6	8	0.5	1	8	11	23	29	0.0	19.83
29-Sep-16	10:23:07	5	7	6	8	0.8	2	8	12	22	28	0.6	19.82
29-Sep-16	10:23:17	5	7	6	8	0.8	2	8	12	21	26	0.6	19.84
29-Sep-16	10:23:27	5	7	6	8	0.5	1	8	11	20	25	0.6	19.83
29-Sep-16	10:23:37	5	7	6	8	0.5	1	8	11	19	24	0.6	19.83
29-Sep-16	10:23:47	5	7	6	8	0.5	1	8	11	18	23	0.6	19.81
29-Sep-16	10:23:57	6	8	6	9	0.5	1	10	13	17	21	0.6	19.79
29-Sep-16	10:24:07	5	7	6	8	0.8	2	8	12	16	20	0.0	19.80
29-Sep-16	10:24:17	5	7	6	8	0.5	1	8	11	16	20	0.6	19.81
29-Sep-16	10:24:27	5	7	6	8	0.5	1	8	11	16	20	0.7	19.82
29-Sep-16	10:24:37	6	8	6	10	0.8	2	10	14	16	20	0.7	19.80
29-Sep-16	10:24:47	5	7	6	8	0.5	1	8	11	18	23	0.7	19.78
29-Sep-16	10:24:57	5	7	6	8	0.8	2	8	12	20	25	0.7	19.78
29-Sep-16	10:25:07	6	8	6	9	0.5	1	10	13	22	28	0.7	19.76
29-Sep-16	10:25:17	5	7	6	9	1.1	2	9	13	24	30	0.7	19.77
29-Sep-16	10:25:27	6	8	6	9	0.5	1	10	13	24	30	0.7	19.77
29-Sep-16	10:25:37	5	7	6	8	0.5	1	8	11	24	30	0.7	19.74
29-Sep-16	10:25:47	5	7	6	9	1.1	2	9	13	24	30	0.7	19.73
29-Sep-16	10:25:57	6	8	6	9	0.5	1	10	13	24	30	0.7	19.72
29-Sep-16	10:26:07	5	7	6	8	0.5	1	8	11	25	31	0.7	19.75
29-Sep-16	10:26:17	5	7	6	8	0.5	1	8	11	26	33	0.7	19.73
29-Sep-16	10:26:27	5	7	6	8	0.5	1	8	11	25	31	0.7	19.72
29-Sep-16	10:26:37	5	7	6	8	0.8	2	8	12	24	30	0.7	19.73
29-Sep-16	10:26:47	6	8	6	9	0.5	1	10	13	24	30	0.7	19.74
29-Sep-16	10:26:57	6	8	6	9	0.5	1	10	13	24	30	0.7	19.73
29-Sep-16	10:27:07	6	8	6	10	0.8	2	10	14	25	31	0.7	19.70
29-Sep-16	10:27:17	5	7	6	8	0.8	2	8	12	26	33	0.7	19.70
29-Sep-16	10:27:27	6	8	6	10	0.8	2	10	14	26	33	0.7	19.72
29-Sep-16	10:27:37	5	7	5	8	0.5	1	8	11	26	33	0.7	19.70
29-Sep-16	10:27:47	6	8	6	10	0.8	2	10	14	27	34	0.7	19.68
29-Sep-16	10:27:57	6	8	7	10	1.1	2	10	15	26	33	0.7	19.69
29-Sep-16	10:28:07	5	7	6	8	0.8	2	8	12	26	33	0.7	19.69
29-Sep-16	10:28:17	6	8	6	10	0.8	2	10	14	26	33	0.7	19.68
29-Sep-16	10:28:27	6	8	6	10	0.8	2	10	14	25	31	0.7	19.69
29-Sep-16	10:28:37	6	8	7	10	1.1	2	10	15	24	30	0.7	19.69
29-Sep-16	10:28:47	5	7	6	8	0.8	2	8	12	23	29	0.7	19.69
29-Sep-16	10:28:57	6	8	7	11	1.3	3	11	15	21	26	0.7	19.70
