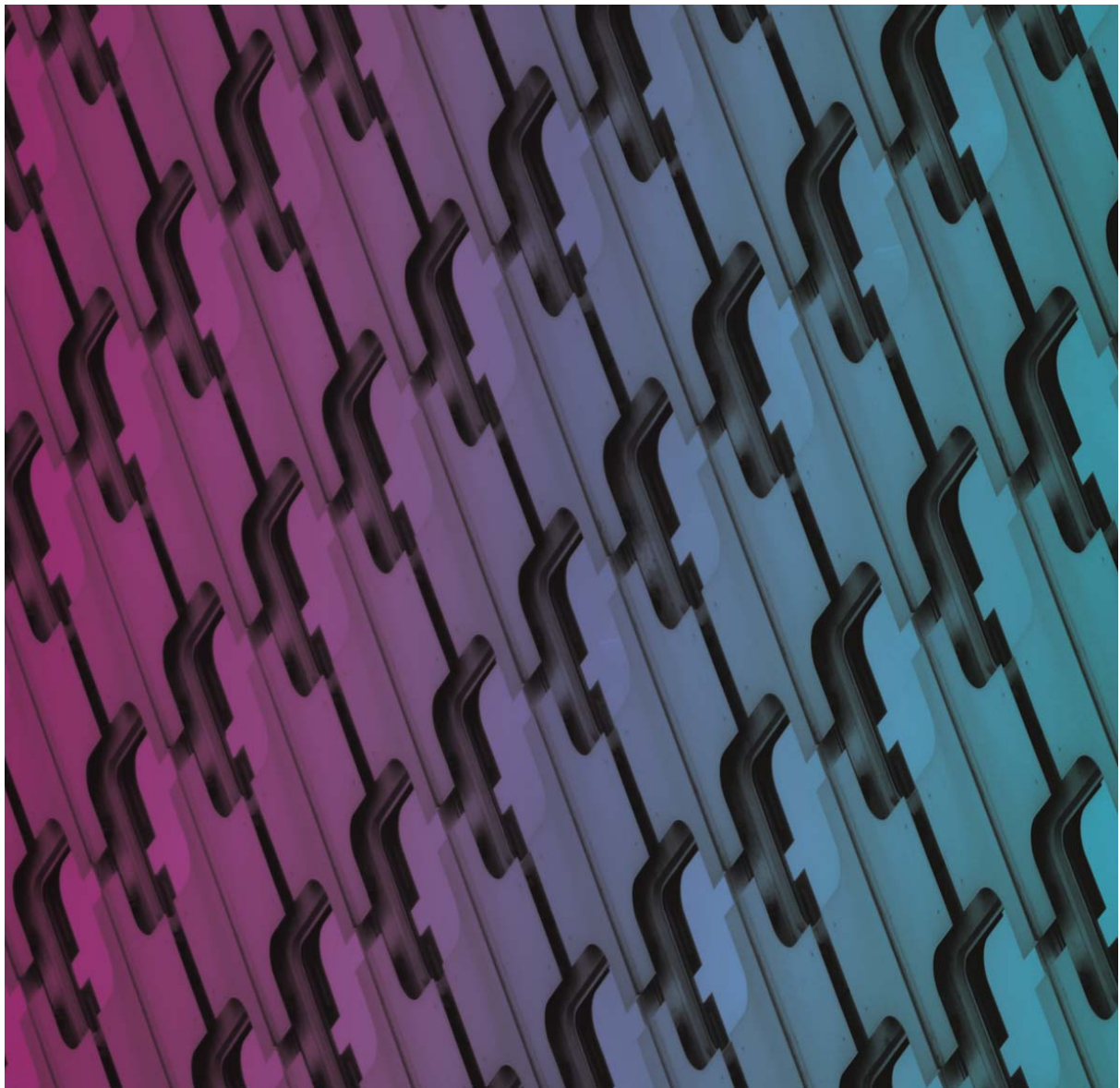


# Stack 1 Emissions Testing Report December 2015

Weston Aluminium



**NATA ACCREDITATION No. 2778 (14391)**

Accredited for compliance with ISO/IEC 17025

This document is issued in accordance with NATA's accreditation requirements.

This document may not be reproduced except in full.

# Stack 1 Emissions Testing Report December 2015

Weston Aluminium

Client: Weston Aluminium

ABN: 91 075 245 108

Prepared by

**AECOM Australia Pty Ltd**

17 Warabrook Boulevard, Warabrook NSW 2304, PO Box 73, Hunter Region MC NSW 2310, Australia

T +61 2 4911 4900 F +61 2 4911 4999 www.aecom.com

ABN 20 093 846 925

25-Jan-2016

Job No.: 60341673

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

## Quality Information


Document Stack 1 Emissions Testing Report December 2015

Ref 60341673


Date 25-Jan-2016

Prepared by James Lang

Reviewed by Chad Whitburn

Approved Signatory  \_\_\_\_\_

### Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	25 Jan 16	Final Report	Chad Whitburn Associate Director - Air Quality	

This page has been left blank intentionally.

## Table of Contents

1.0	Introduction	1
2.0	Sampling Plane Requirements	3
3.0	Methodology	5
	3.1 NATA Accredited Methods	5
	3.2 Deviations from NATA Accredited Methods	6
4.0	Sampling Location	7
	4.1 Sampling Location Summary	7
5.0	Equipment Calibration	9
6.0	Results	11
Appendix A		
	Field Sheets and Final Calculations (64 pages)	A
Appendix B		
	Laboratory Analytical Reports (26 pages)	B
Appendix C		
	Raw & Calculated Gas Data (5 pages)	C

### List of Tables

Table 1	Criteria for Selection of Sampling Planes (AS 4323. 1)	3
Table 2	AECOM NATA Endorsed Methods	5
Table 3	NATA Method Deviations	6
Table 4	Sampling Location Summary	7
Table 5	Stack Emissions Results Summary 16 December 2015	11
Table 6	Calculated PM <sub>10</sub> Cut Sizes	12
Table 7	Calculated Gas Concentrations Data Summary, 16 December 2015	12
Table 8	Gas Mass Emission Rates Summary, 16 December 2015	12
Table 9	Stack 1 Fine Particulate (PM <sub>10</sub> ), Total Particulate, and Cyanide Results, 16 December 2015	13
Table 10	Stack 1 Hazardous Substances (Metals), Particulate Fluoride and Gaseous Fluoride Results, 16 December 2015	14
Table 11	Stack 1 Hydrogen Chloride, Chlorine, Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> ) and Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> ) Results, 16 December 2015	15
Table 12	Stack 1 Polycyclic Aromatic Hydrocarbon (PAH), Dioxins and Furans Results, 16 December 2015	16
Table 13	Stack 1 Speciated Volatile Organic Compounds Results, 16 December 2015	17
Table 14	Stack 1 Speciated Dioxins And Furans Results, 16 December 2016	18
Table 15	Stack 1 Elemental Metals Results, 16 December 2015	19
Table 16	Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 16 December 2015	20

This page has been left blank intentionally.

## 1.0 Introduction

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

Testing was conducted on 16 December 2015 to determine emission concentrations for the following parameters:

### Stack 1 (EPL Point 1)

- Total Particulate;
- Fine Particulate (PM<sub>10</sub>);
- Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub> as SO<sub>3</sub>);
- Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>);
- 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 10284-0-M, 10284-0-P:
  - Moisture;
  - Fine Particulate (PM<sub>10</sub>); and
  - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1514408:
  - 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 ORG15\_156 and DAU16-004:
  - Polycyclic Aromatic Hydrocarbons; and
  - Dioxins and Furans.
- SGS Leeder Consulting, NATA accreditation number 14429, performed the following analysis detailed in report number M152864:
  - Hazardous Substances (Metals).

## 2.0 Sampling Plane Requirements

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

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

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

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

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

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

This page has been left blank intentionally.

## 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 <sub>2</sub> SO <sub>4</sub> ) or sulphur trioxide (SO <sub>3</sub> )
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 <sub>2</sub> )
NSW EPA TM-7	USEPA (2000) 26A	Chlorine (Cl <sub>2</sub> )
NSW EPA TM-8	USEPA (2000) 26A	Hydrogen chloride (HCl)
NSW EPA TM-9	USEPA (2000) Method 13A or 13B (as appropriate)	Fluorine (F <sub>2</sub> ) or any compound containing fluorine, except where emitted by a primary aluminium smelter while manufacturing aluminium from alumina
NSW EPA TM-12	USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate)	Type 1 substances (elements antimony (Sb), arsenic (As), cadmium (Cd), lead (Pb) or mercury (Hg) or any compound containing one or more of those elements)
NSW EPA TM-13	USEPA (2000) Method 29 (Analysis for tin and vanadium to be done by Inductively Coupled Argon Plasma Emission Spectroscopy (ICAP) as defined in USEPA Method 29) or USEPA (1986) Method 7910 (for vanadium only) or USEPA (1986) Method 7911 (for vanadium only) (as appropriate)	Type 2 substances (elements beryllium (Be), chromium (Cr), cobalt (Co), manganese (Mn), nickel (Ni), selenium (Se), tin (Sn) or vanadium (V) or any compound containing one or more of those elements)
NSW EPA TM-14	Cadmium (Cd) or mercury (Hg) or any compound containing one or more of those elements	USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate)
NSW EPA TM-15 (AS 4323.2-1995)	USEPA (2000) Method 5 under approved circumstances	Solid particles (Total)

NSW EPA Approved Methods	USEPA Methods	Parameter measured
NSW EPA TM-22	USEPA (2000) Method 4	Moisture content in stack gases
NSW EPA TM-23	USEPA (2000) Method 3	Dry gas density or molecular weight of stack gases
NSW EPA TM-34	USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate)	Volatile organic compounds
NSW EPA OM-5	USEPA (1997) Method 201 or 201A (as appropriate)	'Fine' particulates (PM <sub>10</sub> )
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 <sub>2</sub> ) 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 method is 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 16 December 2015 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 <sup>2</sup>

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

<sup>1</sup> AS 4323.1 Section 4.1

<sup>2</sup> AS 4323.1 Section 4.2

This page has been left blank intentionally.

## 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.

This page has been left blank intentionally.

## 6.0 Results

A summary of test results for December 2015 testing is presented in **Table 5**. Calculated Fine Particulate (PM<sub>10</sub>) 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 16 December 2015

Parameter	Stack 1 EPL Point 1
Carbon Monoxide (CO) (ppm)	38 (100)
Chlorine (mg/m <sup>3</sup> )	<5.3
Cyanide	0.22 (0.5)
Fine Particulate (PM <sub>10</sub> ) (mg/m <sup>3</sup> )	0.24
Gaseous Fluoride (mg/m <sup>3</sup> )	0.14 (2)
Hydrogen Chloride (mg/m <sup>3</sup> )	<5.3 (400)
Oxides of Nitrogen (as Equivalent NO <sub>2</sub> ) (mg/m <sup>3</sup> )	6 (2500)
Oxygen (%)	20.8
Carbon Dioxide (%)	<0.1
Particulate Fluoride (mg/m <sup>3</sup> )	0.37
Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> ) (mg/m <sup>3</sup> )	<9.3
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> ) (mg/m <sup>3</sup> )	<1.9 (100)
Total Particulate (mg/m <sup>3</sup> )	3.2 (25)
Total Polycyclic Aromatic Hydrocarbons (mg/m <sup>3</sup> )	0.29
Dioxins and Furans	0.0012
Type 1 and 2 Substances in Aggregate (Metals) (mg/m <sup>3</sup> )	0.013 (10)
Volatile Organic Compounds (VOC) (mg/m <sup>3</sup> )	0.11

Note – EPL Limits are in parenthesis

USEPA method 201A, section 6.3.5 (Determination of PM<sub>10</sub> Emissions) and USEPA Conditional Test Method 040, Section 17, Table 2 (Determination of PM<sub>2.5</sub> Emissions) specifies that results are acceptable provided the calculated aerodynamic cut size (D<sub>50</sub>) for the test lies between 9.0µm and 11.0µm. Post sampling cut size calculations performed for the sampling conducted are displayed in **Table 6**.

Cut size, or D<sub>50</sub>, 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<sub>10</sub>) test particle sizes of 10µm and less are expected.

The cut size (D<sub>50</sub>) 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<sub>50</sub>) 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<sub>10</sub> Cut Sizes

Sampling Location	PM <sub>10</sub> Cut Size (D <sub>50</sub> )
Stack 1	9.9

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

**Table 7** Calculated Gas Concentrations Data Summary, 16 December 2015

Parameter	Stack 1
Time Period	7:32-8:32
Nitrogen Oxide (NO) (mg/m <sup>3</sup> )	3
Nitrogen Dioxide (NO <sub>2</sub> ) (mg/m <sup>3</sup> )	1
Nitrogen Oxides (NO <sub>x</sub> ) (mg/m <sup>3</sup> )	4
Oxides of Nitrogen as Equivalent NO <sub>2</sub> (mg/m <sup>3</sup> )	6 (2500)
Carbon Monoxide (ppm)	38 (100)
Carbon Monoxide (mg/m <sup>3</sup> )	48
Carbon Dioxide (%)	<0.1
Oxygen (%)	20.8

Note – EPL Limits are provided in parenthesis.

**Table 8** Gas Mass Emission Rates Summary, 16 December 2015

Parameter	Stack 1
Time Period	7:32-8:32
Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure)	24
Nitrogen Oxide (NO) (mg/s)	72
Nitrogen Dioxide (NO <sub>2</sub> ) (mg/s)	24
Nitrogen Oxides (NO <sub>x</sub> ) (mg/s)	96
Oxides of Nitrogen as Equivalent NO <sub>2</sub> (mg/s)	144
Carbon Monoxide (mg/s)	1,152

**Table 9 Stack 1 Fine Particulate (PM10), Total Particulate, and Cyanide Results, 16 December 2015**

<b>Sampling Conditions:</b>			
Stack internal diameter at test location	1650	mm	
Stack gas temperature (average)	74.9	°C	348.1 K
Stack pressure (average)	1013	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	31	m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24	m <sup>3</sup> /s	
<b>Fine Particulate (PM10) Testing</b>			
Test Period	8:15	-	10:00
Fine Particulate (PM10) Mass	0.3	mg	
Gas Volume Sampled	1.25	m <sup>3</sup>	
Fine Particulate (PM10) Emission*1	0.24	mg/m <sup>3</sup>	
Fine Particulate (PM10) Mass Emission Rate*2	5.7	mg/s	
Regulatory Limit	NA	mg/m <sup>3</sup>	
<b>Total Particulate Testing</b>			
Test Period	8:15	-	10:00
Total Particulate Mass	3.0	mg	
Gas Volume Sampled	0.948	m <sup>3</sup>	
Total Particulate Emission*1	3.2	mg/m <sup>3</sup>	
Total Particulate Mass Emission Rate*2	77	mg/s	
Regulatory Limit	25	mg/m <sup>3</sup>	
<b>Cyanide Testing</b>			
Test Period	8:15	-	10:00
Cyanide Mass	0.21	mg	
Gas Volume Sampled	0.948	m <sup>3</sup>	
Cyanide Emission*1	0.22	mg/m <sup>3</sup>	
Cyanide Mass Emission Rate*2	5.3	mg/s	
Regulatory Limit	0.5	mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	<b>2.4</b>		
<b>Gas Density (dry at 1 atmosphere)</b>	<b>1.29</b>	<b>kg/m<sup>3</sup></b>	
<b>Dry Molecular Weight</b>	<b>28.9</b>	<b>g/g-mole</b>	

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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 10 Stack 1 Hazardous Substances (Metals), Particulate Fluoride and Gaseous Fluoride Results, 16 December 2015

<b>Sampling Conditions:</b>			
Stack internal diameter at test location	1650	mm	
Stack gas temperature (average)	74.8	°C	348.0 K
Stack pressure (average)	1013	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	31	m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24	m <sup>3</sup> /s	
<b>Particulate Fluoride Testing</b>			
Test Period	12:11	-	14:12
Particulate Fluoride Mass	0.44	mg	
Gas Volume Sampled	1.2	m <sup>3</sup>	
Particulate Fluoride Emission*1	0.37	mg/m <sup>3</sup>	
Particulate Fluoride Mass Emission Rate*2	8.9	mg/s	
Regulatory Limit	NA	mg/m <sup>3</sup>	
<b>Gaseous Fluoride Testing</b>			
Test Period	12:11	-	14:12
Gaseous Fluoride Mass	0.17	mg	
Gas Volume Sampled	1.2	m <sup>3</sup>	
Gaseous Fluoride Emission*1	0.14	mg/m <sup>3</sup>	
Gaseous Fluoride Mass Emission Rate*2	3.4	mg/s	
Regulatory Limit	2	mg/m <sup>3</sup>	
<b>Hazardous Substances (Metals) Testing</b>			
Test Period	12:11	-	14:12
Hazardous Substances (Metals) Mass	0.017	mg	
Gas Volume Sampled	1.3	m <sup>3</sup>	
Hazardous Substances (Metals) Emission*1	0.013	mg/m <sup>3</sup>	
Hazardous Substances (Metals) Mass Emission Rate*2	0.31	mg/s	
Regulatory Limit	10	mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	<b>2.0</b>		
<b>Gas Density (dry at 1 atmosphere)</b>	<b>1.29</b>	<b>kg/m<sup>3</sup></b>	
<b>Dry Molecular Weight</b>	<b>28.9</b>	<b>g/g-mole</b>	

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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**Table 11 Stack 1 Hydrogen Chloride, Chlorine, Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub> as SO<sub>3</sub>) and Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>) Results, 16 December 2015**

<b>Sampling Conditions:</b>			
Stack internal diameter at test location	1650	mm	
Stack gas temperature (average)	73.6	°C	346.8 K
Stack pressure (average)	1013	hPa	
Stack gas velocity (average, stack conditions)	15	m/s	
Stack gas flowrate (stack conditions)	32	m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24	m <sup>3</sup> /s	
<b>Hydrogen Chloride Testing</b>			
Test Period	10:18	-	11:59
Hydrogen Chloride Mass	<5	mg	
Gas Volume Sampled	0.937	m <sup>3</sup>	
Hydrogen Chloride Emission*1	<5.3	mg/m <sup>3</sup>	
Hydrogen Chloride Mass Emission Rate*2	<130	mg/s	
Regulatory Limit	400	mg/m <sup>3</sup>	
<b>Chlorine Testing</b>			
Test Period	10:18	-	11:59
Chlorine Mass	<5	mg	
Gas Volume Sampled	0.937	m <sup>3</sup>	
Chlorine Emission*1	<5.3	mg/m <sup>3</sup>	
Chlorine Mass Emission Rate*2	<130	mg/s	
Regulatory Limit	NA	mg/m <sup>3</sup>	
<b>Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub> as SO<sub>3</sub>) Testing</b>			
Test Period	10:18	-	11:59
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> ) Mass	<2	mg	
Gas Volume Sampled	1.07	m <sup>3</sup>	
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> ) Emission*1	<1.9	mg/m <sup>3</sup>	
Sulfuric Acid Mist (H <sub>2</sub> SO <sub>4</sub> as SO <sub>3</sub> ) Mass Emission Rate*2	<47	mg/s	
Regulatory Limit	100	mg/m <sup>3</sup>	
<b>Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>) Testing</b>			
Test Period	10:18	-	11:59
Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> ) Mass	<10	mg	
Gas Volume Sampled	1.07	m <sup>3</sup>	
Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> ) Emission*1	<9.3	mg/m <sup>3</sup>	
Sulfur Dioxide (SO <sub>2</sub> as SO <sub>3</sub> ) Mass Emission Rate*2	<230	mg/s	
Regulatory Limit	NA	mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	<b>2.8</b>		
<b>Gas Density (dry at 1 atmosphere)</b>	<b>1.29</b>	<b>kg/m<sup>3</sup></b>	
<b>Dry Molecular Weight</b>	<b>28.9</b>	<b>g/g-mole</b>	

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<sub>std</sub> 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, 16 December 2015

<b>Sampling Conditions:</b>		
Stack internal diameter at test location	1650	mm
Stack gas temperature (average)	79.2	°C      352.4 K
Stack pressure (average)	1013	hPa
Stack gas velocity (average, stack conditions)	15	m/s
Stack gas flowrate (stack conditions)	31	m <sup>3</sup> /s
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24	m <sup>3</sup> /s
<b>Dioxins and Furans Lower Bound Testing</b>		
Test Period	8:15 -	14:17
Dioxins and Furans Lower Bound Mass	0.003	ng
Gas Volume Sampled	3.83	m <sup>3</sup>
Dioxins and Furans Lower Bound Emission*1	0.00078	ng/m <sup>3</sup>
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.019	ng/s
Regulatory Limit	0.1	ng/m <sup>3</sup>
<b>Dioxins and Furans Middle Bound Testing</b>		
Test Period	8:15 -	14:17
Dioxins and Furans Middle Bound Mass	0.0048	ng
Gas Volume Sampled	3.85	m <sup>3</sup>
Dioxins and Furans Middle Bound Emission*1	0.0012	ng/m <sup>3</sup>
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.028	ng/s
Regulatory Limit	0.1	ng/m <sup>3</sup>
<b>Polycyclic Aromatic Hydrocarbons Testing</b>		
Test Period	8:15 -	14:17
Polycyclic Aromatic Hydrocarbons Mass	1.1	mg
Gas Volume Sampled	3.83	m <sup>3</sup>
Polycyclic Aromatic Hydrocarbons Emission*1	0.29	mg/m <sup>3</sup>
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	6.9	mg/s
Regulatory Limit	NA	mg/m <sup>3</sup>
<b>Moisture Content (%)</b>	<b>2.1</b>	
<b>Gas Density (dry at 1 atmosphere)</b>	<b>1.29 kg/m<sup>3</sup></b>	
<b>Dry Molecular Weight</b>	<b>28.9 g/g-mole</b>	

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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 13 Stack 1 Speciated Volatile Organic Compounds Results, 16 December 2015

Analyte	Sample $\mu\text{g}$	Blank $\mu\text{g}$	Sample Blank Corrected $\mu\text{g}$	( $\text{mg}/\text{m}^3$ )	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.3
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.3
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.3
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.3
Benzene	<1.0	<1.0	<1.0	<0.18	<4.3
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.3
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.3
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.3
MIBK	<1.0	<1.0	<1.0	<0.18	<4.3
Toluene	1.1	<1.0	0.6	0.11	2.6
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.3
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.3
m- & p-xylene	<2.0	<0.2	<2.0	<0.36	<8.6
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.3
Styrene	<1.0	<1.0	<1.0	<0.18	<4.3
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.3
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.3
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.3
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
n-decane	<1.0	<1.0	<1.0	<0.18	<4.3
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,2-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.3
<b>Total</b>	<b>1.1</b>		<b>0.6</b>	<b>0.11</b>	<b>2.6</b>

