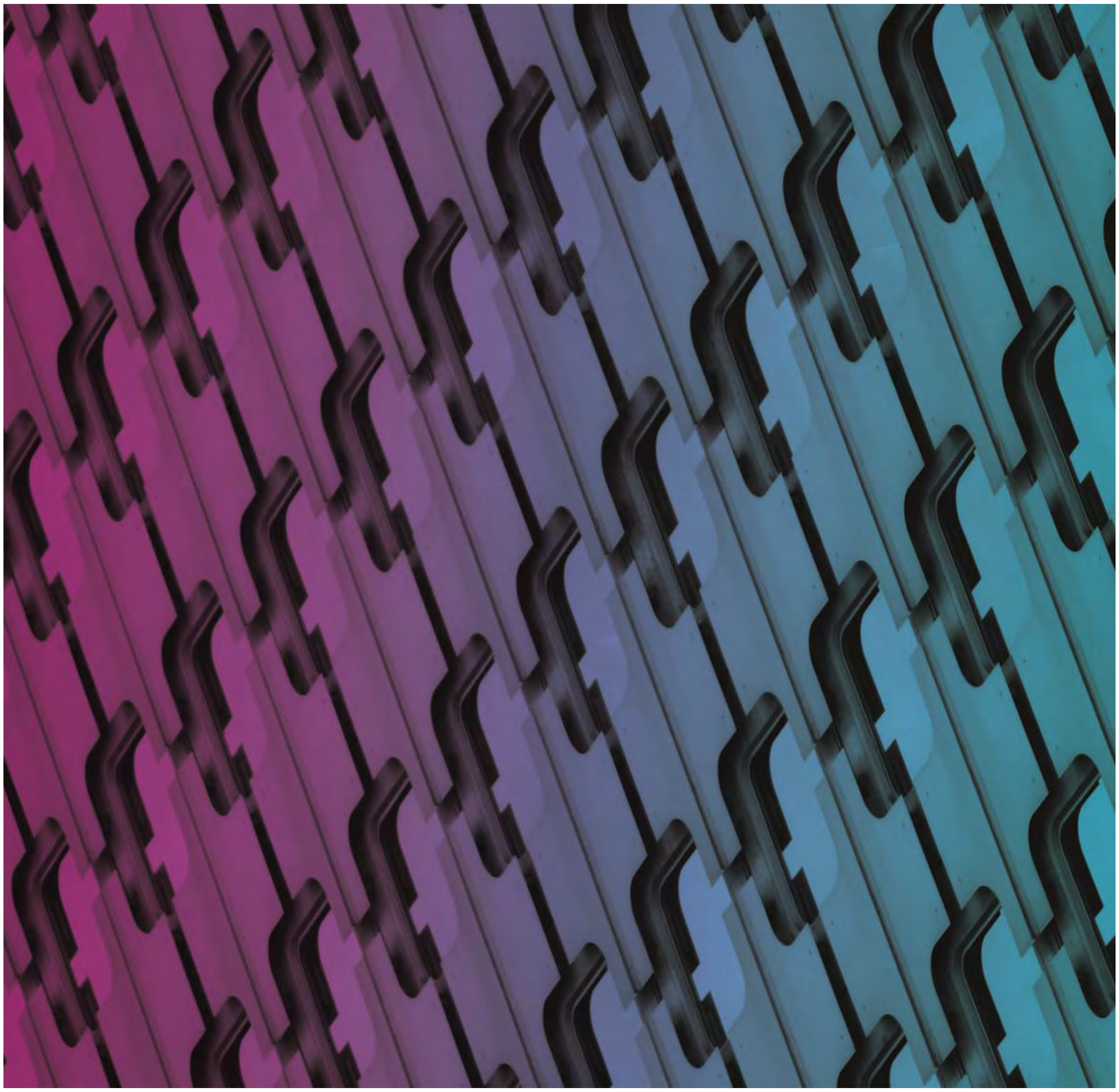
# Annual Emissions Testing Report 2015

## Weston Aluminium



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# Annual Emissions Testing Report 2015

Weston Aluminium

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| | | | | |

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**List of Tables**

# 1.0 Introduction

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

Testing was conducted over the period of June and August 2015 to determine emission concentrations for the following parameters:

**Stack 1 (EPL Point 1)**

- Total Particulate;
- Fine Particulate ($PM_{10}$);
- Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$);
- Sulfur Dioxide ($SO_2$ as $SO_3$);
- Chlorine;
- Hydrogen Chloride;
- Gaseous Fluoride;
- Particulate Fluoride;
- Hazardous Substances (Metals);
- Volatile Organic Compounds (VOC);
- Oxides of Nitrogen;
- Carbon Monoxide;
- Cyanide; and
- Polycyclic Aromatic Hydrocarbons (PAH).

**Stacks 2, 3, and 4 (EPL Points 2, 3, and 4)**

- Total Particulate;
- Fine Particulate ($PM_{10}$); and
- Hydrogen Fluoride.

**Stack 5 (EPL Point 13)**

- Total Particulate;
- Fine Particulate ($PM_{10}$);
- Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$);
- Sulfur Dioxide ($SO_2$ as $SO_3$);
- Chlorine;
- Hydrogen Chloride;
- Hydrogen Fluoride;
- Hazardous Substances (Metals);
- Dioxins and Furans;
- Polycyclic Aromatic Hydrocarbons (PAH);
- Volatile Organic Compounds (VOC);
- Oxides of Nitrogen;

- Oxygen; and
- Carbon Monoxide.

**Stack 6 (EPL Point 14)**

- Total Particulate;
- Fine Particulate ($PM_{10}$);
- Hydrogen Fluoride;
- Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$);
- Sulfur Dioxide ($SO_2$ as $SO_3$);
- Volatile Organic Compounds;
- Polycyclic Aromatic Hydrocarbons;
- Oxides of Nitrogen;
- Carbon Monoxide; and
- Oxygen ($O_2$).

**Stack 7 (EPL Point 15)**

- Total Particulate;
- Fine Particulate ($PM_{10}$);
- Hydrogen Fluoride;
- Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$);
- Sulfur Dioxide ($SO_2$ as $SO_3$);
- Polycyclic Aromatic Hydrocarbons (PAH) ;
- Volatile Organic Compounds (VOC); and
- Oxides of Nitrogen.

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 9080-0-M, 9080-0-P, 9172-0-M, 9172-0-P, 9502-0-M, 9502-0-P, 000006113 and 000006112:
  - Moisture;
  - Particle Sizing (not NATA Accredited);
  - Fine Particulate ($PM_{10}$); and
  - Total Particulate.
- Australian Laboratory Services, NATA accreditation number 18079, performed the following analysis detailed in report number EN1512020, EN1512073, and EN1512153;
  - 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_110, ORG_114, ORG_117 and DAU15_115:
    - Dioxins and Furans; and
    - Polycyclic Aromatic Hydrocarbons.
- Leeder Consulting, NATA accreditation number 14429, performed the following analysis detailed in report numbers M151361 and M151392;
    - Hazardous Substances (Metals)

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# 2.0 Sampling Plane Requirements

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

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

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

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

a. *The gas flow is basically in the same direction at all points along each sampling traverse.*

b. *The gas velocity at all sampling points is greater than 3 m/s.*

c. *The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of $15^o$ to the duct axis, when measured near the periphery of a circular sampling plane.*

d. *The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean.*

e. *The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1.*

f. *The gas temperature at the sampling plane should preferably be above the dewpoint.*

The sampling planes for Stacks 2, 3, 4, 5, 6 and 7(EPA Identification No. 2, 3, 4, 13, 14 and 15 respectively) were in accordance with AS 4323.1 Section 4.1. Stack 1 (EPA Identification No. 1) did not satisfy the requirements of AS 4323.1 Section 4.1 with regard to the upstream and downstream distances from disturbances. To compensate for this, additional sampling points were added in accordance with AS 4323.1 Section 4.2.