29-Sep-16	10:29:07	6	8	7	10	0.8	2	10	14	20	25	0.7	19.69
29-Sep-16	10:29:17	6	8	6	9	0.5	1	10	13	20	25	0.7	19.70
29-Sep-16	10:29:27	6	8	7	10	1.1	2	10	15	19	24	0.7	19.68
29-Sep-16	10:29:37	6	8	7	10	1.1	2	10	15	19	24	0.7	19.69
29-Sep-16	10:29:47	6	8	7	10	0.8	2	10	14	17	21	0.7	19.69
29-Sep-16	10:29:57	6	8	7	10	0.8	2	10	14	17	21	0.7	19.70
29-Sep-16	10:30:07	6	8	7	10	1.1	2	10	15	17	21	0.7	19.68
29-Sep-16	10:30:17	6	8	7	10	1.1	2	10	15	17	21	0.7	19.69
29-Sep-16	10:30:27	6	8	7	10	1.1	2	10	15	17	21	0.7	19.67
29-Sep-16	10:30:37	6	8	7	10	0.8	2	10	14	16	20	0.7	19.67
29-Sep-16	10:30:47	6	8	6	10	0.8	2	10	14	16	20	0.8	19.66
29-Sep-16	10:30:57	6	8	7	10	1.1	2	10	15	15	19	0.7	19.66
29-Sep-16	10:31:07	6	8	7	11	1.3	3	11	15	17	21	0.7	19.66
29-Sep-16	10:31:17	6	8	7	10	1.1	2	10	15	18	23	0.8	19.65
29-Sep-16	10:31:27	6	8	7	10	0.8	2	10	14	17	21	0.7	19.66
29-Sep-16	10:31:37	6	8	7	10	0.8	2	10	14	19	24	0.7	19.67
29-Sep-16	10:31:47	6	8	6	10	0.8	2	10	14	20	25	0.7	19.68
29-Sep-16	10:31:57	6	8	6	10	0.8	2	10	14	20	25	0.7	19.70
29-Sep-16	10:32:07	6	8	7	10	1.1	2	10	15	19	24	0.7	19.71
29-Sep-16	10:32:17	6	8	7	10	1.1	2	10	15	19	24	0.7	19.70
29-Sep-16	10:32:27	5	7	6	9	1.1	2	9	13	18	23	0.8	19.70
29-Sep-16	10:32:37	5	7	6	9	1.1	2	9	13	18	23	0.7	19.70
29-Sep-16	10:32:47	6	8	7	10	1.1	2	10	15	18	23	0.7	19.69
29-Sep-16	10:32:57	5	7	7	9	1.1	2	9	13	17	21	0.7	19.69
29-Sep-16	10:33:07	5	7	7	9	1.1	2	9	13	17	21	0.8	19.69
29-Sep-16	10:33:17	5	7	6	9	1.1	2	9	13	17	21	0.7	19.69
29-Sep-16	10:33:27	5	7	6	8	0.8	2	8	12	16	20	0.8	19.68
29-Sep-16	10:33:37	5	7	6	9	1.1	2	9	13	17	21	0.8	19.70
29-Sep-16	10:33:47	5	7	6	9	1.1	2	9	13	17	21	0.8	19.67
29-Sep-16	10:33:57	5	7	7	9	1.1	2	9	13	16	20	0.8	19.68
29-Sep-16	10:34:07	5	7	7	9	1.1	2	9	13	17	21	0.8	19.67
29-Sep-16	10:34:17	5	7	6	8	0.8	2	8	12	24	30	0.8	19.67
29-Sep-16	10:34:27	5	7	6	9	1.1	2	9	13	39	49	0.8	19.67
29-Sep-16	10:34:37	4	5	5	7	0.8	2	7	10	52	65	0.8	19.68
29-Sep-16	10:34:47	4	5	4	7	0.8	2	7	10	57	71	0.8	19.67
29-Sep-16	10:34:57	3	4	5	6	1.1	2	6	8	56	70	0.7	19.68