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, 16 December 2016

Analyte	Mass ng	Toxic Equivalency Factor (1 - TEFs)	Total Toxic Equivalence (1 - TEQs) ng	Concentration ng/m <sup>3</sup>	Total Toxic Equivalence (1-TEQs) ng/m <sup>3</sup>
2,3,7,8-TCDF	0.014	0.1	0.0014	0.0037	0.00037
Total TCDF isomers	0.45				
2,3,7,8-TCDD	<0.002	1	0.001	<0.00052	0.00026
Total TCDD isomers	0.034				
1,2,3,7,8-PeCDF	0.0029	0.05	0.000145	0.00076	0.000038
2,3,4,7,8-PeCDF	<0.002	0.5	0.0005	<0.00052	0.00013
Total PeCDF isomers	0.018				
1,2,3,7,8-PeCDD	0.0025	0.5	0.00125	0.00065	0.00033
Total PeCDD isomers	0.012				
1,2,3,4,7,8-HxCDF	<0.002	0.1	0.0001	<0.00052	0.000026
1,2,3,6,7,8-HxCDF	0.0016	0.1	0.00016	0.00042	0.000042
2,3,4,6,7,8-HxCDF	<0.0009	0.1	0.000045	<0.00023	0.000012
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00026	0.000013
Total HxCDF isomers	0.0037				
1,2,3,4,7,8-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
1,2,3,6,7,8-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
1,2,3,7,8,9-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
Total HxCDD isomers	<0.004				
1,2,3,4,6,7,8-HpCDF	<0.002	0.01	0.00001	<0.00052	0.0000026
1,2,3,4,7,8,9-HpCDF	<0.001	0.01	0.000005	<0.00026	0.0000013
Total HpCDF isomers	<0.003				
1,2,3,4,6,7,8-HpCDD	<0.002	0.01	0.00001	<0.00052	0.0000026
Total HpCDD isomers	<0.004				
OCDF	<0.002	0.001	0.000001	<0.00052	0.00000026
OCDD	0.0094	0.001	0.0000094	0.0025	0.0000025

I-TEQ<sub>DF</sub>

Lower Bound (excluding LOD Values)

0.003 ng

Middle Bound (including half LOD Values)

0.0048 ng

Date Tested

16-Dec-15

Table 15 Stack 1 Elemental Metals Results, 16 December 2015

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m <sup>3</sup> )	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m <sup>3</sup> )	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m <sup>3</sup> )	Total (mg)	Total (mg/m <sup>3</sup> )	Mass Emission Rate (mg/s)
Antimony	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Arsenic	0.0001	0.000077	<0.0001	<0.000077			0.0001	0.000077	0.0019
Beryllium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Cadmium	0.0063	0.0049	<0.0008	<0.00062			0.0063	0.0049	0.12
Chromium	0.0015	0.0012	<0.0001	<0.000077			0.0015	0.0012	0.029
Cobalt	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Copper	0.0036	0.0028	0.0001	0.000077			0.004	0.0031	0.075
Lead	0.0016	0.0012	<0.0001	<0.000077			0.0016	0.0012	0.029
Magnesium	0.019	0.015	<0.035	<0.027			0.019	0.015	0.36
Manganese	<0.006	<0.0046	<0.0062	<0.0048			<0.0002	<0.00015	<0.0036
Mercury	<0.0002	<0.00015	<0.0001	<0.000077	<0.0005	<0.00039	<0.0002	<0.00015	<0.0036
Nickel	0.0011	0.00085	0.0037	0.0029			0.005	0.0039	0.094
Selenium	<0.0002	<0.00015	<0.0003	<0.00023			<0.0002	<0.00015	<0.0036
Thallium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Tin	0.0019	0.0015	<0.0001	<0.000077			0.0019	0.0015	0.036
Vanadium	0.0003	0.00023	<0.0001	<0.000077			0.0003	0.00023	0.0055
Zinc	0.65	0.5	0.0016	0.0012			0.7	0.54	13
<b>Total Hazardous Metals*</b>	<b>0.011</b>	<b>0.0085</b>	<b>0.0037</b>	<b>0.0029</b>	<b>&lt;0.0005</b>	<b>&lt;0.00039</b>	<b>0.017</b>	<b>0.013</b>	<b>0.31</b>
<b>Total Metals</b>	<b>0.69</b>	<b>0.53</b>	<b>0.0054</b>	<b>0.0042</b>			<b>0.74</b>	<b>0.57</b>	<b>14</b>

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

Table 16 Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results, 16 December 2015

	Sample Result		(mg)	Emission		Mass Emission Rate	
	(ng)	(µg)		(µg/m <sup>3</sup> )	(mg/m <sup>3</sup> )	(µg/s)	(mg/s)
Naphthalene	160000	160	0.16	42	0.042	990	0.99
2 - Methylanthracene	55000	55	0.055	14	0.014	340	0.34
Acenaphthylene	330000	330	0.33	86	0.086	2000	2
Acenaphthene	11000	11	0.011	2.9	0.0029	68	0.068
Fluorene	91000	91	0.091	24	0.024	560	0.56
Phenanthrene	300000	300	0.3	78	0.078	1900	1.9
Anthracene	37000	37	0.037	9.7	0.0097	230	0.23
Fluoranthene	62000	62	0.062	16	0.016	380	0.38
Pyrene	62000	62	0.062	16	0.016	380	0.38
Benz(a)anthracene	32	0.032	0.000032	0.0084	0.0000084	0.2	0.0002
Chrysene	73	0.073	0.000073	0.019	0.000019	0.45	0.00045
Benzo(b)fluoranthene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Perylene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(ghi)perylene	29	0.029	0.000029	0.0076	0.0000076	0.18	0.00018
<b>Sum of reported PAH's</b>	<b>1100000</b>	<b>1100</b>	<b>1.1</b>	<b>290</b>	<b>0.29</b>	<b>6800</b>	<b>6.8</b>

Appendix A

# Field Sheets and Final Calculations (64 pages)

## Appendix A Field Sheets and Final Calculations (64 pages)

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 16-Dec-15

<b>ANALYTE(S)</b>	<b>METHOD</b>
Fine Particulate (PM10)	NSW EPA OM - 5
Total Particulate	NSW EPA TM - 15
Cyanide	USEPA OM-29

Observations made during testing period:

Sampling Performed By:



James Lang



Dylan Turnbull


ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 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	Cross Sectional Area :		2.14 m <sup>2</sup>
OR	Length    Width			
Length/Width (mm)		Minimum No. of		
Equivalent Diameter	N/A    mm	sampling points=		16
Distance from sampling plane to nearest disturbances:		Total No. of sampling points =    20		
		PM2.5/10=    12		
Upstream (m) =	4	No. of sampling traverses/ports sampled =		2
No. Diameters =	2.4			PM2.5/10=    2
Type of Upstream Disturbance:	Fan	No. of sampling points on each traverse/port =		10
Downstream (m) =	6			PM2.5/10=    6
No. Diameters =	3.6			
Type of Down Stream Disturbance:	Stack Exit			
Position of each sampling point, for each traverse:		Exclusion of any sample point numbers - comments:		
		A	B	
No.	Distance from wall	S-type Pitot distances	PM10/2.5 A	PM2.5/10 B
			Distance from wall	S-Type Pitot distances
1	111	81	73	43
2	195	165	241	211
3	292	262	488	458
4	413	383	1162	1132
5	584	554	1409	1379
6	1066	1036	1577	1547
7	1238	1208		
8	1358	1328		
9	1455	1425		
10	1539	1509		
11			Check of total points against minimum, (yes/no) - comments:  <div style="text-align: right; font-size: 2em; margin-top: 20px;">  </div>	
12				
13				
14				
15				
16				
17				
18				
19				
20				
Signed: <i>Buddland</i>			General Comments:	
			Checked: <i>[Signature]</i>	

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Fine Particulate (PM10)  
 Test 2: Total Particulate  
 Test 3: Cyanide

Sampling time start: 7:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	7:45	16	20.6	0.2
2	7:46	17	20.6	0.2
3	7:47	17	20.6	0.2
4	7:48	15	20.6	0.2
5	7:49	14	20.6	0.2
6	7:50	12	20.6	0.2
7	7:51	12	20.6	0.2
8	7:52	14	20.6	0.2
Averages:		14.6 ppm	20.6 %	0.2 %

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

Measurements

CO: 0.0015 %,(dry)	N <sub>2</sub> : 79.2 %,(dry)
CO <sub>2</sub> : 0.2 %,(dry)	O <sub>2</sub> : 20.6 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0014 %,(wet)	N <sub>2</sub> : 77.9 %,(wet)
CO <sub>2</sub> : 0.2 %,(wet)	O <sub>2</sub> : 20.3 %,(wet)
H <sub>2</sub> O: 1.60 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Fine Particulate (PM10)  
 Test 2: Total Particulate  
 Test 3: Cyanide

Sampling time start: 10:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	10:00	3	20.6	0.2
2	10:01	3	20.6	0.2
3	10:02	4	20.6	0.2
4	10:03	4	20.6	0.2
5	10:04	4	20.6	0.2
6	10:05	6	20.6	0.2
7	10:06	5	20.6	0.2
8	10:07	5	20.6	0.2
Averages:		4.3 ppm	20.6 %	0.2 %

Moisture content (M3): 0.97  
 Moisture percentage (M2): 2.55 %

Measurements

CO: 0.0004 %,(dry)	N <sub>2</sub> : 79.2 %,(dry)
CO <sub>2</sub> : 0.2 %,(dry)	O <sub>2</sub> : 20.6 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0004 %,(wet)	N <sub>2</sub> : 77.2 %,(wet)
CO <sub>2</sub> : 0.2 %,(wet)	O <sub>2</sub> : 20.1 %,(wet)
H <sub>2</sub> O: 2.55 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

**Emission Measurement Calculations Spreadsheet**

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

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Fine Particulate (PM10)

Time :		7:50		Barometric Pressure :		1014 hPa	
Page No. :		1 of 1		Pitot Correction Factor :		0.84	
Sampling Port No:		1 to 2		Stack Gas Density:		1.28 kg/m <sup>3</sup>	
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	0.195	65.0	338.2	16.3		
1/2	211	0.148	65.0	338.2	14.2		
1/3	458	0.129	65.0	338.2	13.3		
1/4	1132	0.137	65.0	338.2	13.7		
1/5	1379	0.131	65.0	338.2	13.4		
1/6	1547	0.116	65.0	338.2	12.6		
2/1	43	0.189	65.0	338.2	16.1		
2/2	211	0.179	65.0	338.2	15.6		
2/3	458	0.146	65.0	338.2	14.1		
2/4	1132	0.127	65.0	338.2	13.1		
2/5	1379	0.148	65.0	338.2	14.2		
2/6	1547	0.106	65.0	338.2	12.0		
Average			65.0	338.2	14.1		

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -9.8 mm  
 Absolute pressure in stack (hPa) : 1013.04 hPa



ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 16-Dec-15

Client: Weston Aluminium

AECOM's Project No: 60341673

Stack Description No.: Stack 1

Sample Nozzle No.: fine4 Sample Nozzle Area (An): 1.74 x 10<sup>-5</sup> m<sup>2</sup>

Sampling Port No.: 1 to 2 Thimble No: T394

Page No: 1 of 1 Blank thimble No: NA

Leak Check (Pre-Sampling)

Meter start: 373.4088 Meter finish: 373.4088  
Time start: 8:10 Time finish: 8:11

Leak Check (Post Sampling)

Meter start: 374.7681 Meter finish: 374.7681  
Time start: 10:04 Time finish: 10:05

Therefore, leakage rate = no leak L/min Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable) (>0.1 l/min. is unacceptable)

Repeat:

Comments:

Repeat:

Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)  
Meter start: 373.4092 Time start: 8:15  
Meter correction factor (GMf): 1.0100

Table with 8 columns: 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). Rows include data for 1/1 to 1/6, 2/1 to 2/6, and an Averages row.

Meter Finish: 374.7672 Time Finish: 10:00

Total Condensate collected: 17 ml Silica gel No(s) used: Z13





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

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Fine Particulate (PM10)

Time :		10:00		Barometric Pressure :		1014		hPa		
Page No. :		1 of 1		Pitot Correction Factor :		0.84				
Sampling Port No:		1 to 2		Stack Gas Density:		1.28		kg/m <sup>3</sup>		
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	0.173	71.0	344.2	15.5					
1/2	211	0.195	72.0	345.2	16.5					
1/3	458	0.130	73.0	346.2	13.5					
1/4	1132	0.166	73.0	346.2	15.2					
1/5	1379	0.146	73.0	346.2	14.3					
1/6	1547	0.137	74.0	347.2	13.9					
2/1	43	0.173	72.0	345.2	15.5					
2/2	211	0.185	73.0	346.2	16.1					
2/3	458	0.145	73.0	346.2	14.3					
2/4	1132	0.158	73.0	346.2	14.9					
2/5	1379	0.147	74.0	347.2	14.4					
2/6	1547	0.138	74.0	347.2	13.9					
Average						72.9	346.1	14.8		

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -9.8 mm  
 Absolute pressure in stack (hPa) : 1013.04 hPa

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1

Test 2: Total Particulate  
 Test 3: Cyanide

Time :		10:00	Barometric Pressure :		1014 hPa
Page No. :		1 of 1	Pitot Correction Factor :		0.84
Sampling Port No:		1 to 2	Stack Gas Density:		1.28 kg/m <sup>3</sup>
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	0.173	71.0	344.2	15.5
1/2	165	0.173	71.0	344.2	15.5
1/3	262	0.195	72.0	345.2	16.5
1/4	383	0.153	72.0	345.2	14.6
1/5	554	0.130	73.0	346.2	13.5
1/6	1036	0.166	73.0	346.2	15.2
1/7	1208	0.178	73.0	346.2	15.8
1/8	1328	0.146	73.0	346.2	14.3
1/9	1425	0.137	74.0	347.2	13.9
1/10	1509	0.130	74.0	347.2	13.5
2/1	81	0.184	72.0	345.2	16.1
2/2	165	0.173	72.0	345.2	15.5
2/3	262	0.185	73.0	346.2	16.1
2/4	383	0.143	73.0	346.2	14.2
2/5	554	0.145	73.0	346.2	14.3
2/6	1036	0.158	73.0	346.2	14.9
2/7	1208	0.175	73.0	346.2	15.6
2/8	1328	0.147	74.0	347.2	14.4
2/9	1425	0.138	74.0	347.2	13.9
2/10	1509	0.128	74.0	347.2	13.4
<b>Average</b>			72.9	346.1	14.8

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -9.8 mm  
 Absolute pressure in stack (hPa) : 1013.04 hPa

**STACK ANALYSIS - PM10 CALCULATIONS**

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

**1. Gas Analysis**

	%		
%CO <sub>2</sub>	0.2		
%O <sub>2</sub>	20.6		
%N <sub>2</sub> +%CO	79.2		
Fraction Moisture Content, Ews	0.03	M <sub>s</sub> =	0.97

**2. Molecular Weight of Stack Gas (Dry Basis)**

Mol. Wt. of Stack Gas (dry)	28.86
Mol. Wt. of Stack Gas (wet)	28.68

**3. Absolute Stack Pressure**

	Pascals	in. Hg
Barometric Pressure (Pbar)	101400	29.93
Stack Static Pressure (Pg)	101304	29.91

Absolute Stack Pressure 29.91

**4. Viscosity of Stack Gas**

	°C	°F
Average Stack Temp.	72.9	163.3
Average Meter Temperature:	27.1	
Stack Gas Viscosity		203.8

**5. Cyclone Flow Rate**

	ft <sup>3</sup> /min	m <sup>3</sup> /min	L/min	L/s
Cyclone Flow Rate	0.53	0.0186	18.58	0.31

**6. Nozzle Velocity, Rmin and Rmax**

Nozzle Number	Nozzle Diameter (inches)	Nozzle Velocity		Rmin	Rmax	Vmin	Vmin	Vmax	Vmax
		ft/sec	m/s	[-]	[-]	ft/sec	m/s	ft/sec	m/s
0	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
1	0.133	90.27	29.71	0.758	1.229	68.42	22.45	110.96	36.40
2	0.152	69.63	22.92	0.737	1.243	51.29	16.83	86.53	28.39
3	0.161	62.02	20.41	0.724	1.251	44.88	14.72	77.55	25.44
4	0.185	46.76	15.39	0.676	1.276	31.71	10.40	59.67	19.58
5	0.198	41.17	13.55	0.648	1.291	26.66	8.75	53.15	17.44
6	0.225	31.71	10.44	0.548	1.331	17.39	5.71	42.22	13.85
7	0.237	28.63	9.42	0.482	1.351	14.31	4.70	38.68	12.69
8	0.262	23.46	7.72	#NUM!	1.398	11.73	3.85	32.81	10.76
9	0.303	17.54	5.77	#NUM!	1.491	8.77	2.88	26.16	8.58
10	0.341	13.87	4.56	#NUM!	1.592	6.93	2.27	20.80	6.82
11	0.390	10.56	3.48	#NUM!	1.746	5.26	1.73	15.85	5.20
	Nozzle Diameter	Nozzle Diameter	Nozzle Area	Sample Rate					
Selected Nozzle	(inches)	(m)	(m <sup>2</sup> )	(L/min)					
4	0.185	0.005	0.00017	13.4					



**STACK ANALYSIS - FINAL CALCULATIONS**

**Fine Particulate (PM10)**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.3716 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	27.1 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	300.3 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.2487 m <sup>3</sup>		

(B) PM10 concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	T394	PM10 Weight:	0.0003 g
Final PM10 Weight (Mp1):	0.00030 g		
PM10 Concentration (C1):	=M <sub>p1</sub> /MV <sub>4</sub> =	0.00024 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		0.24 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	

CO<sub>2</sub> Basis 12 % ;and C<sub>2</sub> = 0.24 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure)  
 Average CO<sub>2</sub> %: 0.2 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.014 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = 14 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub> %: 20.6 %  
 Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = 0.0084 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)  
 ;and C<sub>b1</sub> = 8.4 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: Z13  
 V<sub>v</sub> = 10.3 g (from laboratory report) V<sub>w</sub> = 17 mL (=grams) (recorded on Laboratory Form 108)  
 Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0227  
 Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0138  
 Therefore, B<sub>ws</sub> =  $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$   
 B<sub>ws</sub> = 2.83 %

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 <sup>3</sup> (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.29 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure) 1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.030 kg/m <sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	14.05 m/s
(ii) Average of post-sampling velocities:	14.83 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.44 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

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

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

Qstack =	Vs x A =	30.88 m <sup>3</sup> /s (stack conditions)
Qstd =	Qstack x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Qstd =	23.9 m <sup>3</sup> /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	0.0057	g/s (0°C, dry gas, 1 atm pressure )	
	=	5.7	mg/s (0°C, dry gas, 1 atm pressure )	
	C <sub>1a</sub> x Qstd =	0.34	g/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	=	340	mg/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	C <sub>1a</sub> x Qstd =	0.2	g/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )
	=	200	mg/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Total Particulate**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.0671 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	34.4 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	307.6 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	0.9485 m <sup>3</sup>		

(B) Total Particulate concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	SRT-61	Total Particulate Weight:	0.0030 g
Final Total Particulate Weight (Mp1):	0.00300 g		
Total Particulate Concentration (C1):	=Mp1/MV <sub>4</sub> =		0.0032 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
			and C <sub>2</sub> =
CO <sub>2</sub> Basis	12 %		3.2 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
Average CO <sub>2</sub> %:	0.2 %		
Therefore, C <sub>c</sub> :	= C <sub>a</sub> x 12/CO <sub>2</sub> % =		0.19 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO <sub>2</sub> )
			and C <sub>c1</sub> =
			190 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO <sub>2</sub> )
O <sub>2</sub> Basis	7 %		
Average O <sub>2</sub> %:	20.6 %		
Therefore, C <sub>b</sub> :	=C <sub>a</sub> x (21 - O <sub>2ref</sub> %)/(21 - O <sub>2mea</sub> %)		0.11 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )
			and C <sub>b1</sub> =
			110 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )

(C) Moisture content

Silica Gel Number:	P32		
V <sub>v</sub> =	5.6 g (from laboratory report)	V <sub>w</sub> =	12 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V <sub>wc(std)</sub> ) =	0.0160		
Volume of Water Vapour Condensed (V <sub>wsg(std)</sub> ) =	0.0075		
Therefore, B <sub>ws</sub> =	$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$		
B <sub>ws</sub> =	2.41 %		

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

= 1.004 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.77 m/s
- (ii) Average of post-sampling velocities: 14.84 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
  - 14.80 m/s (stack conditions, wet)
  - N/A m/s (stack conditions, wet)

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

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.65 m<sup>3</sup>/s (stack conditions)

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

Q<sub>std</sub> = 24.0 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	0.077	g/s (0°C, dry gas, 1 atm pressure )		
	=	77	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Q <sub>std</sub> =	4.6	g/s (0°C, dry gas, 1 atm pressure )	12%	CO <sub>2</sub>
	=	4600	mg/s (0°C, dry gas, 1 atm pressure )	12%	CO <sub>2</sub>
	C <sub>1a</sub> x Q <sub>std</sub> =	2.7	g/s (0°C, dry gas, 1 atm pressure )	7%	O <sub>2</sub>
	=	2700	mg/s (0°C, dry gas, 1 atm pressure )	7%	O <sub>2</sub>

**STACK ANALYSIS - FINAL CALCULATIONS**

**Cyanide**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.0671 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	34.4 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	307.6 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	0.9485 m <sup>3</sup>		

(B) Cyanide concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	0	Cyanide Weight:	0.00021 g
Final Cyanide Weight (Mp1):	0.00021 g		
Cyanide Concentration (C1):	=M <sub>p1</sub> /MV <sub>4</sub> =		0.00022 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
			0.22 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)

CO<sub>2</sub> Basis 12 % ;and C<sub>2</sub> =  
 Average CO<sub>2</sub>%: 0.2 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.013 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = 13 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub>%: 20.6 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) 0.0077 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)  
 ;and C<sub>b1</sub> = 7.7 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: P32  
 V<sub>v</sub> = 5.6 g (from laboratory report) V<sub>w</sub> = 12 mL (=grams) (recorded on Laboratory Form 108)  
 Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0160  
 Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0075

Therefore, B<sub>ws</sub> =  $\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B<sub>ws</sub> = 2.41 %

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

Cyanide

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

- (i) Initial gas density for sampling: 1.28 kg/m<sup>3</sup> (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
  - 1.29 kg/m<sup>3</sup> (0°C, wet, 1 atm pressure)
  - 1.29 kg/m<sup>3</sup> (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =  $(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$   
 = 1.004 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.77 m/s
  - (ii) Average of post-sampling velocities: 14.84 m/s
  - (iii) Average of while-sampling velocities: N/A m/s
  - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
    - 14.80 m/s (stack conditions, wet)
    - N/A m/s (stack conditions, wet)
- (Note: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 31.65 m<sup>3</sup>/s (stack conditions)

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

Qstd = 24.0 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	0.0053	g/s (0°C, dry gas, 1 atm pressure )		
	=	5.3	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Qstd =	0.32	g/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	320	mg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Qstd =	0.18	g/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	180	mg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