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# 3.0 Methodology

## 3.1 NATA Accredited Methods

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

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

**Table 2 AECOM NATA Endorsed Methods**

| NSW EPA Approved Methods | USEPA Methods | Parameter measured |
|---|---|---|
| NSW EPA TM-1 (AS 4323.1-1995) | USEPA (2000) Method 1 under approved circumstances | Selection of sampling positions |
| NSW EPA TM-2 | USEPA (2000) Method 2 or 2C or USEPA (1999) Method 2F or 2G or 2H (as appropriate) | Velocity or volumetric flow rate or temperature or pressure of stack gases |
| NSW EPA TM-3 | USEPA (2000) Method 8 (for sampling and analysis) or APHA (1998) Method 4110B (for analysis only if interference from fluorides, free ammonia and/or dimethyl aniline has been demonstrated to the satisfaction of the Chief Scientist) (as appropriate) | Sulfuric acid mist ($H_2SO_4$) or sulphur trioxide ($SO_3$) |
| NSW EPA TM-4 | USEPA (2000) Method 6 or 6A or 6B or USEPA (1996) Method 6C or ISO (1989) Method 7934 or ISO (1992) Method 7935 or ISO (1993) Method 10396 or ISO (1998) Method 11632 (as appropriate) | Sulfur dioxide ($SO_2$) |
| NSW EPA TM-7 | USEPA (2000) 26A | Chlorine ($Cl_2$) |
| NSW EPA TM-8 | USEPA (2000) 26A | Hydrogen chloride (HCl) |
| NSW EPA TM-9 | USEPA (2000) Method 13A or 13B (as appropriate) | Fluorine ($F_2$) or any compound containing fluorine, except where emitted by a primary aluminium smelter while manufacturing aluminium from alumina |
| NSW EPA TM-12 | USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate) | Type 1 substances (elements antimony (Sb), arsenic (As), cadmium (Cd), lead (Pb) or mercury (Hg) or any compound containing one or more of those elements) |
| NSW EPA TM-13 | USEPA (2000) Method 29 (Analysis for tin and vanadium to be done by Inductively Coupled Argon Plasma Emission Spectroscopy (ICAP) as defined in USEPA Method 29) or USEPA (1986) Method 7910 (for vanadium only) or USEPA (1986) Method 7911 (for vanadium only) (as appropriate) | Type 2 substances (elements beryllium (Be), chromium (Cr), cobalt (Co), manganese (Mn), nickel (Ni), selenium (Se), tin (Sn) or vanadium (V) or any compound containing one or more of those elements) |
| NSW EPA TM-14 | Cadmium (Cd) or mercury (Hg) or any compound containing one or more of those elements | USEPA (2000) Method 29 or USEPA (2000) Method 102 (for mercury only in hydrogen rich streams) (as appropriate) |
| NSW EPA TM-15 (AS 4323.2-1995) | USEPA (2000) Method 5 under approved circumstances | Solid particles (Total) |

| NSW EPA Approved Methods | USEPA Methods | Parameter measured |
|---|---|---|
| NSW EPA TM-22 | USEPA (2000) Method 4 | Moisture content in stack gases |
| NSW EPA TM-23 | USEPA (2000) Method 3 | Dry gas density or molecular weight of stack gases |
| NSW EPA TM-34 | USEPA (2000) Method 18 or USEPA (2000) Method 25 or 25A or 25B or 25C or 25D or 25E (as appropriate) | Volatile organic compounds |
| NSW EPA OM-5 | USEPA (1997) Method 201 or 201A (as appropriate) | ‘Fine’ particulates ($PM_{10}$) |
| NSW EPA OM-6 | California EPA Air Resources Board (1997) Method 429 | Polycyclic aromatic hydrocarbons (PAHs) |
| NSW EPA TM-18 | USEPA (1995) Method 23 | Dioxins and furans |
| NSW EPA TM-32 | USEPA Method 10 | Determination of Carbon Monoxide emissions from stationary sources |
| NSW EPA TM-25 | USEPA Method 3A | Determination of Oxygen concentrations from stationary sources |
| NSW EPA TM-11 | USEPA(2000) Method 7C | Determination of Nitrogen dioxide or nitric oxide emissions from stationary sources |

## 3.2 Deviations from NATA Accredited Methods

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

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

**Table 3 NATA Method Deviations**

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

# 4.0 Sampling Location

## 4.1 Sampling Location Summary

**Table 4** provides a summary of the locations sampled by AECOM during June and August 2015 at the Weston Aluminium plant in Kurri Kurri, NSW.

**Table 4 Sampling Location Summary**

| Discharge Description | Stack 1 (EPA Identification No. 1) | Stack 2 (EPA Identification No. 2) | Stack 3 (EPA Identification No. 3) | Stack 4 (EPA Identification No. 4) | Stack 5 (EPA Identification No. 13) | Stack 6 (EPA Identification No. 14) | Stack 7 (EPA Identification No. 15) |
|---|---|---|---|---|---|---|---|
| Duct Shape | Circular | Circular | Circular | Circular | Circular | Circular | Circular |
| Construction Material | Metal | Metal | Metal | Metal | Metal | Metal | Metal |
| Duct Diameter (mm) | 1650 | 1265 | 1000 | 1395 | 1490 | 580 | 1500 |
| Minimum No. Sampling Points | 16 | 12 | 12 | 12 | 12 | 8 | 12 |
| Sampling Ports | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Min. Points/Traverse | 8 | 6 | 6 | 6 | 6 | 4 | 6 |
| Disturbance | Yes | No | No | No | No | No | No |
| Distance from Upstream Disturbance | 2D | 6D | 6D | 6D | 7D | 9D | 7D |
| Type of Disturbance | Fan entry | Fan entry | Fan entry | Fan entry | Fan entry | Bend | Fans |
| Distance from Downstream Disturbance | 4D | 6D | 7D | 4D | 7D | 5D | 2D |
| Type of Disturbance | Stack Exit | Stack exit | Stack exit | Stack exit | Stack exit | Stack exit | Stack exit |
| Ideal Sampling Location | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Correction Factors Applied | Yes | No | No | No | No | No | No |
| Total No. Points Sampled | 20 | 12 | 12 | 12 | 12 | 8 | 12 |
| Points/Traverse | 10 | 6 | 6 | 6 | 6 | 4 | 6 |
| Sampling Performed to Standard* | Yes[2] | Yes[1] | Yes[1] | Yes[1] | Yes[1] | Yes[1] | Yes[1] |

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

[1] AS 4323.1 Section 4.1

[2] AS 4323.1 Section 4.2

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# 5.0 Equipment Calibration

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

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# 6.0 Results

A summary of test results for the 2015 annual testing is presented in **Tables 5 & 6**. Calculated Fine Particulate ($PM_{10}$) cut sizes for all stacks tested are displayed in **Table 7**. Gas Data Concentrations and Mass Emission Rate summaries are reported in **Tables 8 & 9** respectively. Detailed results along with gas stream properties during the testing periods can be found in **Tables 10** to **24**. Speciated Volatile Organic Carbons results can be found in **Tables 25** to **28**, Dioxins & Furans results in **Table 29**, Hazardous Substances (Metals) results in **Tables 30** and **31**, and Polycyclic Aromatic Hydrocarbons results in **Tables 32** to **35**.