29-Sep-16	10:35:07	3	4	4	6	0.8	2	5	8	51	64	0.7	19.67
29-Sep-16	10:35:17	5	7	6	8	0.8	2	8	12	48	60	0.7	19.66
29-Sep-16	10:35:27	3	4	4	6	0.8	2	5	8	47	59	0.7	19.66
29-Sep-16	10:35:37	3	4	5	6	1.1	2	6	8	46	58	0.7	19.65
29-Sep-16	10:35:47	3	4	5	6	1.1	2	6	8	45	56	0.7	19.64
29-Sep-16	10:35:57	3	4	4	6	0.8	2	5	8	44	55	0.7	19.65
29-Sep-16	10:41:09	3	4	4	6	0.8	2	5	8	106	133	0.7	20.35
29-Sep-16	10:41:19	3	4	4	5	0.5	1	5	7	87	109	0.7	20.33
29-Sep-16	10:41:29	4	5	5	7	0.8	2	7	10	59	74	0.8	20.35
29-Sep-16	10:41:39	3	4	4	5	0.5	1	5	7	38	48	0.7	20.32
29-Sep-16	10:41:49	4	5	5	6	0.5	1	7	9	25	31	0.8	20.29
29-Sep-16	10:41:59	4	5	5	7	0.8	2	7	10	17	21	0.8	20.28

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
29-Sep-16	10:42:09	3	4	4	5	0.5	1	5	7	12	15	0.8	20.29
29-Sep-16	10:42:19	3	4	4	6	0.8	2	5	8	9	11	0.8	20.31
29-Sep-16	10:42:29	3	4	4	6	0.8	2	5	8	8	10	0.8	20.31
29-Sep-16	10:42:39	3	4	3	5	0.5	1	5	7	20	25	0.8	20.28
29-Sep-16	10:42:49	3	4	4	6	0.8	2	5	8	53	66	0.8	20.19
29-Sep-16	10:42:59	3	4	4	5	0.5	1	5	7	184	230	0.8	20.08
29-Sep-16	10:43:09	4	5	5	6	0.5	1	7	9	248	310	0.8	20.08
29-Sep-16	10:43:19	4	5	5	6	0.5	1	7	9	222	278	0.8	20.12
29-Sep-16	10:43:29	3	4	4	5	0.5	1	5	7	163	204	0.8	20.13
29-Sep-16	10:43:39	4	5	5	6	0.5	1	7	9	149	186	0.8	20.15
29-Sep-16	10:43:49	5	7	6	8	0.8	2	8	12	269	336	0.8	20.09
29-Sep-16	10:43:59	4	5	5	7	0.8	2	7	10	298	373	0.8	20.07
29-Sep-16	10:44:09	4	5	6	8	1.3	3	7	11	249	311	0.0	20.09
29-Sep-16	10:44:19	4	5	5	8	1.1	2	7	10	174	218	0.0	20.13
29-Sep-16	10:44:29	4	5	6	8	1.3	3	7	11	109	136	0.0	20.17
29-Sep-16	10:44:39	4	5	5	8	1.1	2	7	10	69	86	0.0	20.22
29-Sep-16	10:44:49	4	5	5	8	1.1	2	7	10	53	66	0.0	20.23
29-Sep-16	10:44:59	4	5	5	8	1.1	2	7	10	46	58	0.0	20.24
29-Sep-16	10:45:09	5	7	6	9	1.1	2	9	13	42	53	0.0	20.24
29-Sep-16	10:45:19	5	7	6	8	0.8	2	8	12	34	43	0.0	20.24
29-Sep-16	10:45:29	5	7	6	9	1.1	2	9	13	27	34	0.0	20.24
29-Sep-16	10:45:39	4	5	5	8	1.1	2	7	10	18	23	0.0	20.26
29-Sep-16	10:45:49	4	5	5	8	1.1	2	7	10	13	16	0.0	20.28
29-Sep-16	10:45:59	4	5	5	8	1.1	2	7	10	8	10	0.0	20.28