**Emission Measurement Calculations Spreadsheet**

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 16-Dec-15 FINE PARTICULATE (PM10) TOTAL PARTICULATE CYANIDE		
<b>Sampling Conditions:</b>		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	74.9 °C	348.1 K
Stack pressure (average)	1013 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	31 m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24 m <sup>3</sup> /s	
<b>Fine Particulate (PM10) Testing</b>		
Test Period	8:15	- 10:00
Fine Particulate (PM10) Mass	0.3 mg	
Gas Volume Sampled	1.25 m <sup>3</sup>	
Fine Particulate (PM10) Emission*1	0.24 mg/m <sup>3</sup>	
Fine Particulate (PM10) Mass Emission Rate*2	5.7 mg/s	
Regulatory Limit	NA mg/m <sup>3</sup>	
<b>Total Particulate Testing</b>		
Test Period	8:15	- 10:00
Total Particulate Mass	3.0 mg	
Gas Volume Sampled	0.948 m <sup>3</sup>	
Total Particulate Emission*1	3.2 mg/m <sup>3</sup>	
Total Particulate Mass Emission Rate*2	77 mg/s	
Regulatory Limit	25 mg/m <sup>3</sup>	
<b>Cyanide Testing</b>		
Test Period	8:15	- 10:00
Cyanide Mass	0.21 mg	
Gas Volume Sampled	0.948 m <sup>3</sup>	
Cyanide Emission*1	0.22 mg/m <sup>3</sup>	
Cyanide Mass Emission Rate*2	5.3 mg/s	
Regulatory Limit	0.5 mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	2.4	
<b>Gas Density (dry at 1 atmosphere)</b>	1.29 kg/m <sup>3</sup>	
<b>Dry Molecular Weight</b>	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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 16-Dec-15

**ANALYTE(S)****METHOD**

Particulate Fluoride

NSW EPA TM - 9

Gaseous Fluoride

NSW EPA TM - 9

Hazardous Substances (Metals)

NSW EPA TM - 12, 13 &amp; 14

Observations made during testing period:

Sampling Performed By:

  
James Lang  
For Dylan Turnbull

**STACK ANALYSIS - PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Particulate Fluoride  
 Test 2: Gaseous Fluoride  
 Test 3: Hazardous Substances (Metals)

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

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Particulate Fluoride  
 Test 2: Gaseous Fluoride  
 Test 3: Hazardous Substances (Metals)

Sampling time start: 12:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	12:00	14	20.4	0.3
2	12:01	14	20.4	0.3
3	12:02	15	20.4	0.3
4	12:03	15	20.4	0.3
5	12:04	16	20.4	0.3
6	12:05	15	20.4	0.3
7	12:06	16	20.4	0.3
8	12:07	16	20.4	0.3
Averages:		15.1 ppm	20.4 %	0.3 %

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

Measurements

CO: 0.0015 %,(dry)	N <sub>2</sub> : 79.3 %,(dry)
CO <sub>2</sub> : 0.3 %,(dry)	O <sub>2</sub> : 20.4 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0015 %,(wet)	N <sub>2</sub> : 78.0 %,(wet)
CO <sub>2</sub> : 0.3 %,(wet)	O <sub>2</sub> : 20.1 %,(wet)
H <sub>2</sub> O: 1.60 % (=M2)	
Therefore, stack gas density (GD) = 1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)	
Therefore, stack gas density (GD) = 1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)	

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Particulate Fluoride  
 Test 2: Gaseous Fluoride  
 Test 3: Hazardous Substances (Metals)

Sampling time start: 14:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm), (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	14:00	21	20.4	0.3
2	14:01	22	20.4	0.3
3	14:02	25	20.4	0.3
4	14:03	26	20.4	0.3
5	14:04	28	20.4	0.3
6	14:05	27	20.4	0.3
7	14:06	29	20.4	0.3
8	14:07	28	20.4	0.3
Averages:		25.8 ppm	20.4 %	0.3 %

Moisture content (M3): 0.98  
 Moisture percentage (M2): 2.05 %

Measurements

CO: 0.0026 %,(dry)	N <sub>2</sub> : 79.3 %,(dry)
CO <sub>2</sub> : 0.3 %,(dry)	O <sub>2</sub> : 20.4 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0025 %,(wet)	N <sub>2</sub> : 77.7 %,(wet)
CO <sub>2</sub> : 0.3 %,(wet)	O <sub>2</sub> : 20.0 %,(wet)
H <sub>2</sub> O: 2.05 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Particulate Fluoride  
 Test 2: Gaseous Fluoride  
 Test 3: Hazardous Substances (Metals)

Time :		12:05		Barometric Pressure :		1014		hPa	
Page No. :		1 of 1		Pitot Correction Factor :		0.84			
Sampling Port No:		1 to 2		Stack Gas Density:		1.28		kg/m <sup>3</sup>	
Pitot Tube Type :		S						(0 °C, Wet, 1 Atm)	
Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s				
1/1	81	0.145	81.0	354.2	14.4				
1/2	165	0.098	73.0	346.2	11.7				
1/3	262	0.110	73.0	346.2	12.4				
1/4	383	0.125	73.0	346.2	13.2				
1/5	554	0.181	73.0	346.2	15.9				
1/6	1036	0.159	74.0	347.2	14.9				
1/7	1208	0.160	74.0	347.2	15.0				
1/8	1328	0.190	74.0	347.2	16.3				
1/9	1425	0.195	75.0	348.2	16.6				
1/10	1509	0.187	84.0	357.2	16.4				
2/1	81	0.137	72.0	345.2	13.8				
2/2	165	0.121	72.0	345.2	13.0				
2/3	262	0.151	73.0	346.2	14.5				
2/4	383	0.173	73.0	346.2	15.5				
2/5	554	0.165	73.0	346.2	15.2				
2/6	1036	0.185	73.0	346.2	16.1				
2/7	1208	0.187	74.0	347.2	16.2				
2/8	1328	0.183	74.0	347.2	16.0				
2/9	1425	0.164	74.0	347.2	15.1				
2/10	1509	0.176	74.0	347.2	15.7				
Average			74.3	347.5	14.9				

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -7.1 mm  
 Absolute pressure in stack (hPa) : 1013.30 hPa

Emission Measurement Calculations Spreadsheet

**STACK ANALYSIS**

**SAMPLING OF PARTICULATE FLUORIDE**

Date: 16-Dec-15  
Client: Weston Aluminium  
AECOM's Project No: 60341673  
Stack Description No.: Stack 1  
Sample Nozzle No.: s2  
Sampling Port No.: 1 to 2  
Page No: 1 of 1  
Sample Nozzle Area (An): 1.42 x 10<sup>-5</sup> m<sup>2</sup>  
Thimble No: NA  
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 375.8155  
Time start: 12:08  
Meter finish: 375.8155  
Time finish: 12:09

**Leak Check (Post Sampling)**

Meter start: 377.1251  
Time start: 14:14  
Meter finish: 377.1251  
Time finish: 14:15

Therefore, leakage rate = no leak L/min  
(>0.1 l/min. is unacceptable)

Repeat:  
Comments:

Repeat:  
Comments:

**Sampling Record Table**

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)  
Meter start: 375.8162  
Meter correction factor (GMF) : 1.0100  
Time start: 12:11

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	0:06:00	111	10.5	26.0	25.0		Yes
1/2	0:12:00	195	8.7	28.0	26.0		Yes
1/3	0:18:00	292	9.3	28.0	27.0		Yes
1/4	0:24:00	413	9.9	29.0	27.0		Yes
1/5	0:30:00	584	11.9	29.0	27.0		Yes
1/6	0:36:00	1066	11.1	30.0	27.0		Yes
1/7	0:42:00	1238	11.2	30.0	27.0		Yes
1/8	0:48:00	1358	12.1	30.0	27.0		Yes
1/9	0:54:00	1455	12.3	30.0	27.0		Yes
1/10	1:00:00	1539	11.9	30.0	27.0		Yes
2/1	1:06:00	111	10.3	30.0	27.0		Yes
2/2	1:12:00	195	9.7	30.0	27.0		Yes
2/3	1:18:00	292	10.8	30.0	27.0		Yes
2/4	1:24:00	413	11.6	30.0	27.0		Yes
2/5	1:30:00	584	11.4	30.0	28.0		Yes
2/6	1:36:00	1066	12.0	30.0	28.0		Yes
2/7	1:42:00	1238	12.1	30.0	28.0		Yes
2/8	1:48:00	1358	11.9	30.0	28.0		Yes
2/9	1:54:00	1455	11.2	30.0	28.0		Yes
2/10	2:00:00	1539	11.7	30.0	28.0		Yes
Averages							
				29.5	27.2	no result	

Meter Finish: 377.1245  
Total Condensate collected: 5 ml  
Time Finish: 14:12  
Silica gel No(s) used: B66



Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 16-Dec-15

Client: Weston Aluminium

AECOM's Project No: 60341673

Stack Description No.: Stack 1

Sample Nozzle No.: g4

Sample Nozzle Area (An): 1.27 x 10<sup>-5</sup> m<sup>2</sup>

Sampling Port No.: 1 to 2

Thimble No: NA

Page No: 1 of 1

Blank thimble No: NA

Leak Check (Pre-Sampling)

Meter start: 5602.6070 Meter finish: 5602.6070

Time start: 12:09 Time finish: 12:10

Leak Check (Post Sampling)

Meter start: 5604.0635 Meter finish: 5604.0635

Time start: 14:15 Time finish: 14:16

Therefore, leakage rate = no leak L/min

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

Repeat:

Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start);

Meter start: 5602.6076

Meter correction factor (GMf) : 1.0100

1014 hPa (finish)

Time start: 12:11

Table with 8 columns: 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). Rows include 1/1 through 2/10 and an Averages row.

Meter Finish: 5604.0624 Time Finish: 14:12
Total Condensate collected: 7 ml Silica gel No(s) used: I34

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1:Particulate Fluoride  
 Test 2:Gaseous Fluoride  
 Test 3:Hazardous Substances (Metals)

Time :	14:00	Barometric Pressure :	1014	hPa	
Page No. :	1 of 1	Pitot Correction Factor :	0.84		
Sampling Port No:	1 to 2	Stack Gas Density:	1.28	kg/m <sup>3</sup>	
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	0.180	75.0	348.2	15.9
1/2	165	0.154	75.0	348.2	14.7
1/3	262	0.146	76.0	349.2	14.4
1/4	383	0.165	76.0	349.2	15.2
1/5	554	0.158	76.0	349.2	14.9
1/6	1036	0.156	76.0	349.2	14.8
1/7	1208	0.156	76.0	349.2	14.8
1/8	1328	0.129	77.0	350.2	13.5
1/9	1425	0.117	77.0	350.2	12.8
1/10	1509	0.141	76.0	349.2	14.1
2/1	81	0.171	74.0	347.2	15.5
2/2	165	0.138	74.0	347.2	13.9
2/3	262	0.142	74.0	347.2	14.1
2/4	383	0.153	74.0	347.2	14.6
2/5	554	0.173	75.0	348.2	15.6
2/6	1036	0.173	75.0	348.2	15.6
2/7	1208	0.165	75.0	348.2	15.2
2/8	1328	0.140	75.0	348.2	14.0
2/9	1425	0.129	75.0	348.2	13.4
2/10	1509	0.117	76.0	349.2	12.8
Average			75.4	348.6	14.5

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -7.4 mm  
 Absolute pressure in stack (hPa) : 1013.27 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

Metal	Particulate Metals Results	Gaseous Metals Results	Oxidisable Mercury Results		
	Front Half, Filter, Acetone Rinses and Acid Rinses (mg). Containers 1, 2 and 3	Back Half, Impingers + Acid Rinses (mg) Container 4	KO Impinger + Acid Rinses (mg) (5A)	KMnO <sub>4</sub> /H <sub>2</sub> SO <sub>4</sub> + Rinses (mg) (5B)	Residue Rinse 8N HCl (mg) (If Required) (5C)
Antimony	<0.0002	<0.0001			
Arsenic	0.0001	<0.0001			
Beryllium	<0.0002	<0.0001			
Cadmium	0.0063	<0.0008			
Chromium	0.0015	<0.0001			
Cobalt	<0.0002	<0.0001			
Copper	0.0036	0.0001			
Lead	0.0016	<0.0001			
Magnesium	0.019	<0.035			
Manganese	<0.006	<0.0062			
Mercury	<0.0002	<0.0001	<0.0001	<0.0005	<0.0001
Nickel	0.0011	0.0037			
Selenium	<0.0002	<0.0003			
Thallium	<0.0002	<0.0001			
Tin	0.0019	<0.0001			
Vanadium	0.0003	<0.0001			
Zinc	0.65	0.0016			

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: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m <sup>3</sup> )	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m <sup>3</sup> )	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m <sup>3</sup> )	Total (mg)	Total (mg/m <sup>3</sup> )	Mass Emission Rate (mg/s)
Antimony	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Arsenic	0.0001	0.000077	<0.0001	<0.000077			0.0001	0.000077	0.0019
Beryllium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Cadmium	0.0063	0.0049	<0.0008	<0.00062			0.0063	0.0049	0.12
Chromium	0.0015	0.0012	<0.0001	<0.000077			0.0015	0.0012	0.029
Cobalt	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Copper	0.0036	0.0028	0.0001	0.000077			0.004	0.0031	0.075
Lead	0.0016	0.0012	<0.0001	<0.000077			0.0016	0.0012	0.029
Magnesium	0.019	0.015	<0.035	<0.027			0.019	0.015	0.36
Manganese	<0.006	<0.0046	<0.0062	<0.0048			<0.0002	<0.00015	<0.0036
Mercury	<0.0002	<0.00015	<0.0001	<0.000077	<0.0005	<0.00039	<0.0002	<0.00015	<0.0036
Nickel	0.0011	0.00085	0.0037	0.0029			0.005	0.0039	0.094
Selenium	<0.0002	<0.00015	<0.0003	<0.00023			<0.0002	<0.00015	<0.0036
Thallium	<0.0002	<0.00015	<0.0001	<0.000077			<0.0002	<0.00015	<0.0036
Tin	0.0019	0.0015	<0.0001	<0.000077			0.0019	0.0015	0.036
Vanadium	0.0003	0.00023	<0.0001	<0.000077			0.0003	0.00023	0.0055
Zinc	0.65	0.5	0.0016	0.0012			0.7	0.54	13
Total Hazardous Metals*	0.011	0.0085	0.0037	0.0029	<0.0005	<0.00039	0.017	0.013	0.31
Total Metals	0.69	0.53	0.0054	0.0042			0.74	0.57	14

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

**STACK ANALYSIS - FINAL CALCULATIONS**

**Particulate Fluoride**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.3214 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	28.3 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	301.5 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.1983 m <sup>3</sup>		

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Particulate Fluoride Weight:	0.00044 g
Final Particulate Fluoride Weight (Mp1):	0.00044 g		
Particulate Fluoride Concentration (C1):	= M <sub>p1</sub> /MV <sub>4</sub> =	0.00037 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		and C <sub>2</sub> =	0.37 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
CO <sub>2</sub> Basis	12 %		
Average CO <sub>2</sub> %:	0.3 %		

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.015 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = 15 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub>%: 20.4 %

Therefore, C<sub>b</sub>: = C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = 0.0086 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)  
 ;and C<sub>b1</sub> = 8.6 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: B66  
 V<sub>v</sub> = 13 g (from laboratory report) V<sub>w</sub> = 5 mL (=grams) (recorded on Laboratory Form 108)  
 Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0067  
 Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0174

Therefore, B<sub>ws</sub> = 
$$\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$$

B<sub>ws</sub> = 1.97 %

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Particulate Fluoride

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

(i) Initial gas density for sampling:	1.28 kg/m <sup>3</sup> (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure) 1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
=	1.005 kg/m <sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	14.90 m/s
(ii) Average of post-sampling velocities:	14.49 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.69 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

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

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

Qstack =	Vs x A =	31.41 m <sup>3</sup> /s (stack conditions)
Qstd =	Qstack x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Qstd =	24.2 m <sup>3</sup> /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	0.0089	g/s (0°C, dry gas, 1 atm pressure )	
	=	8.9	mg/s (0°C, dry gas, 1 atm pressure )	
	C <sub>1a</sub> x Qstd =	0.36	g/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	=	360	mg/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	C <sub>1a</sub> x Qstd =	0.21	g/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )
	=	210	mg/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Gaseous Fluoride**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.3214 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	28.3 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	301.5 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.1983 m <sup>3</sup>		

(B) Gaseous Fluoride concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Gaseous Fluoride Weight:	0.00017 g
Final Gaseous Fluoride Weight (Mp <sub>1</sub> ):	0.00017 g		
Gaseous Fluoride Concentration (C <sub>1</sub> ):	=M <sub>p1</sub> /MV <sub>4</sub> =	0.00014 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		0.14 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	

CO<sub>2</sub> Basis 12 % ;and C<sub>2</sub> =

Average CO<sub>2</sub>%: 0.3 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.0056 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

;and C<sub>c1</sub> = 5.6 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %

Average O<sub>2</sub>%: 20.4 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) 0.0033 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

;and C<sub>b1</sub> = 3.3 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: B66

V<sub>v</sub> = 13 g (from laboratory report) V<sub>w</sub> = 5 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0067

Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0174

Therefore, B<sub>ws</sub> = 
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

B<sub>ws</sub> = 1.97 %

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 <sup>3</sup> (from Laboratory Form 107)
(ii) Re-calculated gas density based on moisture content in (c):	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure) 1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)
(iii) Gas density at stack conditions =	(ii) x $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
	= 1.005 kg/m <sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities:	14.90 m/s
(ii) Average of post-sampling velocities:	14.49 m/s
(iii) Average of while-sampling velocities:	N/A m/s
(iv) Overall average of pre-sampling and post-sampling velocities (Vs):	14.69 m/s (stack conditions, wet) N/A m/s (stack conditions, wet)

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

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

Qstack =	Vs x A =	31.41 m <sup>3</sup> /s (stack conditions)
Qstd =	Qstack x $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$	
Qstd =	24.2 m <sup>3</sup> /s (0°C, dry gas, 1 atm pressure)	

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	0.0034	g/s (0°C, dry gas, 1 atm pressure )	
	=	3.4	mg/s (0°C, dry gas, 1 atm pressure )	
	C <sub>1a</sub> x Qstd =	0.14	g/s (0°C, dry gas, 1 atm pressure )	12% CO <sub>2</sub>
	=	140	mg/s (0°C, dry gas, 1 atm pressure )	12% CO <sub>2</sub>
	C <sub>1a</sub> x Qstd =	0.079	g/s (0°C, dry gas, 1 atm pressure )	7% O <sub>2</sub>
	=	79	mg/s (0°C, dry gas, 1 atm pressure )	7% O <sub>2</sub>

**STACK ANALYSIS - FINAL CALCULATIONS**

**Hazardous Substances (Metals)**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.4693 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	37.0 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	310.2 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.2950 m <sup>3</sup>		

(B) Metals concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Metals Weight:	0.000017 g
Final Metals Weight (Mp <sub>1</sub> ):	0.00002 g		
Metals Concentration (C <sub>1</sub> ):	=Mp <sub>1</sub> /MV <sub>4</sub> =	0.000013 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		and C <sub>2</sub> =	0.013 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
CO <sub>2</sub> Basis	12 %		
Average CO <sub>2</sub> %:	0.3 %		

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.00052 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = 0.52 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub>%: 20.4 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = 0.0003 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)  
 ;and C<sub>b1</sub> = 0.3 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: I34  
 V<sub>v</sub> = 14.9 g (from laboratory report) V<sub>w</sub> = 7 mL (=grams) (recorded on Laboratory Form 108)  
 Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0093  
 Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0199

Therefore, B<sub>ws</sub> = 
$$\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$$

B<sub>ws</sub> = 2.21 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

### Hazardous Substances (Metals)

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

- (i) Initial gas density for sampling: 1.28 kg/m<sup>3</sup> (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
  - 1.29 kg/m<sup>3</sup> (0°C, wet, 1 atm pressure)
  - 1.29 kg/m<sup>3</sup> (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =
  - (ii) x  $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$
  - = 1.013 kg/m<sup>3</sup> (stack conditions, wet)

#### (E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.90 m/s
  - (ii) Average of post-sampling velocities: 14.49 m/s
  - (iii) Average of while-sampling velocities: N/A m/s
  - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
    - 14.69 m/s (stack conditions, wet)
    - N/A m/s (stack conditions, wet)
- (Note: (Vs) is from all individual data, not from (i) and (ii) alone.)**

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.41 m<sup>3</sup>/s (stack conditions)

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

Q<sub>std</sub> = 24.1 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

#### (G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	0.00031	g/s (0°C, dry gas, 1 atm pressure )		
	=	0.31	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Q <sub>std</sub> =	0.013	g/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	13	mg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Q <sub>std</sub> =	0.0073	g/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	7.3	mg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

<b>EMISSION MONITORING RESULTS, STACK 1</b> <b>WESTON ALUMINIUM</b> 16-Dec-15 PARTICULATE FLUORIDE GASEOUS FLUORIDE HAZARDOUS SUBSTANCES (METALS)		
<b>Sampling Conditions:</b>		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	74.8 °C	348.0 K
Stack pressure (average)	1013 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	31 m <sup>3</sup> /s	
Stack gas flowrate (0 <sup>o</sup> C, dry gas, 1 atm pressure)	24 m <sup>3</sup> /s	
<b>Particulate Fluoride Testing</b>		
Test Period	12:11	- 14:12
Particulate Fluoride Mass	0.44 mg	
Gas Volume Sampled	1.2 m <sup>3</sup>	
Particulate Fluoride Emission*1	0.37 mg/m <sup>3</sup>	
Particulate Fluoride Mass Emission Rate*2	8.9 mg/s	
Regulatory Limit	NA mg/m <sup>3</sup>	
<b>Gaseous Fluoride Testing</b>		
Test Period	12:11	- 14:12
Gaseous Fluoride Mass	0.17 mg	
Gas Volume Sampled	1.2 m <sup>3</sup>	
Gaseous Fluoride Emission*1	0.14 mg/m <sup>3</sup>	
Gaseous Fluoride Mass Emission Rate*2	3.4 mg/s	
Regulatory Limit	2 mg/m <sup>3</sup>	
<b>Hazardous Substances (Metals) Testing</b>		
Test Period	12:11	- 14:12
Hazardous Substances (Metals) Mass	0.017 mg	
Gas Volume Sampled	1.3 m <sup>3</sup>	
Hazardous Substances (Metals) Emission*1	0.013 mg/m <sup>3</sup>	
Hazardous Substances (Metals) Mass Emission Rate*2	0.31 mg/s	
Regulatory Limit	10 mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	2.0	
<b>Gas Density (dry at 1 atmosphere)</b>	1.29 kg/m <sup>3</sup>	
<b>Dry Molecular Weight</b>	28.9 g/g-mole	

Notes \*1 Emission concentration at Standard conditions of 0<sup>o</sup>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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 16-Dec-15