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 Annual 2015**

| Parameter | Stack 1<br>EPL Point 1 | Stack 5<br>EPL Point 13 | Stack 6<br>EPL Point 14 | Stack 7<br>EPL Point 15 |
|---|---|---|---|---|
| Carbon Monoxide (CO) (mg/m$^3$) | 15 | <1 (125) | <1 | |
| Carbon Monoxide (CO) (ppm) | 12 (100) | | | |
| Chlorine (mg/m$^3$) | <2.6 | 0.94 | | |
| Cyanide | <0.0096 (0.5) | | | |
| Dioxins and Furans (Lower Bound) (ng/m$^3$) | | 0.0063 (0.1) | | |
| Dioxins and Furans (Middle Bound) (ng/m$^3$) | | 0.007 (0.1) | | |
| Fine Particulate ($PM_{10}$) (mg/m$^3$) | 1.3 | 2.4 | 1.1 [11.2%]* | 0.52 |
| Gaseous Fluoride (mg/m$^3$) | 0.078 (2) | | | |
| Hydrogen Chloride (mg/m$^3$) | <2.6 (400) | 1.2 (10) | | |
| Oxides of Nitrogen (as Equivalent $NO_2$) (mg/m$^3$) | 9 (2500) | 1 (2500) | 13 | 1 |
| Oxygen (%) | | 20.9 | 14.2 | |
| Particulate Fluoride (mg/m$^3$) | 0.018 | | | |
| Sulfur Dioxide ($SO_2$ as $SO_3$) (mg/m$^3$) | <11 | <15 | <10 | <11 |
| Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$) (mg/m$^3$) | <2.3 (100) | <3 (100) | 5.2 | <2.2 |
| Total Fluoride (mg/m$^3$) | | 0.19 | <5.1 | 0.27 |
| Total Particulate (mg/m$^3$) | 9.7(25) | 8.1 (10) | 9.6(10) | 1.3 (15) |
| Total Polycyclic Aromatic Hydrocarbons (mg/m$^3$) | 0.0048 | 0.0018 | 0.0072 | 0.019 |
| Type 1 and 2 Substances in Aggregate (Metals) (mg/m$^3$) | 0.041(10) | 1.2 (5) | | |
| Volatile Organic Compounds (VOC) (mg/m$^3$) | 0.09 | <0.36 (77) | 0.11 | <0.36 |

* Result calculated from Particle Sizing of the Total Particulate catch

Note – EPL Limits are in parenthesis

**Table 6 Air Emission Results Summary, Stacks 2, 3, & 4 – 2015**

| Parameter | Stack 2 (EPL Point 2) | Stack 3 (EPL Point 3) | Stack 4 (EPL Point 4) |
|---|---|---|---|
| Total Particulate (mg/m$^3$) | 0.56 (35) | 0.38 (50) | 2.1 (24) |
| Fine Particulate ($PM_{10}$) (mg/m$^3$) | 0.26 | <0.29 | 0.66 |
| Total Fluoride (mg/m$^3$) | 0.11 | 0.092 | 0.40 |

Note – EPL Limits are in parenthesis

USEPA method 201A, section 6.3.5 (Determination of $PM_{10}$ Emissions) and USEPA Conditional Test Method 040, Section 17, Table 2 (Determination of $PM_{2.5}$ Emissions) specifies that results are acceptable provided the calculated aerodynamic cut size ($D_{50}$) for the test lies between 9.0µm and 11.0µm. Post sampling cut size calculations performed for the sampling conducted are displayed in **Table 7**.

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

The cut size ($D_{50}$) is calculated prior to testing and is based on the pre-test measurements such as stack gas velocity, stack gas temperature, moisture content of the gas stream and stack gas density. This pre-test calculation of cut size ($D_{50}$) is used in conjunction with the pre-test measurements, some of which are stated above, to establish the sampling conditions or parameters.

**Table 7 Calculated $PM_{10}$ Cut Sizes**

| Sampling Location | $PM_{10}$ Cut Size ($D_{50}$) |
|---|---|
| Stack 1 | 10.3 |
| Stack 2 | 9.9 |
| Stack 3 | 10.5 |
| Stack 4 | 9.5 |
| Stack 5 | 10.2 |
| Stack 7 | 9.9 |

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

**Table 8** **Calculated Gas Concentrations Data Summary**

| Parameter | Stack 1 | Stack 5 | Stack 6 | Stack 7 |
|---|---|---|---|---|
| Date of Sampling | 17 June 2015 | 17 June 2015 | 26 June 2015 | 17 June 2015 |
| Time Period | 9:52-10:52 | 14:15-15:15 | 12:30-13:30 | 11:11-12:11 |
| Nitrogen Oxide (NO) (mg/m$^3$) | 5 | <1 | 8 | <1 |
| Nitrogen Dioxide ($NO_2$) (mg/m$^3$) | 0.4 | 0.2 | 0.6 | <0.1 |
| Nitrogen Oxides ($NO_x$) (mg/m$^3$) | 6 | 1 | 8 | <1 |
| Oxides of Nitrogen as Equivalent $NO_2$ (mg/m$^3$) | 9 (2500) | 1 (100) | 13 | 1 |
| Carbon Monoxide (ppm) | 12 (100) | | | |
| Carbon Monoxide (mg/m$^3$) | 15 | <1 (125) | <1 | |
| Oxygen (%) | | 20.9 | 14.2 | |

Note – EPL Limits are provided in parenthesis.

**Table 9** **Gas Mass Emission Rates Summary**

| Parameter | Stack 1 | Stack 5 | Stack 6 | Stack 7 |
|---|---|---|---|---|
| Date of Sampling | 17 June 2015 | 17 June 2015 | 26 June 2015 | 17 June 2015 |
| Time Period | 9:52-10:52 | 14:15-15:15 | 12:30-13:30 | 11:11-12:11 |
| Stack Gas Flow Rate (0°C, dry gas, 1 atm pressure) | 23.3 | 24.8 | 1.8 | 27.5 |
| Nitrogen Oxide (NO) (mg/s) | 116.5 | <24.8 | 14.4 | <27.5 |
| Nitrogen Dioxide ($NO_2$) (mg/s) | 9.3 | 5.0 | 1.1 | <2.8 |
| Nitrogen Oxides ($NO_x$) (mg/s) | 139.8 | 24.8 | 14.4 | <27.5 |
| Oxides of Nitrogen as Equivalent $NO_2$ (mg/s) | 209.7 | 24.8 | 23.4 | 27.5 |
| Carbon Monoxide (mg/s) | 349.5 | <24.8 | <1.8 | |

**Table 10** **Stack 1 Total Particulate, Fine Particulate (PM10) and Polycyclic Aromatic Hydrocarbon (PAH) Results, 11 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1650 | mm | | |
| Stack gas temperature (average) | 90.0 | °C | 363.2 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 15 | m/s | | |
| Stack gas flowrate (stack conditions) | 32 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 23 | m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 10:17 | - | 12:00 | |
| Fine Particulate (PM10) Mass | 1.6 | mg | | |
| Gas Volume Sampled | 1.2 | m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | 1.3 | mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 30 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 10:17 | - | 12:00 | |
| Total Particulate Mass | 9.5 | mg | | |
| Gas Volume Sampled | 0.983 | m$^3$ | | |
| Total Particulate Emission*1 | 9.7 | mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 230 | mg/s | | |
| Regulatory Limit | 25 | mg/m$^3$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | | |
| Test Period | 10:17 | - | 12:00 | |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0051 | mg | | |
| Gas Volume Sampled | 1.06 | m$^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0048 | mg/m$^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.11 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Moisture Content (%)** | **1.6** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.9** | **g/g-mole** | | |

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

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

**Table 11 Stack 1 Sulfuric Acid Mist (H2SO4 as So3), Sulfur Dioxide (SO2 as SO3), Hydrogen Chloride and Chlorine Results, 11 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1650 | mm | | |
| Stack gas temperature (average) | 90.0 | °C | 363.2 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 15 | m/s | | |
| Stack gas flowrate (stack conditions) | 32 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 23 | $m^3/s$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | | |
| Test Period | 12:20 | - | 14:00 | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 | mg | | |
| Gas Volume Sampled | 0.885 | $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <2.3 | $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <53 | mg/s | | |
| Regulatory Limit | 100 | $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | | |
| Test Period | 12:20 | - | 14:00 | |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 | mg | | |
| Gas Volume Sampled | 0.885 | $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <11 | $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <250 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Hydrogen Chloride Testing** | | | | |
| Test Period | 12:20 | - | 14:00 | |
| Hydrogen Chloride Mass | <2 | mg | | |
| Gas Volume Sampled | 0.769 | $m^3$ | | |
| Hydrogen Chloride Emission*1 | <2.6 | $mg/m^3$ | | |
| Hydrogen Chloride Mass Emission Rate*2 | <61 | mg/s | | |
| Regulatory Limit | 400 | $mg/m^3$ | | |
| **Chlorine Testing** | | | | |
| Test Period | 12:20 | - | 14:00 | |
| Chlorine Mass | <2 | mg | | |
| Gas Volume Sampled | 0.769 | $m^3$ | | |
| Chlorine Emission*1 | <2.6 | $mg/m^3$ | | |
| Chlorine Mass Emission Rate*2 | <61 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **3.4** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.9** | **g/g-mole** | | |