29-Sep-16	10:46:09	4	5	5	8	1.1	2	7	10	6	8	0.0	20.27
29-Sep-16	10:46:19	4	5	5	8	1.1	2	7	10	5	6	0.0	20.28
29-Sep-16	10:46:29	4	5	5	8	1.1	2	7	10	4	5	0.0	20.28
29-Sep-16	10:46:39	4	5	6	8	1.3	3	7	11	4	5	0.0	20.29
29-Sep-16	10:46:49	4	5	6	8	1.3	3	7	11	4	5	0.0	20.29
29-Sep-16	10:46:59	4	5	6	8	1.3	3	7	11	3	4	0.0	20.29
29-Sep-16	10:47:09	4	5	5	8	1.3	3	7	11	3	4	0.0	20.28
29-Sep-16	10:47:19	4	5	5	8	1.1	2	7	10	3	4	0.0	20.30
29-Sep-16	10:47:29	4	5	5	8	1.1	2	7	10	3	4	0.0	20.29
29-Sep-16	10:47:39	4	5	5	8	1.1	2	7	10	3	4	0.0	20.28
29-Sep-16	10:47:49	4	5	5	7	0.8	2	7	10	2	3	0.0	20.29
29-Sep-16	10:47:59	4	5	5	8	1.1	2	7	10	2	3	0.0	20.29
29-Sep-16	10:48:09	4	5	5	8	1.1	2	7	10	2	3	0.0	20.29
29-Sep-16	10:48:19	4	5	5	8	1.1	2	7	10	3	4	0.0	20.29
29-Sep-16	10:48:29	4	5	5	8	1.1	2	7	10	2	3	0.0	20.28
29-Sep-16	10:48:39	4	5	5	8	1.1	2	7	10	2	3	0.0	20.27
29-Sep-16	10:48:49	4	5	6	8	1.3	3	7	11	2	3	0.0	20.28
29-Sep-16	10:48:59	4	5	5	8	1.1	2	7	10	2	3	0.0	20.29
29-Sep-16	10:49:09	4	5	5	7	0.8	2	7	10	2	3	0.0	20.28
29-Sep-16	10:49:19	4	5	5	8	1.1	2	7	10	2	3	0.0	20.27
29-Sep-16	10:49:29	4	5	5	7	0.8	2	7	10	2	3	0.0	20.28
29-Sep-16	10:49:39	5	7	6	8	0.8	2	8	12	2	3	0.0	20.29
29-Sep-16	10:49:49	4	5	5	8	1.1	2	7	10	2	3	0.0	20.29
29-Sep-16	10:49:59	5	7	6	9	1.1	2	9	13	1	1	0.0	20.28
29-Sep-16	10:50:09	4	5	5	8	1.1	2	7	10	2	3	0.0	20.28
29-Sep-16	10:50:19	4	5	5	8	1.3	3	7	11	1	1	0.0	20.29
29-Sep-16	10:50:29	5	7	6	9	1.1	2	9	13	2	3	0.0	20.27
29-Sep-16	10:50:39	4	5	5	7	0.8	2	7	10	1	1	0.0	20.28
29-Sep-16	10:50:49	4	5	5	8	1.1	2	7	10	2	3	0.0	20.28
29-Sep-16	10:50:59	4	5	6	8	1.1	2	7	10	2	3	0.0	20.28
29-Sep-16	10:51:09	4	5	6	8	1.1	2	7	10	2	3	0.0	20.27
29-Sep-16	10:51:19	5	7	6	9	1.1	2	9	13	2	3	0.0	20.27
29-Sep-16	10:51:29	4	5	6	8	1.1	2	7	10	2	3	0.0	20.27
29-Sep-16	10:51:39	4	5	6	8	1.1	2	7	10	2	3	0.0	20.27
29-Sep-16	10:51:49	5	7	6	9	1.1	2	9	13	2	3	0.0	20.27
29-Sep-16	10:51:59	4	5	6	8	1.1	2	7	10	2	3	0.0	20.26
29-Sep-16	10:52:09	5	7	6	9	1.1	2	9	13	1	1	0.0	20.27
29-Sep-16	10:52:19	4	5	6	8	1.1	2	7	10	2	3	0.0	20.28