**ANALYTE(S)****METHOD**

Hydrogen Chloride

NSW EPA TM - 7 &amp; 8

Chlorine

NSW EPA TM - 7 &amp; 8

Sulfuric Acid Mist

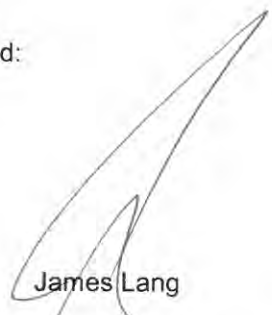
NSW EPA TM - 3

Sulfur Dioxide

NSW EPA TM - 4

Observations made during testing period:

Sampling Performed By:

  
James Lang  
for Dylan Turnbull

ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Hydrogen Chloride  
 Test 2: Chlorine  
 Test 3: Sulfuric Acid Mist (H2SO4 as SO3)  
 Test 4: Sulfur Dioxide (SO2 as SO3)

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

ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Hydrogen Chloride  
 Test 2: Chlorine  
 Test 3: Sulfuric Acid Mist (H2SO4 as SO3)  
 Test 4: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 10:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	10:00	3	20.6	0.2
2	10:01	3	20.6	0.2
3	10:02	4	20.6	0.2
4	10:03	4	20.6	0.2
5	10:04	4	20.6	0.2
6	10:05	6	20.6	0.2
7	10:06	5	20.6	0.2
8	10:07	5	20.6	0.2
Averages:		4.3 ppm	20.6 %	0.2 %

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

Measurements

CO: 0.0004 %,(dry)	N <sub>2</sub> : 79.2 %,(dry)
CO <sub>2</sub> : 0.2 %,(dry)	O <sub>2</sub> : 20.6 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0004 %,(wet)	N <sub>2</sub> : 77.9 %,(wet)
CO <sub>2</sub> : 0.2 %,(wet)	O <sub>2</sub> : 20.3 %,(wet)
H <sub>2</sub> O: 1.60 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Hydrogen Chloride  
 Test 2: Chlorine  
 Test 3: Sulfuric Acid Mist (H2SO4 as SO3)  
 Test 4: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 12:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	12:00	14	20.4	0.3
2	12:01	14	20.4	0.3
3	12:02	15	20.4	0.3
4	12:03	15	20.4	0.3
5	12:04	16	20.4	0.3
6	12:05	15	20.4	0.3
7	12:06	16	20.4	0.3
8	12:07	16	20.4	0.3
Averages:		15.1 ppm	20.4 %	0.3 %

Moisture content (M3): 0.97  
 Moisture percentage (M2): 2.76 %

Measurements

CO: 0.0015 %,(dry)	N <sub>2</sub> : 79.3 %,(dry)
CO <sub>2</sub> : 0.3 %,(dry)	O <sub>2</sub> : 20.4 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0015 %,(wet)	N <sub>2</sub> : 77.1 %,(wet)
CO <sub>2</sub> : 0.3 %,(wet)	O <sub>2</sub> : 19.8 %,(wet)
H <sub>2</sub> O: 2.76 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

**Emission Measurement Calculations Spreadsheet**

**Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1:Hydrogen Chloride  
 Test 2:Chlorine  
 Test 3:Sulfuric Acid Mist (H<sub>2</sub>SO<sub>4</sub> as SO<sub>3</sub>)  
 Test 4:Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>)

Time :		10:00	Barometric Pressure :		1014 hPa
Page No. :		1 of 1	Pitot Correction Factor :		0.84
Sampling Port No:		1 to 2	Stack Gas Density:		1.28 kg/m <sup>3</sup>
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	0.173	71.0	344.2	15.5
1/2	165	0.173	71.0	344.2	15.5
1/3	262	0.195	72.0	345.2	16.5
1/4	383	0.153	72.0	345.2	14.6
1/5	554	0.130	73.0	346.2	13.5
1/6	1036	0.166	73.0	346.2	15.2
1/7	1208	0.178	73.0	346.2	15.7
1/8	1328	0.146	73.0	346.2	14.3
1/9	1425	0.137	74.0	347.2	13.9
1/10	1509	0.130	74.0	347.2	13.5
2/1	81	0.184	72.0	345.2	16.0
2/2	165	0.173	72.0	345.2	15.5
2/3	262	0.185	73.0	346.2	16.1
2/4	383	0.143	73.0	346.2	14.1
2/5	554	0.145	73.0	346.2	14.2
2/6	1036	0.158	73.0	346.2	14.9
2/7	1208	0.175	73.0	346.2	15.6
2/8	1328	0.147	74.0	347.2	14.4
2/9	1425	0.138	74.0	347.2	13.9
2/10	1509	0.128	74.0	347.2	13.4
Average			72.9	346.1	14.8

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -9.8 mm  
 Absolute pressure in stack (hPa) : 1013.04 hPa

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HYDROGEN CHLORIDE

Date: 16-Dec-15
Client: Weston Aluminium
AECOM's Project No.: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: g4
Sampling Port No.: 1 to 2
Page No.: 1 of 1
Sample Nozzle Area (An): 1.27 x 10^-5 m^2
Thimble No.: NA
Blank thimble No.: NA

Leak Check (Pre-Sampling)

Meter start: 374.7804 Meter finish: 374.7804
Time start: 10:14 Time finish: 10:15

Leak Check (Post Sampling)

Meter start: 375.8078 Meter finish: 375.8078
Time start: 12:02 Time finish: 12:03

Therefore, leakage rate = no leak L/min

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

(>0.1 l/min. is unacceptable)

Repeat:

Repeat:

Comments:

Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 374.7825 Time start: 10:18
Meter correction factor (GMf) : 1.0100

Table with 8 columns: 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). Rows include samples 1/1-1/10 and 2/1-2/10, plus an Averages row.

Meter Finish: 375.8078 Time Finish: 11:59
Total Condensate collected: 13 ml Silica gel No(s) used: FA9

ANZ

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS

SAMPLING OF CHLORINE

Date: 16-Dec-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: g4
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.27 x 10^-5 m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling)

Meter start: 374.7804 Meter finish: 374.7804
Time start: 10:14 Time finish: 10:15

Leak Check (Post Sampling)

Meter start: 375.8078 Meter finish: 375.8078
Time start: 12:02 Time finish: 12:03

Therefore, leakage rate = no leak L/min Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable) (>0.1 l/min. is unacceptable)

Repeat: Repeat:
Comments: Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 374.7825 Time start: 10:18
Meter correction factor (GMf) : 1.0100

Table with 8 columns: 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). Rows include 1/1 to 1/10 and 2/1 to 2/10.

Averages Meter Finish: 375.8078 Time Finish: 11:59
Total Condensate collected: 13 ml Silica gel No(s) used: FA9

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3) AND SULFUR DIOXIDE (SO2 AS SO3)

Date: 16-Dec-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: s2
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.42 x 10^-5 m^2
Thimble No: NA
Blank thimble No: NA

Leak Check (Pre-Sampling) Meter start: 5601.3932 Meter finish: 5601.3932 Time start: 10:15 Time finish: 10:16
Leak Check (Post Sampling) Meter start: 5602.5999 Meter finish: 5602.5999 Time start: 12:04 Time finish: 12:05

Therefore, leakage rate = no leak L/min
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1014 hPa (start); 1014 hPa (finish)
Meter start: 5601.3945 Time start: 10:18
Meter correction factor (GMf): 1.0100

Table with 8 columns: 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). Rows 1/1 to 2/10 and Averages.

Meter Finish: 5602.5991 Time Finish: 11:59
Total Condensate collected: 10 ml Silica gel No(s) used: C19



**STACK ANALYSIS - FINAL CALCULATIONS**

**Hydrogen Chloride**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.0356 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	29.0 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	302.2 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	0.9369 m <sup>3</sup>		

(B) Hydrogen Chloride concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	Hydrogen Chloride Weight:	<0.005 g
Final Hydrogen Chloride Weight (M <sub>p1</sub> ):	<0.005 g		
Hydrogen Chloride Concentration (C <sub>1</sub> ):	=M <sub>p1</sub> /MV <sub>4</sub> =	<0.0053 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		and C <sub>2</sub> =	<5.3 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
CO <sub>2</sub> Basis	12 %		
Average CO <sub>2</sub> %:	0.3 %		

Therefore, C <sub>c</sub> :	= C <sub>a</sub> x 12/CO <sub>2</sub> % =	<0.25 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO <sub>2</sub> )
	and C <sub>c1</sub> =	<250 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO <sub>2</sub> )

O <sub>2</sub> Basis	7 %		
Average O <sub>2</sub> %:	20.5 %		
Therefore, C <sub>b</sub> :	=C <sub>a</sub> x (21 - O <sub>2ref</sub> %)/(21 - O <sub>2mea</sub> %)	<0.15 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )	
	and C <sub>b1</sub> =	<150 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )	

(C) Moisture content

Silica Gel Number:	FA9		
V <sub>v</sub> =	9.2 g (from laboratory report)	V <sub>w</sub> =	13 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V <sub>wc(std)</sub> ) =	0.0173		
Volume of Water Vapour Condensed (V <sub>wsg(std)</sub> ) =	0.0123		
Therefore, B <sub>ws</sub> =	$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$		
B <sub>ws</sub> =	3.06 %		

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

**Hydrogen Chloride**

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

- (i) Initial gas density for sampling: 1.28 kg/m<sup>3</sup> (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):  
 1.29 kg/m<sup>3</sup> (0°C, wet, 1 atm pressure)  
 1.29 kg/m<sup>3</sup> (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions = (ii) x  $\frac{(273.2)}{(273.2+T_s)}$  x  $\frac{(P_s)}{(1013.25)}$   
 = 1.016 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.82 m/s
- (ii) Average of post-sampling velocities: 14.93 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):  
 14.87 m/s (stack conditions, wet)  
 N/A m/s (stack conditions, wet)  
 (**Note:** (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.80 m<sup>3</sup>/s (stack conditions)

Q<sub>std</sub> = Q<sub>stack</sub> x  $\frac{P_s}{(P_{std})}$  x  $\frac{(T_{std})}{(T_s)}$  x  $\frac{(100 - B_w)}{100}$

Q<sub>std</sub> = 24.3 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	<0.13	g/s (0°C, dry gas, 1 atm pressure )		
	=	<130	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Q <sub>std</sub> =	<6.2	g/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	<6200	mg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Q <sub>std</sub> =	<3.6	g/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	<3600	mg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Chlorine**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.0356 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	29.0 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	302.2 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	0.9369 m <sup>3</sup>		

(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 <sub>p1</sub> /MV <sub>4</sub> =	<0.0053 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	

CO<sub>2</sub> Basis 12 % ;and C<sub>2</sub> = <5.3 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure)

Average CO<sub>2</sub>%: 0.3 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = <0.25 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

;and C<sub>c1</sub> = <250 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %

Average O<sub>2</sub>%: 20.5 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = <0.15 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

;and C<sub>b1</sub> = <150 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: FA9

V<sub>v</sub> = 9.2 g (from laboratory report) V<sub>w</sub> = 13 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0173

Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0123

Therefore, B<sub>ws</sub> = 
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

B<sub>ws</sub> = 3.06 %

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

**Chlorine**

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

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

= 1.016 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.82 m/s
- (ii) Average of post-sampling velocities: 14.93 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
  - 14.87 m/s (stack conditions, wet)
  - N/A m/s (stack conditions, wet)

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

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

Qstack = Vs x A = 31.80 m<sup>3</sup>/s (stack conditions)

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

Qstd = 24.3 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	<0.13	g/s (0°C, dry gas, 1 atm pressure )		
	=	<130	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Qstd =	<6.2	g/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	<6200	mg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Qstd =	<3.6	g/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	<3600	mg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Sulfuric Acid Mist (H2SO4 as SO3)**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.2166 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	37.0 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	310.2 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.0723 m <sup>3</sup>		

(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 <sub>p1</sub> /MV <sub>4</sub> =		<0.0019 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
		;and C <sub>2</sub> =	<1.9 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
CO <sub>2</sub> Basis	12 %		
Average CO <sub>2</sub> %:	0.3 %		

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = <0.091 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = <91 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub>%: 20.5 %

Therefore, C<sub>b</sub>: = C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = <0.053 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)  
 ;and C<sub>b1</sub> = <53 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: C19  
 V<sub>v</sub> = 7.6 g (from laboratory report) V<sub>w</sub> = 10 mL (=grams) (recorded on Laboratory Form 108)  
 Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0133  
 Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0101

Therefore, B<sub>ws</sub> =  $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B<sub>ws</sub> = 2.14 %

Emission Measurement Calculations Spreadsheet

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

**Sulfuric Acid Mist (H2SO4 as SO3)**

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

- (i) Initial gas density for sampling: 1.28 kg/m<sup>3</sup> (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):  
 1.29 kg/m<sup>3</sup> (0°C, wet, 1 atm pressure)  
 1.29 kg/m<sup>3</sup> (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions = (ii) x  $\frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$   
 = 1.016 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.82 m/s
- (ii) Average of post-sampling velocities: 14.93 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):  
 14.87 m/s (stack conditions, wet)  
 N/A m/s (stack conditions, wet)  
 (Note: (Vs) is from all individual data, not from (i) and (ii) alone.)

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.80 m<sup>3</sup>/s (stack conditions)

Q<sub>std</sub> = Q<sub>stack</sub> x  $\frac{P_s}{(P_{std})} \times \frac{(T_{std})}{(T_s)} \times \frac{(100 - B_w)}{100}$

Q<sub>std</sub> = 24.5 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R<sub>m</sub> = C<sub>1a</sub> x Q<sub>std</sub> = <0.047 g/s (0°C, dry gas, 1 atm pressure )  
 = <47 mg/s (0°C, dry gas, 1 atm pressure )

C<sub>1a</sub> x Q<sub>std</sub> = <2.2 g/s (0°C, dry gas, 1 atm pressure 12% CO<sub>2</sub>)  
 = <2200 mg/s (0°C, dry gas, 1 atm pressure 12% CO<sub>2</sub>)

C<sub>1a</sub> x Q<sub>std</sub> = <1.3 g/s (0°C, dry gas, 1 atm pressure 7% O<sub>2</sub>)  
 = <1300 mg/s (0°C, dry gas, 1 atm pressure 7% O<sub>2</sub>)

**STACK ANALYSIS - FINAL CALCULATIONS**

**Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>)**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	1.2166 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	37.0 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	310.2 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	1.0723 m <sup>3</sup>		

(B) So<sub>2</sub> as SO<sub>3</sub> concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	So <sub>2</sub> as SO <sub>3</sub> Weight:	<0.01 g
Final So <sub>2</sub> as SO <sub>3</sub> Weight (Mp <sub>1</sub> ):	<0.01 g		
So <sub>2</sub> as SO <sub>3</sub> Concentration (C <sub>1</sub> ):	=M <sub>p1</sub> /MV <sub>4</sub> =	<0.0093 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	

CO<sub>2</sub> Basis 12 % ;and C<sub>2</sub> = <9.3 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure)

Average CO<sub>2</sub> %: 0.3 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = <0.45 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

;and C<sub>c1</sub> = <450 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %

Average O<sub>2</sub> %: 20.5 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = <0.26 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

;and C<sub>b1</sub> = <260 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number: C19

V<sub>v</sub> = 7.6 g (from laboratory report) V<sub>w</sub> = 10 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed (V<sub>wc(std)</sub>) = 0.0133

Volume of Water Vapour Condensed (V<sub>wsg(std)</sub>) = 0.0101

Therefore, B<sub>ws</sub> =  $\frac{(V_{wc(std)} + V_{wsg(std)})}{(V_{wc(std)} + V_{wsg(std)} + V_{m(std)})}$

B<sub>ws</sub> = 2.14 %

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

**Sulfur Dioxide (SO<sub>2</sub> as SO<sub>3</sub>)**

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

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

= 1.016 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.82 m/s
- (ii) Average of post-sampling velocities: 14.93 m/s
- (iii) Average of while-sampling velocities: N/A m/s
- (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
  - 14.87 m/s (stack conditions, wet)
  - N/A m/s (stack conditions, wet)

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

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.80 m<sup>3</sup>/s (stack conditions)

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

Q<sub>std</sub> = 24.5 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	<0.23	g/s (0°C, dry gas, 1 atm pressure )		
	=	<230	mg/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Q <sub>std</sub> =	<11	g/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	<11000	mg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Q <sub>std</sub> =	<6.4	g/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	<6400	mg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

Emission Measurement Calculations Spreadsheet

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 16-Dec-15 HYDROGEN CHLORIDE CHLORINE SULFURIC ACID MIST (H2SO4 AS SO3) SULFUR DIOXIDE (SO2 AS SO3)		
<b>Sampling Conditions:</b>		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	73.6 °C	346.8 K
Stack pressure (average)	1013 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	32 m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24 m <sup>3</sup> /s	
<b>Hydrogen Chloride Testing</b>		
Test Period	10:18	- 11:59
Hydrogen Chloride Mass	<5 mg	
Gas Volume Sampled	0.937 m <sup>3</sup>	
Hydrogen Chloride Emission*1	<5.3 mg/m <sup>3</sup>	
Hydrogen Chloride Mass Emission Rate*2	<130 mg/s	
Regulatory Limit	400 mg/m <sup>3</sup>	
<b>Chlorine Testing</b>		
Test Period	10:18	- 11:59
Chlorine Mass	<5 mg	
Gas Volume Sampled	0.937 m <sup>3</sup>	
Chlorine Emission*1	<5.3 mg/m <sup>3</sup>	
Chlorine Mass Emission Rate*2	<130 mg/s	
Regulatory Limit	NA mg/m <sup>3</sup>	
<b>Sulfuric Acid Mist (H2SO4 as SO3) Testing</b>		
Test Period	10:18	- 11:59
Sulfuric Acid Mist (H2SO4 as SO3) Mass	<2 mg	
Gas Volume Sampled	1.07 m <sup>3</sup>	
Sulfuric Acid Mist (H2SO4 as SO3) Emission*1	<1.9 mg/m <sup>3</sup>	
Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2	<47 mg/s	
Regulatory Limit	100 mg/m <sup>3</sup>	
<b>Sulfur Dioxide (SO2 as SO3) Testing</b>		
Test Period	10:18	- 11:59
Sulfur Dioxide (SO2 as SO3) Mass	<10 mg	
Gas Volume Sampled	1.07 m <sup>3</sup>	
Sulfur Dioxide (SO2 as SO3) Emission*1	<9.3 mg/m <sup>3</sup>	
Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2	<230 mg/s	
Regulatory Limit	NA mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	2.8	
<b>Gas Density (dry at 1 atmosphere)</b>	1.29 kg/m <sup>3</sup>	
<b>Dry Molecular Weight</b>	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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 16-Dec-15

**ANALYTE(S)****METHOD**

Dioxins and Furans

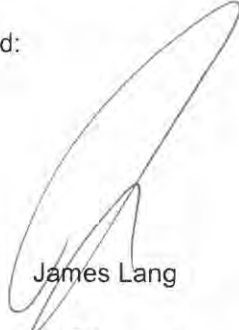
NSW EPA TM - 18

Polycyclic Aromatic Hydrocarbons

NSW EPA OM - 6

Observations made during testing period:

Sampling Performed By:

  
James Lang  
Dylan Turnbull


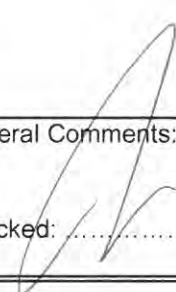
ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Dioxins and Furans Lower Bound  
 Test 2: Dioxins and Furans Middle Bound  
 Test 3: Polycyclic Aromatic Hydrocarbons

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

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Dioxins and Furans Lower Bound  
 Test 2: Dioxins and Furans Middle Bound  
 Test 3: Polycyclic Aromatic Hydrocarbons

Sampling time start: 7:45		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	7:45	16	20.6	0.2
2	7:46	17	20.6	0.2
3	7:47	17	20.6	0.2
4	7:48	15	20.6	0.2
5	7:49	14	20.6	0.2
6	7:50	12	20.6	0.2
7	7:51	12	20.6	0.2
8	7:52	14	20.6	0.2
Averages:		14.6 ppm	20.6 %	0.2 %

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

Measurements

CO: 0.0015 %,(dry)	N <sub>2</sub> : 79.2 %,(dry)
CO <sub>2</sub> : 0.2 %,(dry)	O <sub>2</sub> : 20.6 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0014 %,(wet)	N <sub>2</sub> : 77.9 %,(wet)
CO <sub>2</sub> : 0.2 %,(wet)	O <sub>2</sub> : 20.3 %,(wet)
H <sub>2</sub> O: 1.60 % (=M2)	
Therefore, stack gas density (GD) = 1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)	
Therefore, stack gas density (GD) = 1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)	

ANZ

**Emission Measurement Calculations Spreadsheet**

Q4AN(EV)-332-FM31

**STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Dioxins and Furans Lower Bound  
 Test 2: Dioxins and Furans Middle Bound  
 Test 3: Polycyclic Aromatic Hydrocarbons

Sampling time start: 14:00		Sampling port No.: 1		
Measurement No.	Time sampled	CO (ppm). (dry)	O <sub>2</sub> (%), (dry)	CO <sub>2</sub> (%), (dry)
1	14:00	21	20.4	0.3
2	14:01	22	20.4	0.3
3	14:02	25	20.4	0.3
4	14:03	26	20.4	0.3
5	14:04	28	20.4	0.3
6	14:05	27	20.4	0.3
7	14:06	29	20.4	0.3
8	14:07	28	20.4	0.3
Averages:		25.8 ppm	20.4 %	0.3 %

Moisture content (M3): 0.98  
 Moisture percentage (M2): 2.12 %

Measurements

CO: 0.0026 %,(dry)	N <sub>2</sub> : 79.3 %,(dry)
CO <sub>2</sub> : 0.3 %,(dry)	O <sub>2</sub> : 20.4 %,(dry)
Gas Compositions converted to wet basis:	
CO: 0.0025 %,(wet)	N <sub>2</sub> : 77.6 %,(wet)
CO <sub>2</sub> : 0.3 %,(wet)	O <sub>2</sub> : 20.0 %,(wet)
H <sub>2</sub> O: 2.12 % (=M2)	
Therefore, stack gas density (GD) =	1.28 kg/m <sup>3</sup> (0°C, wet, 1 atm pressure)
Therefore, stack gas density (GD) =	1.29 kg/m <sup>3</sup> (0°C, dry, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

**Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses**

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1  
 Test 1: Dioxins and Furans Lower Bound  
 Test 2: Dioxins and Furans Middle Bound  
 Test 3: Polycyclic Aromatic Hydrocarbons