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

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

**Table 12 Stack 1 Hazardous Substances (Metals) Results, 11 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1650 | mm | | |
| Stack gas temperature (average) | 90.0 | $^{o}C$ | 363.2 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 15 | m/s | | |
| Stack gas flowrate (stack conditions) | 32 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 24 | $m^3/s$ | | |
| **Hazardous Substances (Metals) Testing** | | | | |
| Test Period | 12:20 | - | 14:00 | |
| Hazardous Substances (Metals) Mass | 0.053 | mg | | |
| Gas Volume Sampled | 1.3 | $m^3$ | | |
| Hazardous Substances (Metals) Emission*1 | 0.041 | $mg/m^3$ | | |
| Hazardous Substances (Metals) Mass Emission Rate*2 | 0.97 | mg/s | | |
| Regulatory Limit | 10 | $mg/m^3$ | | |
| **Moisture Content (%)** | **0.8** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.9** | **g/g-mole** | | |

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

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

**Table 13** **Stack 1 Cyanide, Gaseous Fluoride and Particulate Fluoride, Results, 11 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1650 | mm | | |
| Stack gas temperature (average) | 90.1 | $^{o}$C | 363.3 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 15 | m/s | | |
| Stack gas flowrate (stack conditions) | 32 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 23 | $m^3/s$ | | |
| **Cyanide Testing** | | | | |
| Test Period | 14:10 | - | 15:50 | |
| Cyanide Mass | <0.01 | mg | | |
| Gas Volume Sampled | 1.04 | $m^3$ | | |
| Cyanide Emission*1 | <0.0096 | $mg/m^3$ | | |
| Cyanide Mass Emission Rate*2 | <0.23 | mg/s | | |
| Regulatory Limit | 0.5 | $mg/m^3$ | | |
| **Gaseous Fluoride Testing** | | | | |
| Test Period | 14:10 | - | 15:50 | |
| Gaseous Fluoride Mass | 0.06 | mg | | |
| Gas Volume Sampled | 0.769 | $m^3$ | | |
| Gaseous Fluoride Emission*1 | 0.078 | $mg/m^3$ | | |
| Gaseous Fluoride Mass Emission Rate*2 | 1.8 | mg/s | | |
| Regulatory Limit | 2 | $mg/m^3$ | | |
| **Particulate Fluoride Testing** | | | | |
| Test Period | 14:10 | - | 15:50 | |
| Particulate Fluoride Mass | 0.014 | mg | | |
| Gas Volume Sampled | 0.769 | $m^3$ | | |
| Particulate Fluoride Emission*1 | 0.018 | $mg/m^3$ | | |
| Particulate Fluoride Mass Emission Rate*2 | 0.42 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **2.1** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.9** | **g/g-mole** | | |

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

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

**Table 14 Stack 2 Fine Particulate ($PM_{10}$), Total Particulate, Total Fluoride Results, 1 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1265 | mm | | |
| Stack gas temperature (average) | 30.0 | $^{o}$C | 303.2 | K |
| Stack pressure (average) | 1010 | hPa | | |
| Stack gas velocity (average, stack conditions) | 12 | m/s | | |
| Stack gas flowrate (stack conditions) | 15 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 13 | m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 10:14 | - | 11:15 | |
| Fine Particulate (PM10) Mass | 0.2 | mg | | |
| Gas Volume Sampled | 0.758 | m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.26 | mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 3.4 | mg/s | | |
| Regulatory Limit | N/A | mg/m$^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 10:14 | - | 11:15 | |
| Total Particulate Mass | 0.3 | mg | | |
| Gas Volume Sampled | 0.536 | m$^3$ | | |
| Total Particulate Emission*1 | 0.56 | mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 7.4 | mg/s | | |
| Regulatory Limit | 35 | mg/m$^3$ | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 10:14 | - | 11:15 | |
| Total Fluoride Mass | 0.06 | mg | | |
| Gas Volume Sampled | 0.526 | m$^3$ | | |
| Total Fluoride Emission*1 | 0.11 | mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 1.4 | mg/s | | |
| Regulatory Limit | N/A | mg/m$^3$ | | |
| **Moisture Content (%)** | **1.2** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 15 Stack 3 Fine Particulate (PM$_{10}$), Total Particulate, Total Fluoride Results, 1 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1000 | mm | | |
| Stack gas temperature (average) | 30.5 | $^o$C | 303.7 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 12 | m/s | | |
| Stack gas flowrate (stack conditions) | 9.8 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 8.7 | m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 11:47 | - | 12:48 | |
| Fine Particulate (PM10) Mass | <0.2 | mg | | |
| Gas Volume Sampled | 0.699 | m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | <0.29 | mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | <2.5 | mg/s | | |
| Regulatory Limit | N/A | mg/m$^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 11:47 | - | 12:48 | |
| Total Particulate Mass | 0.2 | mg | | |
| Gas Volume Sampled | 0.52 | m$^3$ | | |
| Total Particulate Emission*1 | 0.38 | mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 3.3 | mg/s | | |
| Regulatory Limit | 50 | mg/m$^3$ | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 11:47 | - | 12:48 | |
| Total Fluoride Mass | 0.05 | mg | | |
| Gas Volume Sampled | 0.545 | m$^3$ | | |
| Total Fluoride Emission*1 | 0.092 | mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 0.8 | mg/s | | |
| Regulatory Limit | N/A | mg/m$^3$ | | |
| **Moisture Content (%)** | **1.3** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

Notes *1 Emission concentration at Standard conditions of 0°C, 1 atm, dry gas
*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q$_{std}$ in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