29-Sep-16	10:52:29	5	7	6	9	1.1	2	9	13	1	1	0.0	20.28
29-Sep-16	10:52:39	4	5	6	8	1.3	3	7	11	2	3	0.0	20.27
29-Sep-16	10:52:49	5	7	6	9	1.1	2	9	13	43	54	0.0	20.23
29-Sep-16	10:52:59	5	7	6	9	1.3	3	9	13	237	296	0.0	20.13
29-Sep-16	10:53:09	5	7	6	9	1.1	2	9	13	405	506	0.0	20.08
29-Sep-16	10:53:19	5	7	6	9	1.1	2	9	13	412	515	0.0	20.08
29-Sep-16	10:53:29	5	7	6	8	0.8	2	8	12	359	449	0.0	20.07
29-Sep-16	10:53:39	5	7	6	8	0.8	2	8	12	297	371	0.0	20.06
29-Sep-16	10:53:49	5	7	6	9	1.1	2	9	13	217	271	0.0	20.09
29-Sep-16	10:53:59	5	7	6	9	1.1	2	9	13	140	175	0.0	20.11
29-Sep-16	10:54:09	4	5	5	8	1.1	2	7	10	72	90	0.0	20.13
29-Sep-16	10:54:19	5	7	6	9	1.1	2	9	13	40	50	0.0	20.16
29-Sep-16	10:54:29	5	7	5	8	0.8	2	8	12	23	29	0.0	20.17
29-Sep-16	10:54:39	5	7	6	9	1.1	2	9	13	13	16	0.0	20.18
29-Sep-16	10:54:49	5	7	6	9	1.1	2	9	13	8	10	0.0	20.19
29-Sep-16	10:54:59	5	7	6	9	1.1	2	9	13	5	6	0.0	20.21
29-Sep-16	10:55:09	6	8	7	10	0.8	2	10	14	4	5	0.0	20.21
29-Sep-16	10:55:19	5	7	6	9	1.1	2	9	13	3	4	0.0	20.21
29-Sep-16	10:55:29	5	7	6	9	1.1	2	9	13	3	4	0.0	20.21
29-Sep-16	10:55:39	6	8	7	10	1.1	2	10	15	3	4	0.0	20.21
29-Sep-16	10:55:49	5	7	6	9	1.1	2	9	13	2	3	0.0	20.21
29-Sep-16	10:55:59	6	8	7	10	1.1	2	10	15	3	4	0.0	20.22
29-Sep-16	10:56:09	5	7	6	9	1.1	2	9	13	3	4	0.0	20.21
29-Sep-16	10:56:19	7	9	7	11	0.8	2	12	16	3	4	0.0	20.22
29-Sep-16	10:56:29	6	8	7	10	1.1	2	10	15	2	3	0.0	20.23
29-Sep-16	10:56:39	5	7	6	8	0.8	2	8	12	2	3	0.0	20.24
29-Sep-16	10:56:49	5	7	6	9	1.1	2	9	13	3	4	0.0	20.24
29-Sep-16	10:56:59	5	7	6	9	1.1	2	9	13	20	25	0.0	20.18
29-Sep-16	10:57:09	5	7	6	9	1.1	2	9	13	56	70	0.0	20.14
29-Sep-16	10:57:19	5	7	6	9	1.1	2	9	13	71	89	0.0	20.15
29-Sep-16	10:57:29	5	7	7	9	1.3	3	9	13	64	80	0.0	20.15
29-Sep-16	10:57:39	5	7	6	9	1.3	3	9	13	49	61	0.0	20.17
29-Sep-16	10:57:49	5	7	6	9	1.1	2	9	13	35	44	0.0	20.20
29-Sep-16	10:57:59	5	7	6	9	1.1	2	9	13	24	30	0.0	20.20
29-Sep-16	10:58:09	5	7	6	9	1.1	2	9	13	20	25	0.0	20.22
29-Sep-16	10:58:19	5	7	6	9	1.3	3	9	13	12	15	0.0	20.23
29-Sep-16	10:58:29	5	7	6	9	1.1	2	9	13	9	11	0.0	20.23