Time : 7:50		Barometric Pressure : 1014 hPa			
Page No. : 1 of 1		Pitot Correction Factor : 0.84			
Sampling Port No: 1 to 2		Stack Gas Density: 1.28 kg/m <sup>3</sup>			
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	0.195	81.0	354.2	16.7
1/2	165	0.195	82.0	355.2	16.7
1/3	262	0.177	82.0	355.2	15.9
1/4	383	0.148	83.0	356.2	14.6
1/5	554	0.163	83.0	356.2	15.3
1/6	1036	0.129	83.0	356.2	13.6
1/7	1208	0.137	84.0	357.2	14.1
1/8	1328	0.140	84.0	357.2	14.2
1/9	1425	0.131	83.0	356.2	13.7
1/10	1509	0.116	83.0	356.2	12.9
2/1	81	0.186	82.0	355.2	16.3
2/2	165	0.189	82.0	355.2	16.5
2/3	262	0.179	82.0	355.2	16.0
2/4	383	0.146	83.0	356.2	14.5
2/5	554	0.167	83.0	356.2	15.5
2/6	1036	0.127	84.0	357.2	13.5
2/7	1208	0.141	84.0	357.2	14.3
2/8	1328	0.148	84.0	357.2	14.6
2/9	1425	0.139	84.0	357.2	14.2
2/10	1509	0.106	83.0	356.2	12.3
Average			83.0	356.2	14.8

Static Pressure (Dwyer) (Pa): kPa  
 Static Pressure (U-tube, if required) : -9.8 mm  
 Absolute pressure in stack (hPa) : 1013.04 hPa





## Emission Measurement Calculations Spreadsheet

## Stack Analysis - Speciated Polycyclic Aromatic Hydrocarbons (PAH) Results

Date: 16-Dec-15  
 Client: Weston Aluminium  
 AECOM's Project No: 60341673  
 Stack/Duct Description: Stack 1

	Sample Result			Emission		Mass Emission Rate	
	(ng)	(µg)	(mg)	(µg/m <sup>3</sup> )	(mg/m <sup>3</sup> )	(µg/s)	(mg/s)
Naphthalene	160000	160	0.16	42	0.042	990	0.99
2 - Methyl naphthalene	55000	55	0.055	14	0.014	340	0.34
Acenaphthylene	330000	330	0.33	86	0.086	2000	2
Acenaphthene	11000	11	0.011	2.9	0.0029	68	0.068
Fluorene	91000	91	0.091	24	0.024	560	0.56
Phenanthrene	300000	300	0.3	78	0.078	1900	1.9
Anthracene	37000	37	0.037	9.7	0.0097	230	0.23
Fluoranthene	62000	62	0.062	16	0.016	380	0.38
Pyrene	62000	62	0.062	16	0.016	380	0.38
Benz(a)anthracene	32	0.032	0.000032	0.0084	0.0000084	0.2	0.0002
Chrysene	73	0.073	0.000073	0.019	0.000019	0.45	0.00045
Benzo(b)fluoranthene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(k)fluoranthene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(e)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(a)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Perylene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Indeno(123:cd)pyrene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Dibenzo(ah)anthracene	<20	<0.02	<0.00002	<0.0052	<0.0000052	<0.12	<0.00012
Benzo(ghi)perylene	29	0.029	0.000029	0.0076	0.0000076	0.18	0.00018
Sum of reported PAH's	1100000	1100	1.1	290	0.29	6800	6.8

60341673 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 <sup>3</sup>	Total Toxic Equivalence (1-TEQs) ng/m <sup>3</sup>
2,3,7,8-TCDF	0.014	0.1	0.0014	0.0037	0.00037
Total TCDF isomers	0.45				
2,3,7,8-TCDD	<0.002	1	0.001	<0.00052	0.00026
Total TCDD isomers	0.034				
1,2,3,7,8-PeCDF	0.0029	0.05	0.000145	0.00076	0.000038
2,3,4,7,8-PeCDF	<0.002	0.5	0.0005	<0.00052	0.00013
Total PeCDF isomers	0.018				
1,2,3,7,8-PeCDD	0.0025	0.5	0.00125	0.00065	0.00033
Total PeCDD isomers	0.012				
1,2,3,4,7,8-HxCDF	<0.002	0.1	0.0001	<0.00052	0.000026
1,2,3,6,7,8-HxCDF	0.0016	0.1	0.00016	0.00042	0.000042
2,3,4,6,7,8-HxCDF	<0.0009	0.1	0.000045	<0.00023	0.000012
1,2,3,7,8,9-HxCDF	<0.001	0.1	0.00005	<0.00026	0.000013
Total HxCDF isomers	0.0037				
1,2,3,4,7,8-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
1,2,3,6,7,8-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
1,2,3,7,8,9-HxCDD	<0.001	0.1	0.00005	<0.00026	0.000013
Total HxCDD isomers	<0.004				
1,2,3,4,6,7,8-HpCDF	<0.002	0.01	0.00001	<0.00052	0.0000026
1,2,3,4,7,8,9-HpCDF	<0.001	0.01	0.000005	<0.00026	0.0000013
Total HpCDF isomers	<0.003				
1,2,3,4,6,7,8-HpCDD	<0.002	0.01	0.00001	<0.00052	0.0000026
Total HpCDD isomers	<0.004				
OCDF	<0.002	0.001	0.000001	<0.00052	0.00000026
OCDD	0.0094	0.001	0.0000094	0.0025	0.0000025

**I-TEQ<sub>DF</sub>**

Lower Bound (excluding LOD Values)

0.003 ng

Middle Bound (including half LOD Values)

0.0048 ng

Date Tested

16-Dec-15

**STACK ANALYSIS - FINAL CALCULATIONS**

**Dioxins and Furans Lower Bound**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	4.3655 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	38.4 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	311.6 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	3.8304 m <sup>3</sup>		

(B) Lower Bound concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	µg
Thimble No. used:	NA	Lower Bound Weight:	0.000003 µg
Final Lower Bound Weight (Mp1):	0.00000 µg		
Lower Bound Concentration (C1):	=M <sub>p1</sub> /MV <sub>4</sub> =		7.8E-07 µg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)

;and C<sub>2</sub> = 0.00078 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure)

CO<sub>2</sub> Basis 12 %  
 Average CO<sub>2</sub> %: 0.3 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.000037 µg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

;and C<sub>c1</sub> = 0.037 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O<sub>2</sub> Basis 7 %  
 Average O<sub>2</sub> %: 20.5 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = 0.000022 µg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

;and C<sub>b1</sub> = 0.022 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number:	Z18		
V <sub>v</sub> =	27.4 g (from laboratory report)	V <sub>w</sub> =	35 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V <sub>wc(std)</sub> ) =	0.0467		
Volume of Water Vapour Condensed (V <sub>wsg(std)</sub> ) =	0.0366		

Therefore, B<sub>ws</sub> = 
$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

B<sub>ws</sub> = 2.13 %

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

# Emission Measurement Calculations Spreadsheet

## Dioxins and Furans Lower Bound

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

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

= 1.000 kg/m<sup>3</sup> (stack conditions, wet)

### (E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.77 m/s
  - (ii) Average of post-sampling velocities: 14.50 m/s
  - (iii) Average of while-sampling velocities: N/A m/s
  - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
    - 14.63 m/s (stack conditions, wet)
    - N/A m/s (stack conditions, wet)
- (Note: (Vs) is from all individual data, not from (i) and (ii) alone.)**

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.28 m<sup>3</sup>/s (stack conditions)

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

Q<sub>std</sub> = 23.7 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

### (G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	0.000019	µg/s (0°C, dry gas, 1 atm pressure)	)	
	=	0.019	ng/s (0°C, dry gas, 1 atm pressure)	)	
	C <sub>1a</sub> x Q <sub>std</sub> =	0.00089	µg/s (0°C, dry gas, 1 atm pressure)	12%	CO <sub>2</sub> )
	=	0.89	ng/s (0°C, dry gas, 1 atm pressure)	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Q <sub>std</sub> =	0.00052	µg/s (0°C, dry gas, 1 atm pressure)	7%	O <sub>2</sub> )
	=	0.52	ng/s (0°C, dry gas, 1 atm pressure)	7%	O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Dioxins and Furans Middle Bound**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	4.3655 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	36.5 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	309.7 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	3.8539 m <sup>3</sup>		

(B) Middle Bound concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	µg
Thimble No. used:	NA	Middle Bound Weight:	0.0000048 µg
Final Middle Bound Weight (Mp1):	0.00000 µg		
Middle Bound Concentration (C1):	=M <sub>p1</sub> /MV <sub>4</sub> =	0.0000012 µg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	

;and C<sub>2</sub> = 0.0012 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure)

CO <sub>2</sub> Basis	12 %
Average CO <sub>2</sub> %:	0.3 %

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.000058 µg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

;and C<sub>c1</sub> = 0.058 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O <sub>2</sub> Basis	7 %
Average O <sub>2</sub> %:	20.5 %

Therefore, C<sub>b</sub>: =C<sub>a</sub> x (21 - O<sub>2ref</sub>%)/(21 - O<sub>2mea</sub>%) = 0.000034 µg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

;and C<sub>b1</sub> = 0.034 ng/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O<sub>2</sub>)

(C) Moisture content

Silica Gel Number:	Z18		
V <sub>v</sub> =	27.4 g (from laboratory report)	V <sub>w</sub> =	35 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V <sub>wc(std)</sub> ) =	0.0467		
Volume of Water Vapour Condensed (V <sub>wsg(std)</sub> ) =	0.0366		
Therefore, B <sub>ws</sub> =	$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$		
B <sub>ws</sub> =	2.11 %		

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

# Emission Measurement Calculations Spreadsheet

## Dioxins and Furans Middle Bound

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

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

$$= 1.000 \text{ kg/m}^3 \text{ (stack conditions, wet)}$$

### (E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.77 m/s
  - (ii) Average of post-sampling velocities: 14.50 m/s
  - (iii) Average of while-sampling velocities: N/A m/s
  - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
    - 14.63 m/s (stack conditions, wet)
    - N/A m/s (stack conditions, wet)
- (Note:** (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Q<sub>stack</sub> = V<sub>s</sub> x A = 31.28 m<sup>3</sup>/s (stack conditions)

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

Q<sub>std</sub> = 23.7 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

### (G) Mass Emission Rate

R <sub>m</sub> =	C <sub>1a</sub> x Q <sub>std</sub> =	0.000028	μg/s (0°C, dry gas, 1 atm pressure )		
	=	0.028	ng/s (0°C, dry gas, 1 atm pressure )		
	C <sub>1a</sub> x Q <sub>std</sub> =	0.0014	μg/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	=	1.4	ng/s (0°C, dry gas, 1 atm pressure	12%	CO <sub>2</sub> )
	C <sub>1a</sub> x Q <sub>std</sub> =	0.0008	μg/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )
	=	0.8	ng/s (0°C, dry gas, 1 atm pressure	7%	O <sub>2</sub> )

**STACK ANALYSIS - FINAL CALCULATIONS**

**Polycyclic Aromatic Hydrocarbons**

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

Date: 16-Dec-15 Client: Weston Aluminium  
 AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume (MV <sub>3</sub> ):	4.3655 m <sup>3</sup>	Average barometric pressure (P <sub>BARO</sub> ):	1014 hPa
Average gas meter temp. (T <sub>M,2</sub> ):	38.4 °C	Average pressure at meter (P <sub>M,2</sub> ):	1014.00 hPa
	311.6 K		
Sample gas volume (MV <sub>4</sub> ); (0°C, dry gas, 1 atm pressure):	3.8304 m <sup>3</sup>		

(B) PAH concentration at standard conditions

Blank thimble No.:	NA	Blank weight:	g
Thimble No. used:	NA	PAH Weight:	0.0011 g
Final PAH Weight (Mp1):	0.00110 g		
PAH Concentration (C1):	=M <sub>p1</sub> /MV <sub>4</sub> =	0.00029 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure)	
		and C <sub>2</sub> =	0.29 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure)
CO <sub>2</sub> Basis	12 %		
Average CO <sub>2</sub> %:	0.3 %		

Therefore, C<sub>c</sub>: = C<sub>a</sub> x 12/CO<sub>2</sub>% = 0.014 g/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)  
 ;and C<sub>c1</sub> = 14 mg/m<sup>3</sup> (0°C, dry gas, 1atm pressure, 12% CO<sub>2</sub>)

O <sub>2</sub> Basis	7 %		
Average O <sub>2</sub> %:	20.5 %		
Therefore, C <sub>b</sub> :	=C <sub>a</sub> x (21 - O <sub>2ref</sub> %)/(21 - O <sub>2mea</sub> %)	0.0081 g/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )	
		;and C <sub>b1</sub> =	8.1 mg/m <sup>3</sup> (0°C, dry gas, 1atm pressure, 7% O <sub>2</sub> )

(C) Moisture content

Silica Gel Number: Z18

V <sub>v</sub> =	27.4 g (from laboratory report)	V <sub>w</sub> =	35 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed (V <sub>wc(std)</sub> ) =	0.0467		
Volume of Water Vapour Condensed (V <sub>wsg(std)</sub> ) =	0.0366		
Therefore, B <sub>ws</sub> =	$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$		
B <sub>ws</sub> =	2.13 %		

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<sup>3</sup> (from Laboratory Form 107)
- (ii) Re-calculated gas density based on moisture content in (c):
  - 1.29 kg/m<sup>3</sup> (0°C, wet, 1 atm pressure)
  - 1.29 kg/m<sup>3</sup> (0°C, dry, 1 atm pressure)
- (iii) Gas density at stack conditions =  $(ii) \times \frac{(273.2)}{(273.2+T_s)} \times \frac{(P_s)}{(1013.25)}$ 
  - = 1.000 kg/m<sup>3</sup> (stack conditions, wet)

(E) Gas Velocities

- (i) Average of pre-sampling velocities: 14.77 m/s
  - (ii) Average of post-sampling velocities: 14.50 m/s
  - (iii) Average of while-sampling velocities: N/A m/s
  - (iv) Overall average of pre-sampling and post-sampling velocities (Vs):
    - 14.63 m/s (stack conditions, wet)
    - N/A m/s (stack conditions, wet)
- (Note: (Vs) is from all individual data, not from (i) and (ii) alone.)

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

Qstack = Vs x A = 31.28 m<sup>3</sup>/s (stack conditions)

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

Qstd = 23.7 m<sup>3</sup>/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm =	C <sub>1a</sub> x Qstd =	0.0069	g/s (0°C, dry gas, 1 atm pressure )	
	=	6.9	mg/s (0°C, dry gas, 1 atm pressure )	
	C <sub>1a</sub> x Qstd =	0.33	g/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	=	330	mg/s (0°C, dry gas, 1 atm pressure	12% CO <sub>2</sub> )
	C <sub>1a</sub> x Qstd =	0.19	g/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )
	=	190	mg/s (0°C, dry gas, 1 atm pressure	7% O <sub>2</sub> )

EMISSION MONITORING RESULTS, STACK 1 WESTON ALUMINIUM 16-Dec-15 DIOXINS AND FURANS  POLYCYCLIC AROMATIC HYDROCARBONS		
<b>Sampling Conditions:</b>		
Stack internal diameter at test location	1650 mm	
Stack gas temperature (average)	79.2 °C	352.4 K
Stack pressure (average)	1013 hPa	
Stack gas velocity (average, stack conditions)	15 m/s	
Stack gas flowrate (stack conditions)	31 m <sup>3</sup> /s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	24 m <sup>3</sup> /s	
<b>Dioxins and Furans Lower Bound Testing</b>		
Test Period	8:15	- 14:17
Dioxins and Furans Lower Bound Mass	0.003 ng	
Gas Volume Sampled	3.83 m <sup>3</sup>	
Dioxins and Furans Lower Bound Emission*1	0.00078 ng/m <sup>3</sup>	
Dioxins and Furans Lower Bound Mass Emission Rate*2	0.019 ng/s	
Regulatory Limit	0.1 ng/m <sup>3</sup>	
<b>Dioxins and Furans Middle Bound Testing</b>		
Test Period	8:15	- 14:17
Dioxins and Furans Middle Bound Mass	0.0048 ng	
Gas Volume Sampled	3.85 m <sup>3</sup>	
Dioxins and Furans Middle Bound Emission*1	0.0012 ng/m <sup>3</sup>	
Dioxins and Furans Middle Bound Mass Emission Rate*2	0.028 ng/s	
Regulatory Limit	0.1 ng/m <sup>3</sup>	
<b>Polycyclic Aromatic Hydrocarbons Testing</b>		
Test Period	8:15	- 14:17
Polycyclic Aromatic Hydrocarbons Mass	1.1 mg	
Gas Volume Sampled	3.83 m <sup>3</sup>	
Polycyclic Aromatic Hydrocarbons Emission*1	0.29 mg/m <sup>3</sup>	
Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2	6.9 mg/s	
Regulatory Limit	NA mg/m <sup>3</sup>	
<b>Moisture Content (%)</b>	2.1	
<b>Gas Density (dry at 1 atmosphere)</b>	1.29 kg/m <sup>3</sup>	
<b>Dry Molecular Weight</b>	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<sub>std</sub> in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS**



Client: Weston Aluminium  
 Project Number: 60341673  
 Stack Description: Stack 1  
 Date: 16-Dec-15  
 Rotameter Correction Factor: 1.01  
 Time Start: 12:11  
 Time Finish: 12:41  
 Sample Flow Rate: 0.2 L/min  
 Sample Time: 30 min  
 Sampled Volume: 6.06 litres  
 0.00606 m<sup>3</sup>

Ambient Temperature: 21 °C  
 Barometric Pressure: 1014 hPa  
 Stack Gas Moisture: 2.1 %

Corrected Volume: 0.00551 m<sup>3</sup> (0°C, dry gas, 1 atmosphere pressure)  
 Stack Flow Rate: 24 m<sup>3</sup>/s (0°C, dry gas, 1 atmosphere pressure)

VOC AIR EMISSION TEST RESULTS					
Analyte	Sample µg	Blank µg	Sample Blank Corrected µg	(mg/m <sup>3</sup> )	mg/s
Acetone	<1.0	<1.0	<1.0	<0.18	<4.3
1,1-dichloroethane	<1.0	<1.0	<1.0	<0.18	<4.3
2-Butanone	<1.0	<1.0	<1.0	<0.18	<4.3
Chloroform	<1.0	<1.0	<1.0	<0.18	<4.3
Benzene	<1.0	<1.0	<1.0	<0.18	<4.3
1-heptene	<1.0	<1.0	<1.0	<0.18	<4.3
n-heptane	<1.0	<1.0	<1.0	<0.18	<4.3
Trichloroethene	<1.0	<1.0	<1.0	<0.18	<4.3
MIBK	<1.0	<1.0	<1.0	<0.18	<4.3
Toluene	1.1	<1.0	0.6	0.11	2.6
2-hexanone	<1.0	<1.0	<1.0	<0.18	<4.3
Chlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
Ethyl Benzene	<1.0	<1.0	<1.0	<0.18	<4.3
m- & p-xylene	<2.0	<0.2	<2.0	<0.36	<8.6
o-xylene	<1.0	<1.0	<1.0	<0.18	<4.3
Styrene	<1.0	<1.0	<1.0	<0.18	<4.3
Cyclohexanone	<1.0	<1.0	<1.0	<0.18	<4.3
Isopropylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
2-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.3
4-chlorotoluene	<1.0	<1.0	<1.0	<0.18	<4.3
1,3,5-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
n-decane	<1.0	<1.0	<1.0	<0.18	<4.3
1,2,4-trimethylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,3-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,4-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
1,2-dichlorobenzene	<1.0	<1.0	<1.0	<0.18	<4.3
n-butylbenzene	<1.0	<1.0	<1.0	<0.18	<4.3
Hexachlorobutadiene	<1.0	<1.0	<1.0	<0.18	<4.3
Total	1.1		0.6	0.11	2.6

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 (26 pages)

## Appendix B Laboratory Analytical Reports (26 pages)

# Steel River Testing



5/11 McIntosh Drive, Mayfield West, NSW 2304

Phone: 02 49677880

## STACK EMISSION - MOISTURE REPORT

**Origin:** AECOM - Newcastle

**Report :** 10284-0-M

Page 1 of 1

**Project:** 60341673

**Description :** Stack Emission Samples

**Date :** 24-Dec-15

Received: 18-Dec-15

**Report To :** James Lang

**Copy to:** FILE

17 Warabrook Blvd, Warabrook NSW 2304

---

Jar ID	Moisture (g)
B66	13.0
C19	7.6
FA9	9.2
I34	14.9
P32	5.6
Z13	10.3
Z18	27.4



NATA Accredited Laboratory 18079

Accredited for compliance with  
ISO/IEC 17025

**Reported By:** M. Campbell

Michael Campbell

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

# Steel River Testing

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

## STACK EMISSION - PARTICULATES REPORT

**Origin:** AECOM - Newcastle  
**Project:** 60341673  
**Report :** 10284-0-P Page 1 of 1  
**Description :** Stack Emission Samples  
Received: 18-Dec-15  
**Date :** 24-Dec-15  
**Report To :** James Lang  
17 Warabrook Blvd, Warabrook NSW 2304  
**Copy to:** FILE

---

Thimble ID		Volume (mL)	Total Particulate Matter (g)
SRT-61	Filter	-	0.0030
T394	Filter	-	0.0003
ST1	Acetone Rinse	30	<0.0002



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



CERTIFICATE OF ANALYSIS

Table with 2 columns: Field Name and Value. Fields include Work Order (EN1514408), Client (AECOM Australia Pty Ltd), Contact (MR COLIN CLARKE), Address (17 WARABROOK BOULEVARDE), E-mail (colin.clarke@aecom.com), Telephone (+61 02 4911 4900), Facsimile (+61 02 4911 4999), Project (60341673 Task 1.1), Order number (60341673 Task 1.1), C-O-C number (---), Sampler (JAMES LANG), Site (---), Quote number (---), Page (1 of 11), Laboratory (Environmental Division Newcastle), Contact (---), Address (5/585 Maitland Road Mayfield West NSW Australia 2304), E-mail (---), Telephone (+61 2 4014 2500), Facsimile (+61 2 4967 7382), QC Level (NEPM 2013 B3 & ALS QC Standard), Date Samples Received (18-Dec-2015 14:45), Date Analysis Commenced (24-Dec-2015), Issue Date (04-Jan-2016 15:25), No. of samples received (16), No. of samples analysed (16).

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

This Certificate of Analysis contains the following information:

- General Comments
• Analytical Results



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

Signatories

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

Table with 3 columns: Signatories, Position, Accreditation Category. Rows include Daniel Junek (Senior Air Analyst, Newcastle - Organics, Mayfield West, NSW), Dianne Blane (Laboratory Coordinator (2IC), Newcastle - Inorganics, Mayfield West, NSW), Hoa Nguyen (Senior Inorganic Chemist, Sydney Inorganics, Smithfield, NSW), and Justin Houghton (Senior Analyst - Organic, Newcastle - Organics, Mayfield West, NSW).



## General Comments

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

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

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

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

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

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

LOR = Limit of reporting

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

∅ = ALS is not NATA accredited for these tests.