**Table 16 Stack 4 Fine Particulate (PM$_{10}$), Total Particulate, Total Fluoride Results, 12 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1395 | mm | | |
| Stack gas temperature (average) | 52.0 | $^{o}$C | 325.2 | K |
| Stack pressure (average) | 1012 | hPa | | |
| Stack gas velocity (average, stack conditions) | 16 | m/s | | |
| Stack gas flowrate (stack conditions) | 24 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 20 | m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 10:03 | - | 11:04 | |
| Fine Particulate (PM10) Mass | 0.5 | mg | | |
| Gas Volume Sampled | 0.757 | m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.66 | mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 12 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 10:03 | - | 11:04 | |
| Total Particulate Mass | 1.4 | mg | | |
| Gas Volume Sampled | 0.667 | m$^3$ | | |
| Total Particulate Emission*1 | 2.1 | mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 43 | mg/s | | |
| Regulatory Limit | 24 | mg/m$^3$ | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 10:03 | - | 11:04 | |
| Total Fluoride Mass | 0.23 | mg | | |
| Gas Volume Sampled | 0.578 | m$^3$ | | |
| Total Fluoride Emission*1 | 0.40 | mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 8 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Moisture Content (%)** | **2.8** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 17 Stack 5 Polycyclic Aromatic Hydrocarbons (PAH), Dioxins and Furans Results, 17 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1490 | mm | | |
| Stack gas temperature (average) | 51.4 | $^{o}$C | 324.6 | K |
| Stack pressure (average) | 1014 | hPa | | |
| Stack gas velocity (average, stack conditions) | 16 | m/s | | |
| Stack gas flowrate (stack conditions) | 28 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 23 | m$^3$/s | | |
| **Dioxins and Furans Lower Bound Testing** | | | | |
| Test Period | 9:23 | - | 15:23 | |
| Dioxins and Furans Lower Bound Mass | 0.026 | ng | | |
| Gas Volume Sampled | 4.13 | m$^3$ | | |
| Dioxins and Furans Lower Bound Emission*1 | 0.0063 | ng/m$^3$ | | |
| Dioxins and Furans Lower Bound Mass Emission Rate*2 | 0.15 | ng/s | | |
| Regulatory Limit | 0.1 | ng/m$^3$ | | |
| **Dioxins and Furans Middle Bound Testing** | | | | |
| Test Period | 9:23 | - | 15:23 | |
| Dioxins and Furans Middle Bound Mass | 0.029 | ng | | |
| Gas Volume Sampled | 4.13 | m$^3$ | | |
| Dioxins and Furans Middle Bound Emission*1 | 0.007 | ng/m$^3$ | | |
| Dioxins and Furans Middle Bound Mass Emission Rate*2 | 0.16 | ng/s | | |
| Regulatory Limit | 0.1 | ng/m$^3$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | | |
| Test Period | 9:23 | - | 15:23 | |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0073 | mg | | |
| Gas Volume Sampled | 4.13 | m$^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0018 | mg/m$^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.042 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Moisture Content (%)** | **1.3** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 18 Stack 5 Total Fluoride, Hydrogen Chloride and Chlorine, Results, 17 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1490 | mm | | |
| Stack gas temperature (average) | 42.5 | $^{o}$C | 315.7 | K |
| Stack pressure (average) | 1015 | hPa | | |
| Stack gas velocity (average, stack conditions) | 17 | m/s | | |
| Stack gas flowrate (stack conditions) | 30 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 25 | m$^3$/s | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 11:19 | - | 12:19 | |
| Total Fluoride Mass | 0.12 | mg | | |
| Gas Volume Sampled | 0.643 | m$^3$ | | |
| Total Fluoride Emission*1 | 0.19 | mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 4.7 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Hydrogen Chloride Testing** | | | | |
| Test Period | 11:19 | - | 12:19 | |
| Hydrogen Chloride Mass | 0.899 | mg | | |
| Gas Volume Sampled | 0.726 | m$^3$ | | |
| Hydrogen Chloride Emission*1 | 1.2 | mg/m$^3$ | | |
| Hydrogen Chloride Mass Emission Rate*2 | 31 | mg/s | | |
| Regulatory Limit | 10 | mg/m$^3$ | | |
| **Chlorine Testing** | | | | |
| Test Period | 11:19 | - | 12:19 | |
| Chlorine Mass | 0.679 | mg | | |
| Gas Volume Sampled | 0.726 | m$^3$ | | |
| Chlorine Emission*1 | 0.94 | mg/m$^3$ | | |
| Chlorine Mass Emission Rate*2 | 24 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Moisture Content (%)** | **3.0** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 19 Stack 5 Hazardous Substances (Metals), Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$) & Sulfur Dioxide ($SO_2$ as $SO_3$) Results, 17 June 2015**

| **Sampling Conditions:** | | | | |
|---|---|---|---|---|
| Stack internal diameter at test location | 1490 | mm | | |
| Stack gas temperature (average) | 51.9 | °C | 325.1 | K |
| Stack pressure (average) | 1015 | hPa | | |
| Stack gas velocity (average, stack conditions) | 17 | m/s | | |
| Stack gas flowrate (stack conditions) | 30 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 25 | $m^3/s$ | | |
| **Hazardous Substances (Metals) Testing** | | | | |
| Test Period | 12:30 | - | 14:42 | |
| Hazardous Substances (Metals) Mass | 2.4 | mg | | |
| Gas Volume Sampled | 1.96 | $m^3$ | | |
| Hazardous Substances (Metals) Emission*1 | 1.2 | $mg/m^3$ | | |
| Hazardous Substances (Metals) Mass Emission Rate*2 | 31 | mg/s | | |
| Regulatory Limit | 5 | $mg/m^3$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | | |
| Test Period | 12:30 | - | 13:34 | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 | mg | | |
| Gas Volume Sampled | 0.666 | $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <3 | $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <76 | mg/s | | |
| Regulatory Limit | 100 | $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | | |
| Test Period | 12:30 | - | 13:34 | |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 | mg | | |
| Gas Volume Sampled | 0.666 | $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <15 | $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <380 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **0.7** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

Table 20 **Stack 5 Fine Particulate ($PM_{10}$) and Total Particulate Results, 14 August 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1490 | mm | | |
| Stack gas temperature (average) | 42.5 | $^oC$ | 315.7 | K |
| Stack pressure (average) | 1010 | hPa | | |
| Stack gas velocity (average, stack conditions) | 18 | m/s | | |
| Stack gas flowrate (stack conditions) | 31 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 26 | $m^3/s$ | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 10:31 | - | 11:33 | |
| Fine Particulate (PM10) Mass | 1.7 | mg | | |
| Gas Volume Sampled | 0.709 | $m^3$ | | |
| Fine Particulate (PM10) Emission*1 | 2.4 | $mg/m^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 63 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 10:31 | - | 11:33 | |
| Total Particulate Mass | 5.9 | mg | | |
| Gas Volume Sampled | 0.727 | $m^3$ | | |
| Total Particulate Emission*1 | 8.1 | $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 | 210 | mg/s | | |
| Regulatory Limit | 10 | $mg/m^3$ | | |
| **Moisture Content (%)** | **1.0** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 21 Stack 6 Total Fluoride, Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$) and Sulfur Dioxide ($SO_2$ as $SO_3$) Results, 26 June 2015**

| **Sampling Conditions:** | | | | |
|---|---|---|---|---|
| Stack internal diameter at test location | 580 | mm | | |
| Stack gas temperature (average) | 173.0 | $^oC$ | 446.2 | K |
| Stack pressure (average) | 1026 | hPa | | |
| Stack gas velocity (average, stack conditions) | 11 | m/s | | |
| Stack gas flowrate (stack conditions) | 2.9 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 1.7 | $m^3/s$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 12:28 | - | 1:48 | |
| Total Particulate Mass | 7.7 | mg | | |
| Gas Volume Sampled | 1.79 | $m^3$ | | |
| Total Particulate Emission*1 at 3% O2 | 9.6 | $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 at 3% O2 | 17 | mg/s | | |
| Regulatory Limit at 3% O2 | 10 | $mg/m^3$ | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 12:28 | - | 1:48 | |
| Total Fluoride Mass | 4.63 | mg | | |
| Gas Volume Sampled | 0.908 | $m^3$ | | |
| Total Fluoride Emission*1 | 5.1 | $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 8.9 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | | |
| Test Period | 12:28 | - | 1:48 | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <5 | mg | | |
| Gas Volume Sampled | 0.961 | $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <5.2 | $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <9.1 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | | |
| Test Period | 12:28 | - | 1:48 | |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 | mg | | |
| Gas Volume Sampled | 0.961 | $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <10 | $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <17 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **2.2** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.31** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **29.2** | **g/g-mole** | | |

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

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

**Table 22 Stack 6 Polycyclic Aromatic Hydrocarbons Results, 26 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 580 | mm | | |
| Stack gas temperature (average) | 204.0 | $^{o}$C | 477.2 | K |
| Stack pressure (average) | 1026 | hPa | | |
| Stack gas velocity (average, stack conditions) | 12 | m/s | | |
| Stack gas flowrate (stack conditions) | 3.3 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 1.9 | $m^3/s$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | | |
| Test Period | 12:28 | - | 1:48 | |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0068 | mg | | |
| Gas Volume Sampled | 0.942 | $m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0072 | $mg/m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.013 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **1.8** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.31** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **29.2** | **g/g-mole** | | |