29-Sep-16	10:58:39	5	7	6	9	1.1	2	9	13	7	9	0.0	20.25
29-Sep-16	10:58:49	5	7	6	9	1.3	3	9	13	6	8	0.0	20.24
29-Sep-16	10:58:59	4	5	5	7	0.8	2	7	10	6	8	0.0	20.24

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
29-Sep-16	10:59:09	5	7	5	8	0.8	2	8	12	5	6	0.0	20.24
29-Sep-16	10:59:19	5	7	6	9	1.1	2	9	13	5	6	0.0	20.24
29-Sep-16	10:59:29	5	7	6	9	1.1	2	9	13	4	5	0.0	20.24
29-Sep-16	10:59:39	5	7	6	9	1.1	2	9	13	4	5	0.0	20.24
29-Sep-16	10:59:49	5	7	6	9	1.1	2	9	13	4	5	0.0	20.23
29-Sep-16	10:59:59	5	7	6	9	1.1	2	9	13	4	5	0.0	20.24
29-Sep-16	11:00:09	5	7	6	9	1.1	2	9	13	3	4	0.0	20.24
29-Sep-16	11:00:19	5	7	6	9	1.1	2	9	13	4	5	0.0	20.25
29-Sep-16	11:00:29	5	7	6	9	1.1	2	9	13	3	4	0.0	20.25
29-Sep-16	11:00:39	5	7	6	9	1.1	2	9	13	3	4	0.0	20.25
29-Sep-16	11:00:49	5	7	6	9	1.3	3	9	13	3	4	0.0	20.25
29-Sep-16	11:00:59	5	7	6	9	1.1	2	9	13	3	4	0.0	20.25
29-Sep-16	11:01:09	5	7	6	9	1.1	2	9	13	2	3	0.0	20.25
29-Sep-16	11:01:19	5	7	6	8	0.8	2	8	12	3	4	0.0	20.24
29-Sep-16	11:01:29	5	7	6	9	1.1	2	9	13	2	3	0.0	20.24
29-Sep-16	11:01:39	5	7	6	9	1.3	3	9	13	2	3	0.0	20.26
29-Sep-16	11:01:49	5	7	6	9	1.1	2	9	13	2	3	0.0	20.26
29-Sep-16	11:01:59	5	7	7	9	1.3	3	9	13	2	3	0.0	20.26
29-Sep-16	11:02:09	5	7	6	9	1.1	2	9	13	2	3	0.0	20.26
29-Sep-16	11:02:19	5	7	6	8	0.8	2	8	12	2	3	0.0	20.26
29-Sep-16	11:02:29	5	7	6	9	1.1	2	9	13	2	3	0.0	20.25
29-Sep-16	11:02:39	5	7	6	9	1.1	2	9	13	2	3	0.0	20.25
29-Sep-16	11:02:49	5	7	6	9	1.1	2	9	13	2	3	0.0	20.24
29-Sep-16	11:02:59	5	7	6	9	1.1	2	9	13	1	1	0.0	20.25
29-Sep-16	11:03:09	6	8	7	10	1.1	2	10	15	2	3	0.0	20.25
29-Sep-16	11:03:19	5	7	7	9	1.3	3	9	13	2	3	0.0	20.25
29-Sep-16	11:03:29	6	8	7	10	0.8	2	10	14	2	3	0.0	20.24
29-Sep-16	11:03:39	5	7	6	9	1.1	2	9	13	3	4	0.0	20.23
29-Sep-16	11:03:49	5	7	6	9	1.1	2	9	13	1	1	0.0	20.24
29-Sep-16	11:03:59	6	8	7	10	1.1	2	10	15	2	3	0.0	20.24
29-Sep-16	11:04:09	5	7	7	9	1.1	2	9	13	2	3	0.0	20.24
29-Sep-16	11:04:19	5	7	7	9	1.1	2	9	13	1	1	0.0	20.23
29-Sep-16	11:04:29	6	8	7	11	1.3	3	11	15	1	1	0.0	20.23
29-Sep-16	11:04:39	5	7	7	9	1.1	2	9	13	1	1	0.0	20.24