- ED009-X: LOR has been raised for Chloride due to matrix interference.
- EP091: The LOR values for EP091 have been raised due to increased charcoal sample size 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: <b>EXTRACT</b> (Matrix: <b>WATER</b> )				Client sample ID	St1_Cyanide A	St1_Cyanide B	Cyanide Blank	---	---
Client sampling date / time				[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	---	---	
Compound	CAS Number	LOR	Unit	EN1514408-005	EN1514408-006	EN1514408-016	-----	-----	
EK026SF: Total CN by Segmented Flow Analyser				Result	Result	Result	Result	Result	
<b>Total Cyanide</b>	57-12-5	0.004	mg/L	<b>0.715</b>	<b>0.019</b>	<0.004	---	---	



### Analytical Results

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

Client sample ID

				St1_H2SO4 as SO3(IPA)	St1_SO2 as SO3(H2O2)	St1_HCl (H2SO4)	St1_Cl2 (NaOH)	St1_Cyanide A
Client sampling date / time				[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]
Compound	CAS Number	LOR	Unit	EN1514408-001	EN1514408-002	EN1514408-003	EN1514408-004	EN1514408-005
				Result	Result	Result	Result	Result
<b>EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)</b>								
Volume - Impinger	---	1	mL	285	---	---	---	---
Sulfuric Acid as SO3	---	2	mg/sample	<2	---	---	---	---
Volume - Impinger	---	1	mL	---	295	---	---	---
Sulfur Dioxide as SO3	---	10	mg/sample	---	<10	---	---	---
<b>EA144C: Gaseous and Particulate Fluorides</b>								
Fluoride (as HF)	---	0.01	mg/sample	---	---	---	---	---
Volume - Impinger	---	1	mL	---	---	---	---	---
<b>EA147: Acid Gases</b>								
Hydrogen Chloride	7647-01-0	0.1	mg	---	---	<5.00	---	---
<b>EA147: Halogens</b>								
Chlorine	7782-50-5	0.1	mg	---	---	---	<5.00	---
<b>ED009: Anions</b>								
Chloride	16887-00-6	0.1	mg/L	---	---	<5.00	<5.00	---
<b>EK026-I: Cyanide in Air Impinger Solutions</b>								
Cyanide	57-12-5	0.01	mg	---	---	---	---	0.21
Volume - Impinger	---	1	mL	---	---	---	---	294
<b>Sampling Method</b>								
Volume - Impinger	---	0.01	mL	---	---	266	245	---



## Analytical Results

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

Client sample ID

				St1_Cyanide B	St1_Part particulate Fluoride	St1_Gaseous Fluoride	Fluoride Blank	Hydrogen Chloride Blank
Client sampling date / time				[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]
Compound	CAS Number	LOR	Unit	EN1514408-006	EN1514408-007	EN1514408-008	EN1514408-011	EN1514408-012
				Result	Result	Result	Result	Result
<b>EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)</b>								
Volume - Impinger	---	1	mL	---	---	---	---	---
Sulfuric Acid as SO3	---	2	mg/sample	---	---	---	---	---
Volume - Impinger	---	1	mL	---	---	---	---	---
Sulfur Dioxide as SO3	---	10	mg/sample	---	---	---	---	---
<b>EA144C: Gaseous and Particulate Fluorides</b>								
Fluoride (as HF)	---	0.01	mg/sample	---	0.44	0.17	0.08	---
Volume - Impinger	---	1	mL	---	76	275	182	---
<b>EA147: Acid Gases</b>								
Hydrogen Chloride	7647-01-0	0.1	mg	---	---	---	---	<10.0
<b>EA147: Halogens</b>								
Chlorine	7782-50-5	0.1	mg	---	---	---	---	---
<b>ED009: Anions</b>								
Chloride	16887-00-6	0.1	mg/L	---	---	---	---	<10.0
<b>EK026-I: Cyanide in Air Impinger Solutions</b>								
Cyanide	57-12-5	0.01	mg	<0.01	---	---	---	---
Volume - Impinger	---	1	mL	137	---	---	---	---
<b>Sampling Method</b>								
Volume - Impinger	---	0.01	mL	---	---	---	---	191



## Analytical Results

Sub-Matrix: IMPINGER SOLUTION (Matrix: AIR)				Client sample ID	Chlorine Blank	SO <sub>x</sub> (IPA) Blank	SO <sub>x</sub> (H <sub>2</sub> O <sub>2</sub> ) Blank	Cyanide Blank	---
Client sampling date / time				[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	[16-Dec-2015]	---	
Compound	CAS Number	LOR	Unit	EN1514408-013	EN1514408-014	EN1514408-015	EN1514408-016	-----	
				Result	Result	Result	Result	Result	
<b>EA143C: Sulfuric Acid and Sulfur Dioxide (as SO<sub>3</sub>)</b>									
Volume - Impinger	---	1	mL	---	190	---	---	---	
Sulfuric Acid as SO <sub>3</sub>	---	2	mg/sample	---	<2	---	---	---	
Volume - Impinger	---	1	mL	---	---	192	---	---	
Sulfur Dioxide as SO <sub>3</sub>	---	10	mg/sample	---	---	<10	---	---	
<b>EA144C: Gaseous and Particulate Fluorides</b>									
Fluoride (as HF)	---	0.01	mg/sample	---	---	---	---	---	
Volume - Impinger	---	1	mL	---	---	---	---	---	
<b>EA147: Acid Gases</b>									
Hydrogen Chloride	7647-01-0	0.1	mg	---	---	---	---	---	
<b>EA147: Halogens</b>									
Chlorine	7782-50-5	0.1	mg	<10.0	---	---	---	---	
<b>ED009: Anions</b>									
Chloride	16887-00-6	0.1	mg/L	<10.0	---	---	---	---	
<b>EK026-I: Cyanide in Air Impinger Solutions</b>									
Cyanide	57-12-5	0.01	mg	---	---	---	<0.01	---	
Volume - Impinger	---	1	mL	---	---	---	198	---	
<b>Sampling Method</b>									
Volume - Impinger	---	0.01	mL	196	---	---	---	---	



## Analytical Results

Sub-Matrix: SORBENT TUBE (Matrix: AIR)				Client sample ID	Stack1_VOC	VOC_Blank	---	---	---
Client sampling date / time				[16-Dec-2015]	[16-Dec-2015]	---	---	---	
Compound	CAS Number	LOR	Unit	EN1514408-009	EN1514408-010	---	---	---	
				Result	Result	Result	Result	Result	
<b>EP091A: Aliphatic Hydrocarbons - Total</b>									
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	---	---	---	
<b>EP091B: Monocyclic Aromatic Hydrocarbons - Total</b>									
Benzene	71-43-2	0.5	µg/sample	<1.0	<1.0	---	---	---	
Toluene	108-88-3	0.5	µg/sample	1.1	<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	---	---	---	
<b>EP091C: Oxygenated Compounds - Total</b>									
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	---	---	---	
<b>EP091D: Halogenated Compounds - Total</b>									
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	---	---	---	
<b>EP091A: Aliphatic Hydrocarbons (Section 1)</b>									
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: <b>SORBENT TUBE</b> (Matrix: <b>AIR</b> )				Client sample ID	Stack1_VOC	VOC_Blank	---	---	---
Client sampling date / time					[16-Dec-2015]	[16-Dec-2015]	---	---	---
Compound	CAS Number	LOR	Unit	EN1514408-009	EN1514408-010	---	---	---	
				Result	Result	Result	Result	Result	
<b>EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)</b>									
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	---	---	---	
<b>EP091C: Oxygenated Compounds (Section 1)</b>									
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	---	---	---	
<b>EP091D: Halogenated Compounds (Section 1)</b>									
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	---	---	---	
<b>EP091A: Aliphatic Hydrocarbons (Section 2)</b>									
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	---	---	---	
<b>EP091B: Monocyclic Aromatic Hydrocarbons (Section 2)</b>									
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: <b>SORBENT TUBE</b> (Matrix: <b>AIR</b> )				Client sample ID	Stack1_VOC	VOC_Blank	---	---	---
Client sampling date / time					[16-Dec-2015]	[16-Dec-2015]	---	---	---
Compound	CAS Number	LOR	Unit	EN1514408-009	EN1514408-010	---	---	---	
				Result	Result	Result	Result	Result	
<b>EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued</b>									
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	---	---	---	
<b>EP091C: Oxygenated Compounds (Section 2)</b>									
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	---	---	---	
<b>EP091D: Halogenated Compounds (Section 2)</b>									
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	---	---	---	
<b>EP091A: Aliphatic Hydrocarbons (Section 3)</b>									
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	---	---	---	
<b>EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)</b>									
Benzene	71-43-2	0.5	µg	<1.0	<1.0	---	---	---	
Toluene	108-88-3	0.5	µg	1.1	<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	Stack1_VOC	VOC_Blank	---	---	---
Client sampling date / time					[16-Dec-2015]	[16-Dec-2015]	---	---	---
Compound	CAS Number	LOR	Unit	EN1514408-009	EN1514408-010	---	---	---	
				Result	Result	Result	Result	Result	
<b>EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued</b>									
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	---	---	---	
<b>EP091C: Oxygenated Compounds (Section 3)</b>									
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	---	---	---	
<b>EP091D: Halogenated Compounds (Section 3)</b>									
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	---	---	---	
<b>EP091: Chlorinated Organic Surrogates (Section 1)</b>									
1.2-Dichloroethane-D4	17060-07-0	0.5	%	102	102	---	---	---	
4-Bromofluorobenzene	460-00-4	0.5	%	81.2	79.4	---	---	---	
<b>EP091: Chlorinated Organic Surrogates (Section 2)</b>									
1.2-Dichloroethane-D4	17060-07-0	0.5	%	100	105	---	---	---	
4-Bromofluorobenzene	460-00-4	0.5	%	77.8	77.5	---	---	---	
<b>EP091: Chlorinated Organic Surrogates (Section 3)</b>									
1.2-Dichloroethane-D4	17060-07-0	0.5	%	103	101	---	---	---	
4-Bromofluorobenzene	460-00-4	0.5	%	76.2	72.6	---	---	---	
<b>EP091: MAH Surrogates (Section 1)</b>									
Toluene-D8	2037-26-5	0.5	%	94.2	93.5	---	---	---	
<b>EP091: MAH Surrogates (Section 2)</b>									
Toluene-D8	2037-26-5	0.5	%	91.6	97.5	---	---	---	
<b>EP091: MAH Surrogates (Section 3)</b>									



**Analytical Results**

Sub-Matrix: **SORBENT TUBE**  
 (Matrix: **AIR**)

				Client sample ID	Stack1_VOC	VOC_Blank	---	---	---
				Client sampling date / time	[16-Dec-2015]	[16-Dec-2015]	---	---	---
Compound	CAS Number	LOR	Unit	EN1514408-009	EN1514408-010	---	---	---	
				Result	Result	Result	Result	Result	
<b>EP091: MAH Surrogates (Section 3) - Continued</b>									
<b>Toluene-D8</b>	2037-26-5	0.5	%	<b>92.5</b>	<b>90.0</b>	---	---	---	

The logo for SGS, consisting of the letters 'SGS' in a bold, sans-serif font, with a vertical line to the right and a horizontal line below.

**LEEDER  
CONSULTING**

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

Chartered Chemists

15-Jan-2016

AECOM

17 Warabrook Bvde  
Warabrook

NSW 2304  
Attention: James Lang

**REPORT NUMBER: M152864**

Site/Client Ref: 60341673/1.1

Order No: 60341673/1.1

## CERTIFICATE OF ANALYSIS

**SAMPLES:** Twelve samples were received for analysis

**DATE RECEIVED:** 18-Dec-2015

**DATE COMMENCED:** 22-Dec-2015

**METHODS:** See Attached Results

**RESULTS:** Please refer to attached pages for results.

Note: Results are based on samples as received at SGS Leeder Consulting's laboratories

**REPORTED BY:**

A handwritten signature in black ink that reads '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: 13/01/2016

Analyte Name	Leader ID	Client ID	Sampled Date	PQL
	2015035863	Metals No.12	15/12/2015	
Sb	0.2	nd		
As	0.2	nd		
Be	0.2	nd		
Cd	0.2	nd		
Cr	0.2	nd		
Co	0.2	nd		
Cu	0.2	0.5		
Pb	0.2	nd		
Mg	2	19		
Mn	0.2	nd		
Hg	0.2	nd		
Ni	0.2	nd		
Se	0.2	nd		
Tl	0.2	nd		
Sn	0.2	nd		
V	0.2	nd		
Zn	0.2	160		

**Matrix: Filter**

**Method: USEPA M29 (Analysis only) - MA-1400.FL.M29.02**

Sample units are expressed in µg total

Test Started: 13/01/2016

Analyte Name	Sampled Date	Leeder ID	2015035888	2015035889
		Client ID	St 1 Metals No.1	Method
	PQL		16/12/2015	Blank
Sb	0.2		nd	nd
As	0.2		0.2	nd
Be	0.2		nd	nd
Cd	0.2		6.8	nd
Cr	0.2		1.1	nd
Co	0.2		nd	nd
Cu	0.2		0.6	nd
Pb	0.2		0.3	nd
Mg	2		47	nd
Mn	0.2		1.0	nd
Hg	0.2		nd	nd
Ni	0.2		0.2	nd
Se	0.2		nd	nd
Tl	0.2		nd	nd
Sn	0.2		nd	nd
V	0.2		nd	nd
Zn	0.2		810	nd

**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: 13/01/2016

Analyte Name	Sampled Date PQL	Leader ID Client ID	2015035869 Metals No.8A	2015035870 Metals No.9	2015035874 Metals No.8B	2015035875 Metals No.11
			15/12/2015	15/12/2015	15/12/2015	15/12/2015
Sb	0.1		nd	nd		
As	0.1		nd	nd		
Be	0.1		nd	nd		
Cd	0.1		0.7	0.1		
Cr	0.1		nd	nd		
Co	0.1		nd	nd		
Cu	0.1		0.6	nd		
Pb	0.1		nd	nd		
Mg	0.1		20	15		
Mn	0.1		6.0	0.2		
Hg	0.1		nd	nd	nd	nd
Ni	0.1		nd	nd		
Se	0.1		nd	0.3		
Tl	0.1		nd	nd		
Sn	0.1		nd	nd		
V	0.1		nd	nd		
Zn	0.1		1.3	0.5		
Sample Volume			300	210	100	260

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: 13/01/2016

Analyte Name	Sampled Date PQL	Leader ID Client ID	2015035890 St 1 Metals No.3	2015035891 St 1 Metals No.4	2015035892 St 1 Metals No.5A	2015035893 St 1 Metals No.5C
		16/12/2015	16/12/2015	16/12/2015	16/12/2015	
Sb	0.1		nd	nd		
As	0.1		nd	nd		
Be	0.1		nd	nd		
Cd	0.1		0.2	0.5		
Cr	0.1		0.5	nd		
Co	0.1		nd	nd		
Cu	0.1		4.1	0.7		
Pb	0.1		1.4	nd		
Mg	0.1		11	22		
Mn	0.1		0.9	5.3		
Hg	0.1		nd	nd	nd	nd
Ni	0.1		1.0	3.7		
Se	0.1		0.1	nd		
Tl	0.1		nd	nd		
Sn	0.1		2.0	nd		
V	0.1		0.4	nd		
Zn	0.1		55	3.4		
Sample Volume			92	300	100	260

**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: 13/01/2016

Analyte Name	Sampled Date	Leeder ID	2015035894
		Client ID	Method
PQL		Blank	
Sb	0.1	nd	
As	0.1	nd	
Be	0.1	nd	
Cd	0.1	nd	
Cr	0.1	nd	
Co	0.1	nd	
Cu	0.1	nd	
Pb	0.1	nd	
Mg	0.1	nd	
Mn	0.1	nd	
Hg	0.1	nd	
Ni	0.1	nd	
Se	0.1	nd	
Tl	0.1	nd	
Sn	0.1	nd	
V	0.1	nd	
Zn	0.1	nd	

**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: 12/01/2016

Analyte Name	Sampled Date	Leeder ID	2015035880
		Client ID	Metals No.10
PQL		15/12/2015	
Hg	0.5	nd	
Sample Volume		100	

**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: 12/01/2016

Analyte Name	Sampled Date	Leeder ID	2015035895	2015035896
		Client ID	St 1 Metals No.5B	Method
PQL		16/12/2015		Blank
Hg	0.5	nd	nd	
Sample Volume		400		

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: 13/01/2016

Analyte Name	Sampled Date	Leeder ID	2015035897	2015035898
		Client ID	Matrix	Matrix
	PQL		Spike	Spike Dup
Sb			104	105
As			97	97
Be			97	109
Cd			97	98
Cr			94	96
Co			98	98
Cu			105	106
Pb			95	95
Mg			117	117
Mn			101	100
Hg			93	92
Ni			99	99
Se			92	98
Tl			95	95
Sn			107	108
V			109	110
Zn			U	U

**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: 13/01/2016

Analyte Name	Sampled Date PQL	Leeder ID Client ID	2015035899 Matrix	2015035900 Matrix
			Spike	Spike Dup
Sb			98	102
As			99	100
Be			105	107
Cd			100	102
Cr			96	97
Co			99	100
Cu			111	111
Pb			106	106
Mg			103	104
Mn			104	106
Hg			97	100
Ni			103	103
Se			97	95
Tl			107	106
Sn			104	107
V			106	106
Zn			116	118

**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: 12/01/2016

Analyte Name	Sampled Date PQL	Leeder ID Client ID	2015035901 Matrix	2015035902 Matrix
			Spike	Spike Dup
Hg			109	108

**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 no n-petroleum hydrocarbon profile

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions/General-Conditions-of-Services-English.aspx>. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents

This report must not be reproduced, except in full.

**SGS**

**LEEDER  
CONSULTING**

**APPENDIX ONE.**

**CHAIN OF CUSTODY DOCUMENT**

**Chain of Custody Record -  
SGS Leeder Consulting**

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

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

CLIENT NAME: AECOM

CONTACT PHONE No: 02 4911 4900

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

CLIENT ADDRESS: 17 Warabrook Blvd

CONTACT FAX No: 02 4911 4999

Warabrook NSW 2304

RESULTS REQUIRED BY: Normal TAT

CONTACT: James Lang

EMAIL REPORT TO: [james.lang@aecom.com](mailto:james.lang@aecom.com)

SAMPLED BY: AECOM

LAB QUOTE NUMBER:

PROJECT REF. / ORDER No: 60341673 / 1.1

**Analyses Required (Analyte + Method Code)**

Client Sample ID	Date Sampled	Matrix			Containers/Preservation (please tick)												Metals - USEPA Method 29*	Mercury									
		Filler	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													
St 1 - Metals No. 1	16/12/15	X			1												X									Please report the blank results from the blanks labelled for the other project accompanying this delivery. The blank solutions were from the same stock prepaped to cover both projects	
St 1 - Metals No. 3	16/12/15		X														X										
St 1 - Metals No. 4	16/12/15		X														X										
St 1 - Metals No. 5A	16/12/15		X															X									
St 1 - Metals No. 5B	16/12/15			X														X									
St 1 - Metals No. 5C	16/12/15		X															X									
Metals No. 8A	15/12/15		X														X										
Metals No. 8B	15/12/15		X															X									
Metals No. 9	15/12/15		X														X										
Metals No. 10	15/12/15			X														X									
Metals No. 11	15/12/15		X															X									
Metals No. 12	15/12/15	X															X										
-----	<b>Totals:</b>	2	8	2	2	2	8										6	6									

**CHAIN OF CUSTODY RECORD**

RELEASED BY: (Name) James Lang (Signature) (Date / Time) 17/12/15 2:45pm

RECEIVED BY: (Name) Lyndall Stevens (Signature) (Date / Time) 18/12/15 3:45pm

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



## ANALYSIS REPORT # ORG15\_156

<b>Client</b>	AECOM AUSTRALIA 17 WARABROOK BOULEVARDE WARABROOK NSW 2304	<b>Job No.</b>	AECO01/151218
<b>Contact</b>	JAMES LANG	<b>Sampled by</b>	Client
		<b>Date Sampled</b>	Not specified
		<b>Date Received</b>	18-Dec-2015

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  
January 19, 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. AECO01/151218			
Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N15/034411	DAU101215A	EMISSIONS	STACK 1 Cartridge, Filter, 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 <sup>†</sup>	Benzo(a)pyrene Potency Equivalent Factor
BaP-TEQ <sub>PAH</sub>	Benzo(a)pyrene Toxic Equivalents
<p>† as defined in "Benzo(a)pyrene as a Toxic Air Contaminant", CARB/OEHHA Executive Summary, July 1994</p> <p>TEQs are calculated by multiplying the quantified level for each toxic PAH by corresponding PEF and summing the result:</p> $\text{BaP-TEQ}_{\text{PAH}} = \sum_{i=1}^n [\text{PAH}_i \times \text{BaP-PEF}_i] \quad i = \text{toxic PAH analyte index (1 to } n=7)$	
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. AECO01/151218**

Laboratory Reg. No. N15/034411

Date Reported 19-Jan-2016

Client Sample Ref. DAU101215A

Date Extracted 24-Dec-2015

Matrix EMISSIONS

Description STACK 1 Cartridge, Filter, Rinses

PAH	Conc. ng	Reporting Level (LOR, ng)	BaP-PEF Value	BaP-TEQ Contribution	Labelled Internal recovery (%)	Flags
Naphthalene	160000	445	-	-	83	
2-Methylnaphthalene	55000	200	-	-		
Acenaphthylene	330000	200	-	-	76	
Acenaphthene	11000	200	-	-	82	
Fluorene	91000	200	-	-	80	
Phenanthrene	300000	200	-	-	83	
Anthracene	37000	200	-	-		
Fluoranthene	62000	200	-	-	82	
Pyrene	62000	200	-	-		
Benz(a)anthracene	32	20	0.1	3.2	84	
Chrysene	73	20	0.01	0.7	81	
Benzo(b)fluoranthene	<20	20	0.1	1.0	73	
Benzo(k)fluoranthene	<20	20	0.1	1.0	74	
Benzo(e)pyrene	<20	20	-	-		
Benzo(a)pyrene	<20	20	1.0	10	73	
Perylene	<20	20	-	-		
Indeno(1,2,3-cd)pyrene	<20	20	0.1	1.0	75	
Dibenz(ah)anthracene	<20	20	0.4	4.0	72	
Benzo(ghi)perylene	29	20	-	-	66	

**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	83

**Summary Results****BaP-TEQ<sub>PAH</sub>**

Lower Bound [excluding LOD values]	<b>3.9</b>	ng
Middle Bound [including half LOD values]	<b>21</b>	ng
Upper Bound [including LOD values]	<b>38</b>	ng



## CERTIFICATE OF ANALYSIS # DAU16\_004

<b>Client</b>	AECOM 17 Warabrook Boulevard Warabrook NSW 2304	<b>Job No.</b>	AECO01/151218
<b>Contact</b>	James Lang	<b>Sampled by</b>	Client
		<b>Date Sampled</b>	Not Specified
		<b>Date Received</b>	18-Dec-15

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

**Method** | AUTL\_02 | **Date Reported** | 18-Jan-16

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

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

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

**Authorisation**

Nino Piro  
Senior Chemist  
Dioxin Analysis Unit

Robert Crough  
Chemist  
Dioxin Analysis Unit

**Accreditation**



NATA Accredited Laboratory Number : 198

Accredited for compliance with ISO/IEC 17025.