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

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

**Table 23 Stack 7 Fine Particulate ($PM_{10}$), Total Particulate and Total Fluoride Results, 25 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1500 | mm | | |
| Stack gas temperature (average) | 31.4 | $^{o}$C | 304.6 | K |
| Stack pressure (average) | 1022 | hPa | | |
| Stack gas velocity (average, stack conditions) | 17 | m/s | | |
| Stack gas flowrate (stack conditions) | 30 | m$^3$/s | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 27 | m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | | |
| Test Period | 11:19 | - | 12:24 | |
| Fine Particulate (PM10) Mass | 0.4 | mg | | |
| Gas Volume Sampled | 0.765 | m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.52 | mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 14 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Total Particulate Testing** | | | | |
| Test Period | 11:19 | - | 12:24 | |
| Total Particulate Mass | 1 | mg | | |
| Gas Volume Sampled | 0.768 | m$^3$ | | |
| Total Particulate Emission*1 | 1.3 | mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 34 | mg/s | | |
| Regulatory Limit | 15 | mg/m$^3$ | | |
| **Total Fluoride Testing** | | | | |
| Test Period | 11:19 | - | 12:24 | |
| Total Fluoride Mass | 0.18 | mg | | |
| Gas Volume Sampled | 0.672 | m$^3$ | | |
| Total Fluoride Emission*1 | 0.27 | mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 7.3 | mg/s | | |
| Regulatory Limit | NA | mg/m$^3$ | | |
| **Moisture Content (%)** | **2.4** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **kg/m$^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 24** **Stack 7 Polycyclic Aromatic Hydrocarbon (PAH), Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$), and Sulfur Dioxide ($SO_2$ as $SO_3$) Results, 25 June 2015**

| | | | | |
|---|---|---|---|---|
| **Sampling Conditions:** | | | | |
| Stack internal diameter at test location | 1500 | mm | | |
| Stack gas temperature (average) | 22.7 | °C | 295.9 | K |
| Stack pressure (average) | 1021 | hPa | | |
| Stack gas velocity (average, stack conditions) | 16 | m/s | | |
| Stack gas flowrate (stack conditions) | 29 | $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 26 | $m^3/s$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | | |
| Test Period | 10:02 | - | 11:08 | |
| Polycyclic Aromatic Hydrocarbons Mass | 0.018 | mg | | |
| Gas Volume Sampled | 0.95 | $m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.019 | $mg/m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.5 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | | |
| Test Period | 10:02 | - | 11:08 | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 | mg | | |
| Gas Volume Sampled | 0.895 | $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <2.2 | $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <58 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | | |
| Test Period | 10:02 | - | 11:08 | |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 | mg | | |
| Gas Volume Sampled | 0.895 | $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <11 | $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <290 | mg/s | | |
| Regulatory Limit | NA | $mg/m^3$ | | |
| **Moisture Content (%)** | **1.6** | | | |
| **Gas Density (dry at 1 atmosphere)** | **1.29** | **$kg/m^3$** | | |
| **Dry Molecular Weight** | **28.8** | **g/g-mole** | | |

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

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

**Table 25 Stack 1 Speciated Volatile Organic Compounds Results**

| Analyte | Sample µg | Blank µg | Sample Blank Corrected µg | (mg/m$^3$) | mg/s |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,1-dichloroethane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 2-Butanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Chloroform | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1-heptene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-heptane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Trichloroethene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| MIBK | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Toluene | 1.0 | <1.0 | 0.5 | 0.09 | 2.1 |
| 2-hexanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Chlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Ethyl Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| m- & p-xylene | <2.0 | <0.2 | <2.0 | <0.36 | <8.3 |
| o-xylene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Styrene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Cyclohexanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Isopropylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 2-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 4-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,3,5-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-decane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,2,4-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,3-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,4-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,2-dichlorobenzne | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-butylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Hexachlorobutadiene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| **Total** | **1.0** | | **0.5** | **0.09** | **2.1** |

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

**Table 26 Stack 5 Speciated Volatile Organic Compounds Results**

| **Analyte** | **Sample µg** | **Blank µg** | **Sample Blank Corrected µg** | **(mg/m$^3$)** | **mg/s** |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <4.3 |
| 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 | <1.0 | <1.0 | <1.0 | <0.18 | <4.3 |
| 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-dichlorobenzne | <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** | **<0.36** | **<8.6** |

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.

**Table 27 Stack 6 Speciated Volatile Organic Compounds Results**

| Analyte | Sample µg | Blank µg | Sample Blank Corrected µg | (mg/m$^3$) | mg/s |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,1-dichloroethane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 2-Butanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Chloroform | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1-heptene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-heptane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Trichloroethene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| MIBK | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Toluene | 1.1 | <1.0 | 0.6 | 0.11 | 0.21 |
| 2-hexanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Chlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Ethyl Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| m- & p-xylene | <2.0 | <0.2 | <2.0 | <0.36 | <0.68 |
| o-xylene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Styrene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Cyclohexanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Isopropylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 2-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 4-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,3,5-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-decane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,2,4-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,3-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,4-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,2-dichlorobenzne | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-butylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Hexachlorobutadiene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| **Total** | **1.1** | | **0.6** | **0.11** | **0.21** |

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.

**Table 28 Stack 7 Speciated Volatile Organic Compounds Results**

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

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

**Table 29 Stack 5 Speciated Dioxins & Furans Results**

| Analyte | Mass ng | Toxic Equivalency Factor (WHO - TEFs) (2005) | Total Toxic Equivalence (WHO - TEQs) ng | Concentration ng/m$^3$ | Total Toxic Equivalence (1-TEQs) ng/m$^3$ |
|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 0.015 | 0.1 | 0.0015 | 0.0036 | 0.00036 |
| Total TCDF isomers | 0.26 | | | | |
| 2,3,7,8-TCDD | <0.005 | 1 | 0.0025 | <0.0012 | 0.0006 |
| Total TCDD isomers | 0.042 | | | | |
| | | | | | |
| 1,2,3,7,8-PeCDF | 0.017 | 0.05 | 0.00085 | 0.0041 | 0.00021 |
| 2,3,4,7,8-PeCDF | 0.019 | 0.5 | 0.0095 | 0.0046 | 0.0023 |
| Total PeCDF isomers | 0.2 | | | | |
| 1,2,3,7,8-PeCDD | 0.0044 | 0.5 | 0.0022 | 0.0011 | 0.00053 |
| Total PeCDD isomers | 0.086 | | | | |
| | | | | | |
| 1,2,3,4,7,8-HxCDF | 0.02 | 0.1 | 0.002 | 0.0048 | 0.00048 |
| 1,2,3,6,7,8-HxCDF | 0.02 | 0.1 | 0.002 | 0.0048 | 0.00048 |
| 2,3,4,6,7,8-HxCDF | 0.022 | 0.1 | 0.0022 | 0.0053 | 0.00053 |
| 1,2,3,7,8,9-HxCDF | <0.004 | 0.1 | 0.0002 | <0.00097 | 0.000048 |
| Total HxCDF isomers | 0.17 | | | | |
| 1,2,3,4,7,8-HxCDD | 0.0085 | 0.1 | 0.00085 | 0.0021 | 0.00021 |
| 1,2,3,6,7,8-HxCDD | 0.014 | 0.1 | 0.0014 | 0.0034 | 0.00034 |
| 1,2,3,7,8,9-HxCDD | 0.016 | 0.1 | 0.0016 | 0.0039 | 0.00039 |
| Total HxCDD isomers | 0.19 | | | | |
| | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 0.058 | 0.01 | 0.00058 | 0.014 | 0.00014 |
| 1,2,3,4,7,8,9-Hp CDF | 0.0054 | 0.01 | 0.000054 | 0.0013 | 0.000013 |
| Total HpCDF isomers | 0.084 | | | | |
| 1,2,3,4,6,7,8-HpCDD | 0.082 | 0.01 | 0.00082 | 0.02 | 0.0002 |
| Total HpCDD isomers | 0.16 | | | | |
| | | | | | |
| OCDF | 0.0099 | 0.001 | 0.0000099 | 0.0024 | 0.0000024 |
| OCDD | 0.59 | 0.001 | 0.00059 | 0.14 | 0.00014 |