29-Sep-16	11:04:49	6	8	7	10	1.1	2	10	15	1	1	0.0	20.23
29-Sep-16	11:04:59	5	7	7	9	1.3	3	9	13	1	1	0.0	20.24
29-Sep-16	11:05:09	6	8	7	10	1.1	2	10	15	1	1	0.0	20.23
29-Sep-16	11:05:19	6	8	7	10	1.1	2	10	15	1	1	0.0	20.25
29-Sep-16	11:05:29	6	8	7	10	1.1	2	10	15	2	3	0.0	20.24
29-Sep-16	11:05:39	6	8	7	10	1.1	2	10	15	1	1	0.0	20.23
29-Sep-16	11:05:49	6	8	7	10	1.1	2	10	15	2	3	0.0	20.23
29-Sep-16	11:05:59	6	8	7	10	1.1	2	10	15	1	1	0.0	20.24
29-Sep-16	11:06:09	6	8	7	10	1.1	2	10	15	2	3	0.0	20.24
29-Sep-16	11:06:19	6	8	7	10	1.1	2	10	15	1	1	0.0	20.24
29-Sep-16	11:06:29	5	7	7	9	1.3	3	9	13	1	1	0.0	20.24
29-Sep-16	11:06:39	6	8	7	10	1.1	2	10	15	2	3	0.0	20.23
29-Sep-16	11:06:49	6	8	7	10	1.1	2	10	15	1	1	0.0	20.24
29-Sep-16	11:06:59	6	8	7	11	1.3	3	11	15	1	1	0.0	20.23
29-Sep-16	11:07:09	6	8	7	10	1.1	2	10	15	1	1	0.0	20.23
29-Sep-16	11:07:19	7	9	8	12	1.3	3	12	17	1	1	0.0	20.23
29-Sep-16	11:07:29	6	8	7	10	1.1	2	10	15	2	3	0.0	20.22
29-Sep-16	11:07:39	7	9	8	12	1.1	2	12	17	5	6	0.0	20.22
29-Sep-16	11:07:49	6	8	7	11	1.3	3	11	15	7	9	0.0	20.22
29-Sep-16	11:07:59	7	9	8	11	0.8	2	12	16	9	11	0.0	20.21
29-Sep-16	11:08:09	7	9	8	12	1.1	2	12	17	10	13	0.0	20.21
29-Sep-16	11:08:19	6	8	7	10	1.1	2	10	15	9	11	0.0	20.20
29-Sep-16	11:08:29	7	9	8	12	1.1	2	12	17	10	13	0.0	20.21
29-Sep-16	11:08:39	7	9	8	12	1.3	3	12	17	11	14	0.0	20.19
29-Sep-16	11:08:49	6	8	7	10	0.8	2	10	14	19	24	0.0	20.16
29-Sep-16	11:08:59	6	8	7	10	1.1	2	10	15	29	36	0.0	20.14
29-Sep-16	11:09:09	7	9	8	12	1.3	3	12	17	35	44	0.0	20.12
29-Sep-16	11:09:19	6	8	8	11	1.3	3	11	15	35	44	0.0	20.12
29-Sep-16	11:09:29	6	8	7	10	1.1	2	10	15	34	43	0.0	20.12
29-Sep-16	11:09:39	6	8	7	11	1.3	3	11	15	31	39	0.0	20.12
29-Sep-16	11:09:49	7	9	8	12	1.1	2	12	17	28	35	0.0	20.12
29-Sep-16	11:09:59	6	8	7	10	1.1	2	10	15	24	30	0.0	20.12
29-Sep-16	11:10:09	7	9	8	12	1.1	2	12	17	21	26	0.0	20.13
29-Sep-16	11:10:19	6	8	8	11	1.3	3	11	15	19	24	0.0	20.13
29-Sep-16	11:10:29	6	8	7	10	1.1	2	10	15	18	23	0.0	20.14
29-Sep-16	11:10:39	6	8	7	10	1.1	2	10	15	18	23	0.0	20.15