This report shall not be reproduced, except in full.

Sample Details : Job No. AECO01/151218			
Laboratory Reg. No.	Client Sample Ref.	Matrix	Description
N15/034411X	DAU101215A	Emission	Resin, Filter, Solvent Rinse

Project Details	
Project Name	Not Specified
Project Number	PO No. 60341673/1.1

Key			
<b>Analytes</b>			
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
<b>Units &amp; Abbreviations</b>			
pg	picograms		
<	level less than limit of detection (LOD)		
I-TEF <sup>‡</sup>	International toxic equivalency factor		
I-TEQ <sup>‡</sup>	International toxic equivalents - dioxins & furans		
TEQs are calculated by multiplying the quantified level for each individual dioxin and furan congener reported by the corresponding TEF value and summing the result:			
$I-TEQ = \sum_{i=1}^7 [PCDD_i \times TEF_i] + \sum_{j=1}^{10} [PCDF_j \times TEF_j]$		<i>i</i> = PCDD congener index (1 - 7) <i>j</i> = 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 <sup>13</sup> C <sub>12</sub> labelled surrogate standard		
ℓ <sub>l</sub>	Laboratory surrogate recovery outside normal acceptance criteria:		
	<b>40-130%</b> for Tetra/Penta/Hexa congeners - <b>25-130%</b> for Hepta/Octa congeners		
ℓ <sub>f</sub>	Field surrogate recovery outside normal acceptance criteria ( <b>70-130%</b> )		
‡	as defined in USEPA publication <b>EPA/625/3-89/016</b> (1989)		
USEPA	US Environmental Protection Agency		

**Results : Job No. AECO01/151218**

Laboratory Reg. No. N15/034411X

Date Extracted 24-Dec-15

Client Sample Ref. DAU101215A

DB5 Analysis #N/A

Matrix Emission

DB-Dioxin Analysis 11-Jan-16

Description Resin, Filter, Solvent Rinse

PCDD/F Congeners	Level pg	I-TEF	I-TEQ middle bound contribution	Labelled Surrogate recovery
2,3,7,8-TCDF	14	0.1	1.4	60
2,3,7,8-TCDD	<2	1	1	58
1,2,3,7,8-PeCDF	2.9	0.05	0.15	58
2,3,4,7,8-PeCDF	<2	0.5	0.5	120
1,2,3,7,8-PeCDD	2.5	0.5	1.3	61
1,2,3,4,7,8-HxCDF	<2	0.1	0.1	105
1,2,3,6,7,8-HxCDF	1.6	0.1	0.16	89
2,3,4,6,7,8-HxCDF	<0.9	0.1	0.045	
1,2,3,7,8,9-HxCDF	<1	0.1	0.05	
1,2,3,4,7,8-HxCDD	<1	0.1	0.05	92
1,2,3,6,7,8-HxCDD	<1	0.1	0.05	85
1,2,3,7,8,9-HxCDD	<1	0.1	0.05	
1,2,3,4,6,7,8-HpCDF	<2	0.01	0.01	71
1,2,3,4,7,8,9-HpCDF	<1	0.01	0.005	92
1,2,3,4,6,7,8-HpCDD	<2	0.01	0.01	75
OCDF	<2	0.001	0.001	
OCDD	9.4	0.001	0.0094	49

PCDD/F Homologue Groups	Level pg
Total TCDF isomers	450
Total TCDD isomers	34
Total PeCDF isomers	18
Total PeCDD isomers	12
Total HxCDF isomers	3.7
Total HxCDD isomers	<4
Total HpCDF isomers	<3
Total HpCDD isomers	<4

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

Excluding LOD values 530 pg

**I-TEQ**

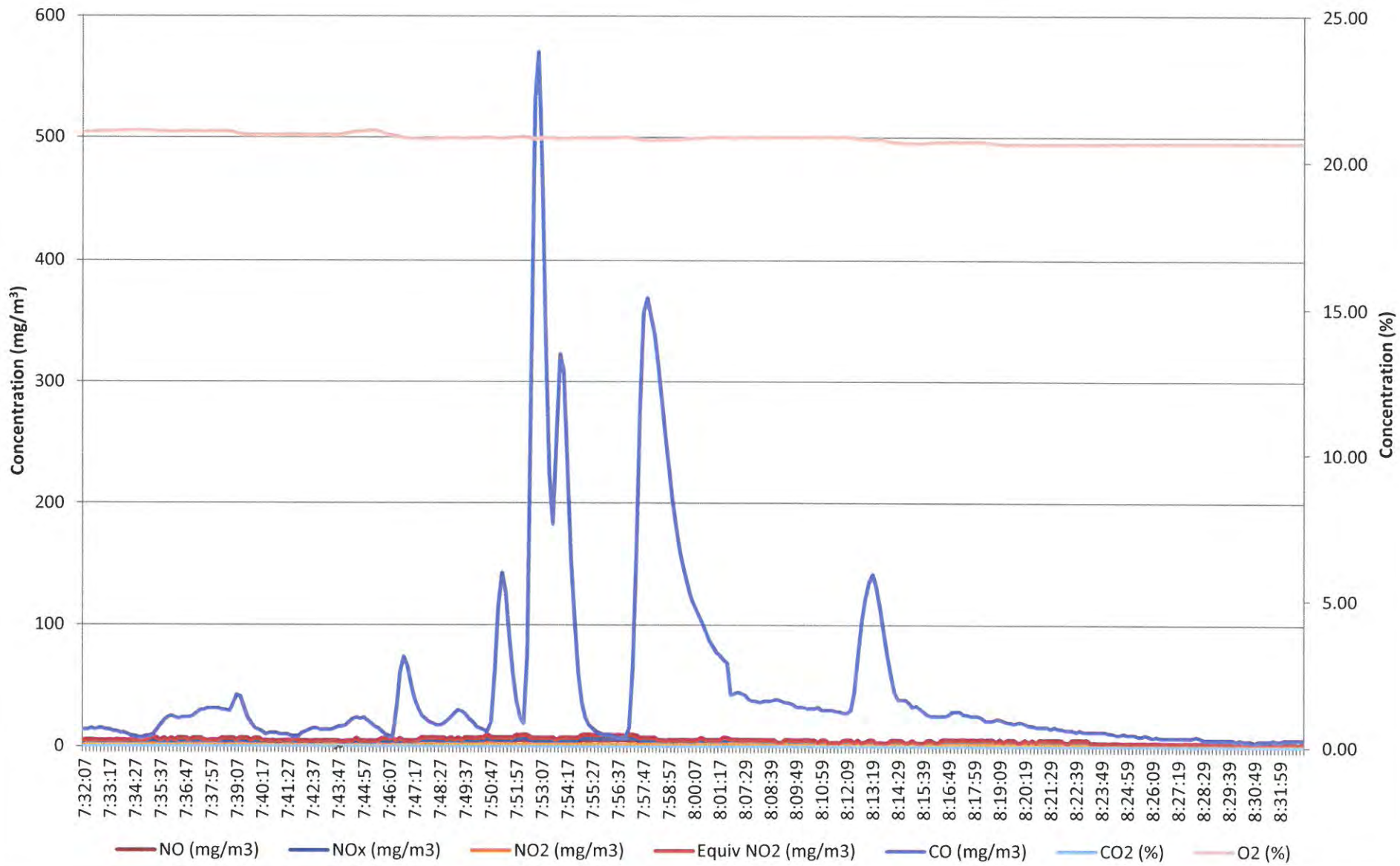
Lower Bound [excluding LOD values] 3.0 pg  
Middle Bound [including half LOD values] 4.9 pg  
Upper Bound [including LOD values] 6.8 pg

Appendix C

# Raw & Calculated Gas Data (5 pages)

## Appendix C Raw & Calculated Gas Data (5 pages)

### 60341673 Stack 1 Gas Data Plot, 16 December 2015



Date	Time	NO (ppm)	NO (mg/m <sup>3</sup> )	NOx (ppm)	NOx (mg/m <sup>3</sup> )	NO <sub>2</sub> (ppm)	NO <sub>2</sub> (mg/m <sup>3</sup> )	Equiv NO <sub>2</sub> (ppm)	Equiv NO <sub>2</sub> (mg/m <sup>3</sup> )	CO (ppm)	CO (mg/m <sup>3</sup> )	CO <sub>2</sub> (%)	O <sub>2</sub> (%)
16-Dec-15	7:32:07	2	3	3	4	0.6	1	4	4	11	14	0.00	20.99
16-Dec-15	7:32:17	2	3	3	4	0.7	1	4	6	11	14	0.00	21.00
16-Dec-15	7:32:27	2	3	3	4	0.7	1	4	6	12	15	0.00	21.01
16-Dec-15	7:32:37	2	3	3	4	0.6	1	4	5	11	14	0.00	21.01
16-Dec-15	7:32:47	2	3	3	4	0.5	1	4	5	12	15	0.00	21.02
16-Dec-15	7:32:57	2	3	3	4	0.5	1	4	5	12	15	0.00	21.03
16-Dec-15	7:33:07	2	3	2	4	0.5	1	4	5	11	14	0.00	21.03
16-Dec-15	7:33:17	2	3	3	4	0.6	1	4	5	11	14	0.00	21.03
16-Dec-15	7:33:27	2	3	3	4	0.5	1	4	5	10	13	0.00	21.03
16-Dec-15	7:33:37	2	3	3	4	0.7	1	4	6	10	13	0.00	21.03
16-Dec-15	7:33:47	2	3	3	4	0.6	1	4	5	9	11	0.00	21.04
16-Dec-15	7:33:57	2	3	3	4	0.6	1	4	5	9	11	0.00	21.04
16-Dec-15	7:34:07	2	3	3	4	0.5	1	4	5	8	10	0.00	21.05
16-Dec-15	7:34:17	2	3	3	4	0.5	1	4	5	7	9	0.00	21.05
16-Dec-15	7:34:27	2	3	3	4	0.5	1	4	5	7	9	0.00	21.05
16-Dec-15	7:34:37	2	3	3	4	0.5	1	4	5	6	8	0.00	21.06
16-Dec-15	7:34:47	2	3	3	4	0.7	1	4	6	6	8	0.00	21.05
16-Dec-15	7:34:57	2	3	3	4	0.6	1	4	5	7	9	0.00	21.05
16-Dec-15	7:35:07	3	4	3	5	0.6	1	5	7	7	9	0.00	21.05
16-Dec-15	7:35:17	3	4	3	6	0.8	2	5	8	8	10	0.00	21.04
16-Dec-15	7:35:27	3	4	3	5	0.6	1	5	7	11	14	0.00	21.03
16-Dec-15	7:35:37	2	3	3	4	0.5	1	4	5	14	18	0.00	21.02
16-Dec-15	7:35:47	3	4	3	5	0.5	1	5	7	17	21	0.00	21.02
16-Dec-15	7:35:57	2	3	3	4	0.5	1	4	5	19	24	0.00	21.02
16-Dec-15	7:36:07	3	4	3	5	0.5	1	5	7	20	25	0.00	21.02
16-Dec-15	7:36:17	2	3	3	4	0.5	1	4	5	19	24	0.00	21.02
16-Dec-15	7:36:27	3	4	3	5	0.7	1	5	8	18	23	0.00	21.02
16-Dec-15	7:36:37	3	4	3	5	0.6	1	5	7	19	24	0.00	21.03
16-Dec-15	7:36:47	3	4	3	5	0.6	1	5	7	19	24	0.00	21.03
16-Dec-15	7:36:57	2	3	3	4	0.7	1	4	6	19	24	0.00	21.03
16-Dec-15	7:37:07	3	4	3	5	0.6	1	5	7	20	25	0.00	21.02
16-Dec-15	7:37:17	3	4	3	5	0.6	1	5	7	22	28	0.00	21.02
16-Dec-15	7:37:27	3	4	3	5	0.6	1	5	7	24	30	0.00	21.03
16-Dec-15	7:37:37	2	3	3	4	0.7	1	4	6	24	30	0.00	21.02
16-Dec-15	7:37:47	2	3	3	4	0.5	1	4	5	25	31	0.00	21.02
16-Dec-15	7:37:57	2	3	3	4	0.7	1	4	6	25	31	0.00	21.03
16-Dec-15	7:38:07	2	3	3	4	0.7	1	4	6	25	31	0.00	21.03
16-Dec-15	7:38:17	2	3	3	4	0.6	1	4	5	25	31	0.00	21.03
16-Dec-15	7:38:27	3	4	3	5	0.6	1	5	7	24	30	0.00	21.03
16-Dec-15	7:38:37	3	4	3	5	0.4	1	5	7	24	30	0.00	21.03
16-Dec-15	7:38:47	3	4	3	5	0.6	1	5	7	23	29	0.00	21.03
16-Dec-15	7:38:57	3	4	3	5	0.6	1	5	7	28	35	0.00	21.00
16-Dec-15	7:39:07	2	3	3	4	0.8	2	4	6	34	43	0.00	20.95
16-Dec-15	7:39:17	3	4	3	5	0.7	1	5	8	33	41	0.00	20.93
16-Dec-15	7:39:27	3	4	3	5	0.6	1	5	7	26	33	0.00	20.92
16-Dec-15	7:39:37	3	4	3	5	0.6	1	5	7	19	24	0.00	20.91
16-Dec-15	7:39:47	2	3	3	4	0.5	1	4	5	15	19	0.00	20.91
16-Dec-15	7:39:57	3	4	3	5	0.5	1	5	7	12	15	0.00	20.91
16-Dec-15	7:40:07	3	4	3	5	0.5	1	5	7	11	14	0.00	20.92
16-Dec-15	7:40:17	2	3	3	4	0.5	1	4	5	10	13	0.00	20.91
16-Dec-15	7:40:27	2	3	3	4	0.5	1	4	5	8	10	0.00	20.90
16-Dec-15	7:40:37	2	3	3	4	0.4	1	3	5	9	11	0.00	20.91
16-Dec-15	7:40:47	2	3	3	4	0.5	1	4	5	9	11	0.00	20.91
16-Dec-15	7:40:57	2	3	3	3	0.3	1	3	5	9	11	0.00	20.91
16-Dec-15	7:41:07	2	3	2	4	0.4	1	3	5	8	10	0.00	20.91
16-Dec-15	7:41:17	2	3	3	4	0.5	1	4	5	8	10	0.00	20.91
16-Dec-15	7:41:27	2	3	3	4	0.6	1	4	5	8	10	0.00	20.92
16-Dec-15	7:41:37	2	3	3	4	0.4	1	3	5	7	9	0.00	20.92
16-Dec-15	7:41:47	3	4	3	5	0.5	1	5	7	7	9	0.00	20.92
16-Dec-15	7:41:57	2	3	2	4	0.5	1	4	5	7	9	0.00	20.92
16-Dec-15	7:42:07	2	3	2	4	0.4	1	3	5	9	11	0.00	20.91
16-Dec-15	7:42:17	2	3	3	4	0.5	1	4	5	10	13	0.00	20.91
16-Dec-15	7:42:27	2	3	3	3	0.3	1	3	5	11	14	0.00	20.90
16-Dec-15	7:42:37	2	3	2	3	0.3	1	3	5	12	15	0.00	20.91
16-Dec-15	7:42:47	2	3	3	4	0.5	1	4	5	12	15	0.00	20.91
16-Dec-15	7:42:57	2	3	3	4	0.4	1	3	5	11	14	0.00	20.91
16-Dec-15	7:43:07	2	3	2	4	0.5	1	4	5	11	14	0.00	20.92
16-Dec-15	7:43:17	2	3	3	4	0.5	1	4	5	11	14	0.00	20.92
16-Dec-15	7:43:27	2	3	2	4	0.5	1	4	5	11	14	0.00	20.91
16-Dec-15	7:43:37	2	3	2	4	0.5	1	4	5	12	15	0.00	20.90
16-Dec-15	7:43:47	2	3	2	4	0.4	1	3	5	13	16	0.00	20.91
16-Dec-15	7:43:57	2	3	2	3	0.1	0	3	4	13	16	0.00	20.92
16-Dec-15	7:44:07	2	3	2	3	0.3	1	3	5	14	18	0.00	20.95
16-Dec-15	7:44:17	2	3	3	4	0.4	1	3	5	16	20	0.00	20.98
16-Dec-15	7:44:27	2	3	3	4	0.4	1	3	5	18	23	0.00	21.00
16-Dec-15	7:44:37	3	4	3	5	0.5	1	5	7	19	24	0.00	21.02
16-Dec-15	7:44:47	2	3	2	4	0.4	1	3	5	18	23	0.00	21.03
16-Dec-15	7:44:57	2	3	3	4	0.4	1	3	5	19	24	0.00	21.03
16-Dec-15	7:45:07	2	3	3	3	0.3	1	3	5	17	21	0.00	21.05
16-Dec-15	7:45:17	2	3	3	4	0.4	1	3	5	15	19	0.00	21.05
16-Dec-15	7:45:27	2	3	2	3	0.3	1	3	5	13	16	0.00	21.06
16-Dec-15	7:45:37	2	3	3	4	0.5	1	4	5	12	15	0.00	21.04
16-Dec-15	7:45:47	3	4	3	5	0.4	1	5	7	10	13	0.00	20.99
16-Dec-15	7:45:57	3	4	3	5	0.4	1	5	7	8	10	0.00	20.94
16-Dec-15	7:46:07	3	4	3	5	0.3	1	5	7	7	9	0.00	20.91
16-Dec-15	7:46:17	3	4	3	5	0.5	1	5	7	7	9	0.00	20.89
16-Dec-15	7:46:27	2	3	3	4	0.4	1	3	5	25	31	0.00	20.86
16-Dec-15	7:46:37	3	4	3	5	0.4	1	5	7	49	61	0.00	20.83
16-Dec-15	7:46:47	2	3	3	4	0.5	1	4	5	59	74	0.00	20.80
16-Dec-15	7:46:57	2	3	2	4	0.5	1	4	5	53	66	0.00	20.79
16-Dec-15	7:47:07	2	3	3	4	0.4	1	3	5	41	51	0.00	20.78
16-Dec-15	7:47:17	2	3	2	4	0.5	1	4	5	31	39	0.00	20.78
16-Dec-15	7:47:27	2	3	2	4	0.6	1	4	5	25	31	0.00	20.78
16-Dec-15	7:47:37	3	4	4	6	0.9	2	6	8	20	25	0.00	20.78
16-Dec-15	7:47:47	3	4	4	6	0.8	2	5	8	18	23	0.00	20.77
16-Dec-15	7:47:57	3	4	4	6	0.8	2	5	8	16	20	0.00	20.77
16-Dec-15	7:48:07	3	4	4	6	0.9	2	6	8	15	19	0.00	20.77
16-Dec-15	7:48:17	3	4	4	5	0.7	1	5	8	14	18	0.00	20.78
16-Dec-15	7:48:27	3	4	4	5	0.7	1	5	8	14	18	0.00	20.79
16-Dec-15	7:48:37	3	4	3	5	0.7	1	5	8	15	19	0.00	20.79
16-Dec-15	7:48:47	2	3	3	5	0.9	2	4	6	17	21	0.00	20.80