**I-TEQ$_{DF}$**

| | | |
|---|---|---|
| Lower Bound (excluding LOD Values) | 0.026 | ng |
| Middle Bound (including half LOD Values) | 0.029 | ng |

**Table 30 Stack 1 Elemental Metals Results**

| Sample | Total Particulate Metals (mg) | Total Particulate Metals ($mg/m^3$) | Total Gaseous Metals (mg) | Total Gaseous Metals ($mg/m^3$) | Total Oxidisable Mercury (mg) | Total Oxidisable Mercury ($mg/m^3$) | Total (mg) | Total ($mg/m^3$) | Mass Emission Rate (mg/s) |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Arsenic | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Beryllium | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Cadmium | 0.0013 | 0.001 | 0.0003 | 0.00023 | | | 0.002 | 0.0015 | 0.036 |
| Chromium | 0.0002 | 0.00015 | 0.0074 | 0.0057 | | | 0.008 | 0.0061 | 0.14 |
| Cobalt | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Copper | 0.0017 | 0.0013 | 0.0018 | 0.0014 | | | 0.004 | 0.0031 | 0.073 |
| Lead | 0.017 | 0.013 | 0.0012 | 0.00092 | | | 0.02 | 0.015 | 0.36 |
| Magnesium | <0.02 | <0.015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Manganese | 0.0085 | 0.0065 | 0.00058 | 0.00045 | | | 0.009 | 0.0069 | 0.16 |
| Mercury | <0.002 | <0.0015 | <0.0001 | <0.000077 | <0.0001 | <0.000077 | <0.002 | <0.0015 | <0.036 |
| Nickel | <0.004 | <0.0031 | 0.013 | 0.01 | | | 0.013 | 0.01 | 0.24 |
| Selenium | <0.0002 | <0.00015 | 0.00055 | 0.00042 | | | 0.00055 | 0.00042 | 0.0099 |
| Thallium | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Tin | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Vanadium | 0.0007 | 0.00054 | <0.0001 | <0.000077 | | | 0.0007 | 0.00054 | 0.013 |
| Zinc | 1.4 | 1.1 | 0.0019 | 0.0015 | | | 1 | 0.77 | 18 |
| **Total Hazardous Metals*** | **0.028** | **0.021** | **0.023** | **0.018** | **<0.0001** | **<0.000077** | **0.053** | **0.041** | **0.97** |
| **Total Metals** | **1.4** | **1.1** | **0.027** | **0.021** | | | **1.1** | **0.81** | **19** |

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

**Table 31 Stack 5 Elemental Metals Results**

| Sample | Total Particulate Metals (mg) | Total Particulate Metals (mg/m$^3$) | Total Gaseous Metals (mg) | Total Gaseous Metals (mg/m$^3$) | Total Oxidisable Mercury (mg) | Total Oxidisable Mercury (mg/m$^3$) | Total (mg) | Total (mg/m$^3$) | Mass Emission Rate (mg/s) |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | 0.025 | 0.013 | <0.0001 | <0.000051 | | | 0.025 | 0.013 | 0.33 |
| Arsenic | 0.019 | 0.0097 | <0.0001 | <0.000051 | | | 0.019 | 0.0097 | 0.25 |
| Beryllium | 0.0003 | 0.00015 | <0.0001 | <0.000051 | | | 0.0003 | 0.00015 | 0.0038 |
| Cadmium | 0.0017 | 0.00087 | 0.00035 | 0.00018 | | | 0.002 | 0.001 | 0.025 |
| Chromium | 0.57 | 0.29 | 0.0012 | 0.00061 | | | 0.6 | 0.31 | 7.9 |
| Cobalt | 0.055 | 0.028 | <0.0001 | <0.000051 | | | 0.055 | 0.028 | 0.71 |
| Copper | 0.32 | 0.16 | 0.00029 | 0.00015 | | | 0.3 | 0.15 | 3.8 |
| Lead | 0.1 | 0.051 | 0.00045 | 0.00023 | | | 0.1 | 0.051 | 1.3 |
| Magnesium | 4.9 | 2.5 | 0.00094 | 0.00048 | | | 5 | 2.6 | 66 |
| Manganese | 0.41 | 0.21 | 0.0052 | 0.0027 | | | 0.4 | 0.2 | 5.1 |
| Mercury | <0.002 | <0.001 | <0.0001 | <0.000051 | <0.0001 | <0.000051 | <0.002 | <0.001 | <0.025 |
| Nickel | 0.11 | 0.056 | 0.0099 | 0.0051 | | | 0.1 | 0.051 | 1.3 |
| Selenium | 0.0067 | 0.0034 | 0.00055 | 0.00028 | | | 0.007 | 0.0036 | 0.092 |
| Thallium | <0.0002 | <0.0001 | <0.0001 | <0.000051 | | | <0.0002 | <0.0001 | <0.0025 |
| Tin | 1.1 | 0.56 | 0.00045 | 0.00023 | | | 1 | 0.51 | 13 |
| Vanadium | 0.05 | 0.026 | <0.0001 | <0.000051 | | | 0.05 | 0.026 | 0.66 |
| Zinc | 17 | 8.7 | 0.0031 | 0.0016 | | | 17 | 8.7 | 220 |
| **Total Hazardous Metals*** | **1.3** | **0.69** | **0.018** | **0.0091** | **<0.0001** | **<0.000051** | **2.4** | **1.2** | **31** |
| **Total Metals** | **25** | **13** | **0.022** | **0.012** | | | **25** | **13** | **320** |

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

**Table 32** **Stack 1 Speciated Polycyclic Aromatic Hydrocarbons Results**

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | 2100 | 2.1 | 0.0021 | 2 | 0.002 | 47 | 0.047 |
| 2 - Methylnapthalene | 790 | 0.79 | 0.00079 | 0.75 | 0.00075 | 18 | 0.018 |
| Acenaphthylene | 42 | 0.042 | 0.000042 | 0.04 | 0.00004 | 0.94 | 0.00094 |
| Acenaphthene | 26 | 0.026 | 0.000026 | 0.025 | 0.000025 | 0.58 | 0.00058 |
| Fluorene | 52 | 0.052 | 0.000052 | 0.049 | 0.000049 | 1.2 | 0.0012 |
| Phenanthrene | 400 | 0.4 | 0.0004 | 0.38 | 0.00038 | 8.9 | 0.0089 |
| Anthracene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Fluoranthene | 280 | 0.28 | 0.00028 | 0.27 | 0.00027 | 6.2 | 0.0062 |
| Pyrene | 170 | 0.17 | 0.00017 | 0.16 | 0.00016 | 3.8 | 0.0038 |
| Benz(a)anthracene | 120 | 0.12 | 0.00012 | 0.11 | 0.00011 | 2.7 | 0.0027 |
| Chrysene | 360 | 0.36 | 0.00036 | 0.34 | 0.00034 | 8 | 0.008 |
| Benzo(b)fluoranthene | 350 | 0.35 | 0.00035 | 0.33 | 0.00033 | 7.8 | 0.0078 |
| Benzo(k)fluoranthene | 190 | 0.19 | 0.00019 | 0.18 | 0.00018 | 4.2 | 0.0042 |
| Benzo(e)pyrene | 150 | 0.15 | 0.00015 | 0.14 | 0.00014 | 3.3 | 0.0033 |
| Benzo(a)pyrene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Perylene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Indeno(123:cd)pyrene | 34 | 0.034 | 0.000034 | 0.032 | 0.000032 | 0.76 | 0.00076 |
| Dibenzo(ah)anthracene | <26 | <0.026 | <0.000026 | 0.025 | <0.000025 | <0.58 | <0.00058 |
| Benzo(ghi)perylene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| **Sum of reported PAH's** | **5100** | **5.1** | **0.0051** | **4.9** | **0.0048** | **110** | **0.11** |