29-Sep-16	11:10:49	6	8	7	10	1.1	2	10	15	18	23	0.0	20.15
29-Sep-16	11:10:59	7	9	8	12	1.1	2	12	17	20	25	0.0	20.15
29-Sep-16	11:16:11	3	4	4	6	0.8	2	5	8	7	9	0.0	20.71
29-Sep-16	11:16:21	3	4	3	5	0.5	1	5	7	7	9	0.0	20.72
29-Sep-16	11:16:31	2	3	3	4	0.8	2	4	6	7	9	0.0	20.71
29-Sep-16	11:16:41	2	3	2	4	0.5	1	4	5	5	6	0.0	20.72
29-Sep-16	11:16:51	3	4	3	5	0.5	1	5	7	5	6	0.0	20.73
29-Sep-16	11:17:01	2	3	3	4	0.8	2	4	6	5	6	0.0	20.73
29-Sep-16	11:17:11	2	3	3	4	0.5	1	4	5	4	5	0.0	20.73
29-Sep-16	11:17:21	2	3	3	4	0.8	2	4	6	4	5	0.0	20.73
29-Sep-16	11:17:31	2	3	3	4	0.8	2	4	6	4	5	0.0	20.73
29-Sep-16	11:17:41	1	1	2	3	0.8	2	2	4	4	5	0.0	20.72
29-Sep-16	11:17:51	3	4	3	5	0.5	1	5	7	4	5	0.0	20.72
29-Sep-16	11:18:01	2	3	3	4	0.5	1	4	5	4	5	0.0	20.72
29-Sep-16	11:18:11	1	1	2	3	0.8	2	2	4	3	4	0.0	20.72
29-Sep-16	11:18:21	2	3	3	4	0.5	1	4	5	4	5	0.0	20.72
29-Sep-16	11:18:31	3	4	3	6	0.8	2	5	8	4	5	0.0	20.72
29-Sep-16	11:18:41	3	4	3	5	0.5	1	5	7	4	5	0.0	20.72
29-Sep-16	11:18:51	3	4	3	5	0.5	1	5	7	4	5	0.0	20.74
29-Sep-16	11:19:01	2	3	3	4	0.5	1	4	5	4	5	0.0	20.73
29-Sep-16	11:19:11	2	3	3	4	0.8	2	4	6	3	4	0.0	20.74
29-Sep-16	11:19:21	1	1	2	3	0.8	2	2	4	4	5	0.0	20.74
29-Sep-16	11:19:31	3	4	3	5	0.5	1	5	7	4	5	0.0	20.74
29-Sep-16	11:19:41	2	3	3	4	0.5	1	4	5	4	5	0.0	20.73
29-Sep-16	11:19:51	2	3	3	4	0.5	1	4	5	4	5	0.0	20.74
29-Sep-16	11:20:01	1	1	2	2	0.5	1	2	3	4	5	0.0	20.75
29-Sep-16	11:20:11	2	3	3	4	0.5	1	4	5	4	5	0.0	20.75
29-Sep-16	11:20:21	2	3	2	3	0.3	1	3	5	3	4	0.0	20.75
29-Sep-16	11:20:31	1	1	2	2	0.5	1	2	3	3	4	0.0	20.75
29-Sep-16	11:20:41	2	3	2	3	0.3	1	3	5	4	5	0.0	20.75
29-Sep-16	11:20:51	1	1	2	2	0.5	1	2	3	3	4	0.0	20.75
	Average	**5**	**6**	**6**	**8**	**0.9**	**2**	**8**	**12**	**28**	**35**	**0.2**	**20.1**

Date	Time	NO (ppm)	NO (mg/m^3)	NOx (ppm)	NOx (mg/m^3)	NO_2 (ppm)	NO_2 (mg/m^3)	Equiv NO_2 (ppm)	Equiv NO_2 (mg/m^3)	CO (ppm)	CO (mg/m^3)	CO2 (%)	O2 (%)
	Maximum	7	9	8	12	1.3	3	12	17	412	515	0.8	20.8
	Minimum	1	1	2	2	0.3	1	2	3	1	1	0.0	19.6

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