Date	Time	NO (ppm)	NO (mg/m <sup>3</sup> )	NOx (ppm)	NOx (mg/m <sup>3</sup> )	NO <sub>2</sub> (ppm)	NO <sub>2</sub> (mg/m <sup>3</sup> )	Equiv NO <sub>2</sub> (ppm)	Equiv NO <sub>2</sub> (mg/m <sup>3</sup> )	CO (ppm)	CO (mg/m <sup>3</sup> )	C02 (%)	O2 (%)
16-Dec-15	7:48:57	3	4	4	6	0.8	2	5	8	19	24	0.00	20.80
16-Dec-15	7:49:07	2	3	3	4	0.8	2	4	6	22	28	0.00	20.80
16-Dec-15	7:49:17	3	4	3	5	0.7	1	5	8	24	30	0.00	20.80
16-Dec-15	7:49:27	2	3	3	4	0.7	1	4	6	23	29	0.00	20.79
16-Dec-15	7:49:37	3	4	4	6	0.9	2	6	8	21	26	0.00	20.79
16-Dec-15	7:49:47	3	4	4	6	0.8	2	5	8	18	23	0.00	20.80
16-Dec-15	7:49:57	3	4	4	5	0.7	1	5	8	16	20	0.00	20.80
16-Dec-15	7:50:07	3	4	4	5	0.6	1	5	7	13	16	0.00	20.81
16-Dec-15	7:50:17	3	4	4	6	0.9	2	6	8	12	15	0.00	20.81
16-Dec-15	7:50:27	3	4	4	6	0.8	2	5	8	11	14	0.00	20.82
16-Dec-15	7:50:37	4	5	5	8	1.1	2	7	10	10	13	0.00	20.82
16-Dec-15	7:50:47	3	4	4	6	1.0	2	6	8	16	20	0.00	20.82
16-Dec-15	7:50:57	3	4	4	6	0.9	2	6	8	48	60	0.00	20.80
16-Dec-15	7:51:07	3	4	4	6	0.9	2	6	8	92	115	0.00	20.79
16-Dec-15	7:51:17	3	4	4	6	0.9	2	6	8	114	143	0.00	20.79
16-Dec-15	7:51:27	3	4	4	6	0.8	2	5	8	102	128	0.00	20.80
16-Dec-15	7:51:37	3	4	4	6	0.9	2	6	8	74	93	0.00	20.81
16-Dec-15	7:51:47	3	4	4	6	0.8	2	5	8	48	60	0.00	20.82
16-Dec-15	7:51:57	4	5	5	7	0.8	2	7	10	30	38	0.00	20.84
16-Dec-15	7:52:07	4	5	5	7	0.6	1	7	9	19	24	0.00	20.84
16-Dec-15	7:52:17	4	5	4	7	0.9	2	7	10	15	19	0.00	20.85
16-Dec-15	7:52:27	4	5	4	7	0.8	2	7	10	61	76	0.00	20.84
16-Dec-15	7:52:37	3	4	4	6	0.9	2	6	8	242	303	0.00	20.80
16-Dec-15	7:52:47	3	4	4	5	0.7	1	5	8	424	530	0.00	20.78
16-Dec-15	7:52:57	3	4	4	5	0.7	1	5	8	456	570	0.00	20.79
16-Dec-15	7:53:07	3	4	3	5	0.7	1	5	8	379	474	0.00	20.80
16-Dec-15	7:53:17	3	4	4	5	0.7	1	5	8	272	340	0.00	20.80
16-Dec-15	7:53:27	3	4	4	5	0.7	1	5	8	179	224	0.00	20.81
16-Dec-15	7:53:37	3	4	3	6	0.8	2	5	8	146	183	0.00	20.80
16-Dec-15	7:53:47	2	3	3	4	0.8	2	4	6	201	251	0.00	20.79
16-Dec-15	7:53:57	3	4	3	5	0.7	1	5	8	258	323	0.00	20.79
16-Dec-15	7:54:07	3	4	3	6	0.8	2	5	8	247	309	0.00	20.78
16-Dec-15	7:54:17	3	4	4	6	0.8	2	5	8	187	234	0.00	20.79
16-Dec-15	7:54:27	3	4	4	6	0.8	2	5	8	123	154	0.00	20.80
16-Dec-15	7:54:37	3	4	4	5	0.7	1	5	8	84	105	0.00	20.80
16-Dec-15	7:54:47	3	4	4	6	0.8	2	5	8	48	60	0.00	20.81
16-Dec-15	7:54:57	4	5	4	7	0.8	2	7	10	29	36	0.00	20.80
16-Dec-15	7:55:07	4	5	4	7	0.9	2	7	10	19	24	0.00	20.81
16-Dec-15	7:55:17	4	5	5	7	0.9	2	7	10	14	18	0.00	20.80
16-Dec-15	7:55:27	4	5	4	7	0.8	2	7	10	12	15	0.00	20.81
16-Dec-15	7:55:37	4	5	5	7	0.7	1	7	10	10	13	0.00	20.81
16-Dec-15	7:55:47	4	5	5	7	0.9	2	7	10	9	11	0.00	20.81
16-Dec-15	7:55:57	4	5	5	7	0.8	2	7	10	8	10	0.00	20.81
16-Dec-15	7:56:07	4	5	5	7	0.8	2	7	10	8	10	0.00	20.81
16-Dec-15	7:56:17	4	5	5	7	0.8	2	7	10	8	10	0.00	20.81
16-Dec-15	7:56:27	4	5	5	7	0.7	1	7	10	7	9	0.00	20.81
16-Dec-15	7:56:37	4	5	5	7	0.8	2	7	10	6	8	0.00	20.82
16-Dec-15	7:56:47	4	5	5	7	0.7	1	7	10	6	8	0.00	20.83
16-Dec-15	7:56:57	4	5	5	7	0.7	1	7	10	6	8	0.00	20.83
16-Dec-15	7:57:07	4	5	5	7	0.9	2	7	10	12	15	0.00	20.82
16-Dec-15	7:57:17	4	5	5	7	0.9	2	7	10	51	64	0.00	20.80
16-Dec-15	7:57:27	4	5	4	7	0.6	1	7	9	130	163	0.00	20.78
16-Dec-15	7:57:37	3	4	4	5	0.7	1	5	8	223	279	0.00	20.76
16-Dec-15	7:57:47	3	4	3	6	0.8	2	5	8	286	358	0.00	20.74
16-Dec-15	7:57:57	3	4	4	6	0.8	2	5	8	295	369	0.00	20.73
16-Dec-15	7:58:07	3	4	3	5	0.7	1	5	8	283	354	0.00	20.73
16-Dec-15	7:58:17	3	4	3	6	0.9	2	6	8	272	340	0.00	20.73
16-Dec-15	7:58:27	2	3	3	4	0.8	2	4	6	251	314	0.00	20.74
16-Dec-15	7:58:37	2	3	3	4	0.8	2	4	6	228	285	0.00	20.74
16-Dec-15	7:58:47	2	3	2	4	0.5	1	4	5	203	254	0.00	20.75
16-Dec-15	7:58:57	2	3	3	5	0.9	2	4	6	182	228	0.00	20.74
16-Dec-15	7:59:07	2	3	3	4	0.7	1	4	6	161	201	0.00	20.75
16-Dec-15	7:59:17	2	3	3	4	0.8	2	4	6	143	179	0.00	20.76
16-Dec-15	7:59:27	2	3	3	5	0.9	2	4	6	128	160	0.00	20.76
16-Dec-15	7:59:37	2	3	3	5	0.9	2	4	6	117	146	0.00	20.77
16-Dec-15	7:59:47	2	3	3	4	0.8	2	4	6	107	134	0.00	20.78
16-Dec-15	7:59:57	2	3	3	4	0.7	1	4	6	98	123	0.00	20.78
16-Dec-15	8:00:07	2	3	3	4	0.8	2	4	6	92	115	0.00	20.79
16-Dec-15	8:00:17	2	3	3	5	1.0	2	4	6	87	109	0.00	20.80
16-Dec-15	8:00:27	3	4	3	6	0.8	2	5	8	82	103	0.00	20.80
16-Dec-15	8:00:37	2	3	3	5	0.9	2	4	6	76	95	0.00	20.81
16-Dec-15	8:00:47	2	3	3	5	0.9	2	4	6	70	88	0.00	20.82
16-Dec-15	8:00:57	2	3	3	4	0.8	2	4	6	66	83	0.00	20.82
16-Dec-15	8:01:07	2	3	3	5	0.9	2	4	6	62	78	0.00	20.82
16-Dec-15	8:01:17	2	3	3	4	0.8	2	4	6	60	75	0.00	20.83
16-Dec-15	8:01:27	3	4	4	6	0.9	2	6	8	57	71	0.00	20.82
16-Dec-15	8:01:37	3	4	4	6	0.8	2	5	8	55	69	0.00	20.83
16-Dec-15	8:06:49	2	3	3	5	1.1	2	4	6	34	43	0.00	20.81
16-Dec-15	8:06:59	2	3	3	5	1.1	2	4	6	35	44	0.00	20.81
16-Dec-15	8:07:09	2	3	3	5	1.1	2	4	6	36	45	0.00	20.81
16-Dec-15	8:07:19	2	3	3	5	0.9	2	4	6	35	44	0.00	20.82
16-Dec-15	8:07:29	2	3	3	5	0.9	2	4	6	34	43	0.00	20.82
16-Dec-15	8:07:39	2	3	3	5	1.0	2	4	6	31	39	0.00	20.82
16-Dec-15	8:07:49	2	3	3	5	0.9	2	4	6	30	38	0.00	20.82
16-Dec-15	8:07:59	2	3	3	5	0.9	2	4	6	30	38	0.00	20.82
16-Dec-15	8:08:09	2	3	3	5	1.0	2	4	6	29	36	0.00	20.82
16-Dec-15	8:08:19	2	3	3	4	0.8	2	4	6	30	38	0.00	20.82
16-Dec-15	8:08:29	2	3	3	4	0.8	2	4	6	30	38	0.00	20.82
16-Dec-15	8:08:39	2	3	3	5	0.9	2	4	6	30	38	0.00	20.83
16-Dec-15	8:08:49	2	3	3	4	0.8	2	4	6	31	39	0.00	20.82
16-Dec-15	8:08:59	1	1	2	3	0.8	2	2	4	31	39	0.00	20.82
16-Dec-15	8:09:09	1	1	2	3	0.8	2	2	4	30	38	0.00	20.83
16-Dec-15	8:09:19	2	3	3	5	1.0	2	4	6	29	36	0.00	20.83
16-Dec-15	8:09:29	2	3	3	5	0.9	2	4	6	29	36	0.00	20.82
16-Dec-15	8:09:39	2	3	3	4	0.8	2	4	6	28	35	0.00	20.83
16-Dec-15	8:09:49	2	3	3	4	0.7	1	4	6	26	33	0.00	20.83
16-Dec-15	8:09:59	2	3	3	4	0.8	2	4	6	26	33	0.00	20.82
16-Dec-15	8:10:09	2	3	3	4	0.8	2	4	6	26	33	0.00	20.83
16-Dec-15	8:10:19	2	3	3	5	1.0	2	4	6	25	31	0.00	20.83
16-Dec-15	8:10:29	2	3	3	4	0.7	1	4	6	25	31	0.00	20.83
16-Dec-15	8:10:39	2	3	3	4	0.8	2	4	6	25	31	0.00	20.83

Date	Time	NO (ppm)	NO (mg/m <sup>3</sup> )	NOx (ppm)	NOx (mg/m <sup>3</sup> )	NO <sub>2</sub> (ppm)	NO <sub>2</sub> (mg/m <sup>3</sup> )	Equiv NO <sub>2</sub> (ppm)	Equiv NO <sub>2</sub> (mg/m <sup>3</sup> )	CO (ppm)	CO (mg/m <sup>3</sup> )	CO <sub>2</sub> (%)	O <sub>2</sub> (%)
16-Dec-15	8:10:49	1	1	2	3	0.8	2	2	4	26	33	0.00	20.83
16-Dec-15	8:10:59	2	3	3	5	0.9	2	4	6	24	30	0.00	20.83
16-Dec-15	8:11:09	2	3	3	4	0.8	2	4	6	24	30	0.00	20.84
16-Dec-15	8:11:19	1	1	2	3	0.7	1	2	3	24	30	0.00	20.84
16-Dec-15	8:11:29	1	1	2	3	0.8	2	2	4	24	30	0.00	20.83
16-Dec-15	8:11:39	1	1	2	3	0.8	2	2	4	23	29	0.00	20.83
16-Dec-15	8:11:49	1	1	2	3	0.7	1	2	3	23	29	0.00	20.83
16-Dec-15	8:11:59	2	3	2	4	0.7	1	4	6	22	28	0.00	20.83
16-Dec-15	8:12:09	2	3	3	4	0.8	2	4	6	22	28	0.00	20.83
16-Dec-15	8:12:19	2	3	3	4	0.8	2	4	6	24	30	0.00	20.83
16-Dec-15	8:12:29	1	1	2	3	0.7	1	2	3	36	45	0.00	20.81
16-Dec-15	8:12:39	2	3	2	4	0.8	2	4	6	59	74	0.00	20.78
16-Dec-15	8:12:49	1	1	2	3	0.7	1	2	3	82	103	0.00	20.75
16-Dec-15	8:12:59	1	1	2	3	1.0	2	3	4	97	121	0.00	20.74
16-Dec-15	8:13:09	2	3	2	4	0.8	2	4	6	108	135	0.00	20.75
16-Dec-15	8:13:19	2	3	2	5	0.9	2	4	6	113	141	0.00	20.76
16-Dec-15	8:13:29	1	1	2	3	0.7	1	2	3	105	131	0.00	20.77
16-Dec-15	8:13:39	1	1	2	3	0.8	2	2	4	91	114	0.00	20.78
16-Dec-15	8:13:49	1	1	2	3	0.7	1	2	3	76	95	0.00	20.75
16-Dec-15	8:13:59	1	1	2	3	0.6	1	2	3	61	76	0.00	20.71
16-Dec-15	8:14:09	2	3	2	4	0.7	1	4	6	47	59	0.00	20.68
16-Dec-15	8:14:19	2	3	3	4	0.8	2	4	6	36	45	0.00	20.66
16-Dec-15	8:14:29	2	3	3	4	0.7	1	4	6	31	39	0.00	20.66
16-Dec-15	8:14:39	2	3	2	4	0.7	1	4	6	31	39	0.00	20.64
16-Dec-15	8:14:49	1	1	2	3	0.7	1	2	3	31	39	0.00	20.64
16-Dec-15	8:14:59	1	1	2	3	0.8	2	2	4	29	36	0.00	20.64
16-Dec-15	8:15:09	2	3	2	4	0.7	1	4	6	26	33	0.00	20.63
16-Dec-15	8:15:19	1	1	2	3	0.7	1	2	3	27	34	0.00	20.62
16-Dec-15	8:15:29	1	1	2	3	0.6	1	2	3	25	31	0.00	20.62
16-Dec-15	8:15:39	1	1	2	3	0.6	1	2	3	23	29	0.00	20.63
16-Dec-15	8:15:49	2	3	2	4	0.7	1	4	6	21	26	0.00	20.64
16-Dec-15	8:15:59	2	3	2	4	0.8	2	4	6	20	25	0.00	20.65
16-Dec-15	8:16:09	1	1	2	3	0.9	2	2	4	20	25	0.00	20.65
16-Dec-15	8:16:19	1	1	2	3	0.6	1	2	3	20	25	0.00	20.66
16-Dec-15	8:16:29	2	3	3	5	0.9	2	4	6	20	25	0.00	20.66
16-Dec-15	8:16:39	2	3	3	5	1.1	2	4	6	20	25	0.00	20.67
16-Dec-15	8:16:49	2	3	3	5	1.0	2	4	6	21	26	0.00	20.68
16-Dec-15	8:16:59	2	3	3	5	1.0	2	4	6	23	29	0.00	20.68
16-Dec-15	8:17:09	2	3	3	5	0.9	2	4	6	23	29	0.00	20.68
16-Dec-15	8:17:19	2	3	3	5	1.0	2	4	6	23	29	0.00	20.67
16-Dec-15	8:17:29	2	3	3	5	1.1	2	4	6	21	26	0.00	20.67
16-Dec-15	8:17:39	2	3	3	5	0.9	2	4	6	21	26	0.00	20.68
16-Dec-15	8:17:49	2	3	3	5	1.0	2	4	6	20	25	0.00	20.68
16-Dec-15	8:17:59	2	3	3	5	1.0	2	4	6	20	25	0.00	20.68
16-Dec-15	8:18:09	2	3	3	5	0.9	2	4	6	20	25	0.00	20.68
16-Dec-15	8:18:19	2	3	3	5	1.1	2	4	6	19	24	0.00	20.68
16-Dec-15	8:18:29	2	3	3	5	0.9	2	4	6	17	21	0.00	20.66
16-Dec-15	8:18:39	2	3	3	5	1.0	2	4	6	17	21	0.00	20.65
16-Dec-15	8:18:49	2	3	3	5	1.1	2	4	6	17	21	0.00	20.63
16-Dec-15	8:18:59	1	1	2	4	1.1	2	3	4	18	23	0.00	20.61
16-Dec-15	8:19:09	2	3	3	5	1.1	2	4	6	18	23	0.00	20.60
16-Dec-15	8:19:19	1	1	2	3	0.9	2	2	4	17	21	0.00	20.60
16-Dec-15	8:19:29	2	3	3	5	0.9	2	4	6	16	20	0.00	20.59
16-Dec-15	8:19:39	2	3	3	5	0.9	2	4	6	16	20	0.00	20.60
16-Dec-15	8:19:49	2	3	2	5	0.9	2	4	6	15	19	0.00	20.60
16-Dec-15	8:19:59	1	1	2	3	0.8	2	2	4	16	20	0.00	20.60
16-Dec-15	8:20:09	1	1	2	3	1.0	2	3	4	16	20	0.00	20.60
16-Dec-15	8:20:19	2	3	3	5	0.9	2	4	6	15	19	0.00	20.59
16-Dec-15	8:20:29	1	1	2	3	0.9	2	2	4	14	18	0.00	20.59
16-Dec-15	8:20:39	2	3	3	4	0.8	2	4	6	14	18	0.00	20.60
16-Dec-15	8:20:49	1	1	2	3	0.8	2	2	4	13	16	0.00	20.59
16-Dec-15	8:20:59	2	3	3	5	1.0	2	4	6	13	16	0.00	20.59
16-Dec-15	8:21:09	2	3	3	4	0.8	2	4	6	13	16	0.00	20.60
16-Dec-15	8:21:19	2	3	3	5	0.9	2	4	6	13	16	0.00	20.60
16-Dec-15	8:21:29	2	3	3	5	0.9	2	4	6	12	15	0.00	20.59
16-Dec-15	8:21:39	2	3	3	5	0.9	2	4	6	13	16	0.00	20.60
16-Dec-15	8:21:49	2	3	3	5	0.9	2	4	6	12	15	0.00	20.60
16-Dec-15	8:21:59	2	3	3	4	0.8	2	4	6	12	15	0.00	20.60
16-Dec-15	8:22:09	1	1	2	3	0.8	2	2	4	11	14	0.00	20.60
16-Dec-15	8:22:19	1	1	2	3	0.8	2	2	4	11	14	0.00	20.60
16-Dec-15	8:22:29	2	3	2	5	0.9	2	4	6	11	14	0.00	20.60
16-Dec-15	8:22:39	2	3	3	5	0.9	2	4	6	10	13	0.00	20.60
16-Dec-15	8:22:49	2	3	3	5	0.9	2	4	6	11	14	0.00	20.60
16-Dec-15	8:22:59	2	3	2	4	0.8	2	4	6	10	13	0.00	20.60
16-Dec-15	8:23:09	2	3	2	5	0.9	2	4	6	10	13	0.00	20.60
16-Dec-15	8:23:19	1	1	2	3	0.7	1	2	3	10	13	0.00	20.60
16-Dec-15	8:23:29	1	1	1	3	0.8	2	2	4	10	13	0.00	20.60
16-Dec-15	8:23:39	1	1	2	3	0.7	1	2	3	10	13	0.00	20.60
16-Dec-15	8:23:49	1	1	2	3	0.7	1	2	3	10	13	0.00	20.61
16-Dec-15	8:23:59	1	1	2	3	0.7	1	2	3	10	13	0.00	20.60
16-Dec-15	8:24:09	1	1	1	3	0.6	1	2	3	9	11	0.00	20.60
16-Dec-15	8:24:19	1	1	2	3	0.8	2	2	4	9	11	0.00	20.61
16-Dec-15	8:24:29	1	1	2	3	0.8	2	2	4	8	10	0.00	20.61
16-Dec-15	8:24:39	1	1	2	3	0.7	1	2	3	8	10	0.00	20.61
16-Dec-15	8:24:49	1	1	2	3	0.6	1	2	3	9	11	0.00	20.60
16-Dec-15	8:24:59	1	1	2	3	0.7	1	2	3	8	10	0.00	20.61
16-Dec-15	8:25:09	1	1	2	3	0.7	1	2	3	8	10	0.00	20.61
16-Dec-15	8:25:19	1	1	2	3	0.6	1	2	3	8	10	0.00	20.61
16-Dec-15	8:25:29	1	1	2	3	0.7	1	2	3	7	9	0.00	20.61
16-Dec-15	8:25:39	1	1	2	3	0.7	1	2	3	7	9	0.00	20.61
16-Dec-15	8:25:49	1	1	2	3	0.7	1	2	3	8	10	0.00	20.61
16-Dec-15	8:25:59	1	1	2	3	0.6	1	2	3	7	9	0.00	20.61
16-Dec-15	8:26:09	1	1	2	3	0.7	1	2	3	6	8	0.00	20.61
16-Dec-15	8:26:19	1	1	2	3	0.7	1	2	3	7	9	0.00	20.61
16-Dec-15	8:26:29	1	1	2	3	0.7	1	2	3	6	8	0.00	20.61
16-Dec-15	8:26:39	1	1	2	3	0.6	1	2	3	6	8	0.00	20.62
16-Dec-15	8:26:49	1	1	1	3	0.6	1	2	3	6	8	0.00	20.62
16-Dec-15	8:26:59	1	1	2	3	0.6	1	2	3	6	8	0.00	20.61
16-Dec-15	8:27:09	1	1	2	3	0.6	1	2	3	6	8	0.00	20.62
16-Dec-15	8:27:19	1	1	2	3	0.6	1	2	3	6	8	0.00	20.62
16-Dec-15	8:27:29	1	1	2	3	0.6	1	2	3	6	8	0.00	20.62

Date	Time	NO (ppm)	NO (mg/m <sup>3</sup> )	NOx (ppm)	NOx (mg/m <sup>3</sup> )	NO <sub>2</sub> (ppm)	NO <sub>2</sub> (mg/m <sup>3</sup> )	Equiv NO <sub>2</sub> (ppm)	Equiv NO <sub>2</sub> (mg/m <sup>3</sup> )	CO (ppm)	CO (mg/m <sup>3</sup> )	CO <sub>2</sub> (%)	O <sub>2</sub> (%)
16-Dec-15	8:27:39	1	1	1	3	0.7	1	2	3	6	8	0.00	20.62
16-Dec-15	8:27:49	1	1	2	3	0.7	1	2	3	6	8	0.00	20.62
16-Dec-15	8:27:59	1	1	2	3	0.7	1	2	3	6	8	0.00	20.62
16-Dec-15	8:28:09	1	1	2	3	0.7	1	2	3	7	9	0.00	20.62
16-Dec-15	8:28:19	1	1	2	3	0.7	1	2	3	6	8	0.00	20.61
16-Dec-15	8:28:29	1	1	1	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:28:39	1	1	2	3	0.6	1	2	3	5	6	0.00	20.62
16-Dec-15	8:28:49	1	1	2	3	0.8	2	2	4	5	6	0.00	20.61
16-Dec-15	8:28:59	1	1	2	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:09	1	1	2	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:19	1	1	1	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:29	1	1	1	2	0.5	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:39	1	1	2	3	0.6	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:49	1	1	2	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:29:59	1	1	2	3	0.6	1	2	3	4	5	0.00	20.62
16-Dec-15	8:30:09	1	1	2	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:30:19	1	1	2	3	0.7	1	2	3	4	5	0.00	20.62
16-Dec-15	8:30:29	1	1	1	3	0.6	1	2	3	4	5	0.00	20.62
16-Dec-15	8:30:39	1	1	2	2	0.5	1	2	3	4	5	0.00	20.63
16-Dec-15	8:30:49	1	1	1	3	0.6	1	2	3	3	4	0.00	20.62
16-Dec-15	8:30:59	0	0	1	1	0.7	1	1	1	4	5	0.00	20.62
16-Dec-15	8:31:09	1	1	1	3	0.6	1	2	3	4	5	0.00	20.62
16-Dec-15	8:31:19	1	1	2	3	0.6	1	2	3	4	5	0.00	20.62
16-Dec-15	8:31:29	1	1	2	2	0.5	1	2	3	4	5	0.00	20.62
16-Dec-15	8:31:39	1	1	1	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:31:49	1	1	1	3	0.7	1	2	3	4	5	0.00	20.63
16-Dec-15	8:31:59	1	1	1	3	0.6	1	2	3	4	5	0.00	20.62
16-Dec-15	8:32:09	1	1	1	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:32:19	1	1	1	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:32:29	1	1	1	3	0.8	2	2	4	5	6	0.00	20.62
16-Dec-15	8:32:39	1	1	2	3	0.7	1	2	3	5	6	0.00	20.62
16-Dec-15	8:32:49	0	0	1	1	0.7	1	1	1	5	6	0.00	20.63
16-Dec-15	8:32:59	1	1	1	3	0.7	1	2	3	5	6	0.00	20.63
	<b>Average</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>4</b>	<b>0.7</b>	<b>1</b>	<b>4</b>	<b>6</b>	<b>38</b>	<b>48</b>	<b>0.0</b>	<b>20.8</b>
	<b>Maximum</b>	<b>4</b>	<b>5</b>	<b>5</b>	<b>8</b>	<b>1.1</b>	<b>2</b>	<b>7</b>	<b>10</b>	<b>456</b>	<b>570</b>	<b>0.0</b>	<b>21.1</b>
	<b>Minimum</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0.1</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>0.0</b>	<b>20.6</b>

# AECOM

## **AECOM Australia Pty Ltd**

17 Warabrook Boulevard

Warabrook NSW 2304

PO Box 73

Hunter Region MC NSW 2310

T +612 4911 4900

F + 612 4911 4999

[www.aecom.com](http://www.aecom.com)

ABN 20 093 846 925