**Table 33 Stack 5 Speciated Polycyclic Aromatic Hydrocarbon Results**

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | <470 | <0.47 | <0.00047 | 0.11 | <0.00011 | <2.7 | <0.0027 |
| 2 - Methylnapthalene | 610 | 0.61 | 0.00061 | 0.15 | 0.00015 | 3.5 | 0.0035 |
| Acenaphthylene | 970 | 0.97 | 0.00097 | 0.23 | 0.00023 | 5.5 | 0.0055 |
| Acenaphthene | 440 | 0.44 | 0.00044 | 0.11 | 0.00011 | 2.5 | 0.0025 |
| Fluorene | 1100 | 1.1 | 0.0011 | 0.27 | 0.00027 | 6.3 | 0.0063 |
| Phenanthrene | 2600 | 2.6 | 0.0026 | 0.63 | 0.00063 | 15 | 0.015 |
| Anthracene | 84 | 0.084 | 0.000084 | 0.02 | 0.00002 | 0.48 | 0.00048 |
| Fluoranthene | 620 | 0.62 | 0.00062 | 0.15 | 0.00015 | 3.5 | 0.0035 |
| Pyrene | 290 | 0.29 | 0.00029 | 0.07 | 0.00007 | 1.6 | 0.0016 |
| Benz(a)anthracene | 40 | 0.04 | 0.00004 | 0.0097 | 0.0000097 | 0.23 | 0.00023 |
| Chrysene | 110 | 0.11 | 0.00011 | 0.027 | 0.000027 | 0.63 | 0.00063 |
| Benzo(b)fluoranthene | 120 | 0.12 | 0.00012 | 0.029 | 0.000029 | 0.68 | 0.00068 |
| Benzo(k)fluoranthene | 66 | 0.066 | 0.000066 | 0.016 | 0.000016 | 0.38 | 0.00038 |
| Benzo(e)pyrene | 53 | 0.053 | 0.000053 | 0.013 | 0.000013 | 0.3 | 0.0003 |
| Benzo(a)pyrene | 110 | 0.11 | 0.00011 | 0.027 | 0.000027 | 0.63 | 0.00063 |
| Perylene | <20 | <0.02 | <0.00002 | 0.0048 | <0.0000048 | <0.11 | <0.00011 |
| Indeno(123:cd)pyrene | 37 | 0.037 | 0.000037 | 0.009 | 0.000009 | 0.21 | 0.00021 |
| Dibenzo(ah)anthracene | <20 | <0.02 | <0.00002 | 0.0048 | <0.0000048 | <0.11 | <0.00011 |
| Benzo(ghi)perylene | 41 | 0.041 | 0.000041 | 0.0099 | 0.0000099 | 0.23 | 0.00023 |
| **Sum of reported PAH's** | **7300** | **7.3** | **0.0073** | **1.9** | **0.0018** | **42** | **0.042** |

**Table 34 Stack 6 Speciated Polycyclic Aromatic Hydrocarbon Results**

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | 4700 | 4.7 | 0.0047 | 5 | 0.005 | 9.2 | 0.0092 |
| 2 - Methylnapthalene | 890 | 0.89 | 0.00089 | 0.94 | 0.00094 | 1.8 | 0.0018 |
| Acenaphthylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Acenaphthene | 180 | 0.18 | 0.00018 | 0.19 | 0.00019 | 0.35 | 0.00035 |
| Fluorene | 74 | 0.074 | 0.000074 | 0.079 | 0.000079 | 0.15 | 0.00015 |
| Phenanthrene | 420 | 0.42 | 0.00042 | 0.45 | 0.00045 | 0.83 | 0.00083 |
| Anthracene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Fluoranthene | 270 | 0.27 | 0.00027 | 0.29 | 0.00029 | 0.53 | 0.00053 |
| Pyrene | 140 | 0.14 | 0.00014 | 0.15 | 0.00015 | 0.28 | 0.00028 |
| Benz(a)anthracene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Chrysene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(b)fluoranthene | 25 | 0.025 | 0.000025 | 0.027 | 0.000027 | 0.049 | 0.000049 |
| Benzo(k)fluoranthene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(e)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(a)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Perylene | 42 | 0.042 | 0.000042 | 0.045 | 0.000045 | 0.083 | 0.000083 |
| Indeno(123:cd)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Dibenzo(ah)anthracene | 39 | 0.039 | 0.000039 | 0.041 | 0.000041 | 0.077 | 0.000077 |
| Benzo(ghi)perylene | <29 | <0.029 | <0.000029 | 0.031 | <0.000031 | <0.057 | <0.000057 |
| **Sum of reported PAH's** | **6800** | **6.8** | **0.0068** | **7.4** | **0.0072** | **13** | **0.013** |

**Table 35 Stack 7 Speciated Polycyclic Aromatic Hydrocarbon Results**

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | 6400 | 6.4 | 0.0064 | 6.7 | 0.0067 | 180 | 0.18 |
| 2 - Methylnapthalene | 9600 | 9.6 | 0.0096 | 10 | 0.01 | 270 | 0.27 |
| Acenaphthylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Acenaphthene | 78 | 0.078 | 0.000078 | 0.082 | 0.000082 | 2.2 | 0.0022 |
| Fluorene | 140 | 0.14 | 0.00014 | 0.15 | 0.00015 | 3.9 | 0.0039 |
| Phenanthrene | 550 | 0.55 | 0.00055 | 0.58 | 0.00058 | 15 | 0.015 |
| Anthracene | 21 | 0.021 | 0.000021 | 0.022 | 0.000022 | 0.58 | 0.00058 |
| Fluoranthene | 380 | 0.38 | 0.00038 | 0.4 | 0.0004 | 11 | 0.011 |
| Pyrene | 170 | 0.17 | 0.00017 | 0.18 | 0.00018 | 4.7 | 0.0047 |
| Benz(a)anthracene | 26 | 0.026 | 0.000026 | 0.027 | 0.000027 | 0.72 | 0.00072 |
| Chrysene | 65 | 0.065 | 0.000065 | 0.068 | 0.000068 | 1.8 | 0.0018 |
| Benzo(b)fluoranthene | 46 | 0.046 | 0.000046 | 0.048 | 0.000048 | 1.3 | 0.0013 |
| Benzo(k)fluoranthene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Benzo(e)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Benzo(a)pyrene | 44 | 0.044 | 0.000044 | 0.046 | 0.000046 | 1.2 | 0.0012 |
| Perylene | 33 | 0.033 | 0.000033 | 0.035 | 0.000035 | 0.92 | 0.00092 |
| Indeno(123:cd)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Dibenzo(ah)anthracene | <26 | <0.026 | <0.000026 | 0.027 | <0.000027 | <0.72 | <0.00072 |
| Benzo(ghi)perylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| **Sum of reported PAH's** | **18000** | **18** | **0.018** | **18** | **0.018** | **490** | **0.49** |

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## Appendix A

# Field Sheets and Final Calculations (246 pages)

# Appendix A Field Sheets and Final Calculations (246 pages)

# Emission Measurement Calculations Spreadsheet

AECOM

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 11-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Fine Particulate (PM10) | NSW EPA OM - 5 |
| Total Particulate | NSW EPA TM - 15 |
| Polycyclic Aromatic Hydrocarbons | NSW EPA OM - 6 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 11-Jun-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: Polycyclic Aromatic Hydrocarbons

### Measurement/Observations

Stack Internal Dimensions:

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

Cross Sectional Area : 2.14 $m^2$

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

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

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

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

| | A | B | PM10/2.5 A | PM2.5/10 B |
|---|---|---|---|---|
| No. | Distance from wall | S-type Pitot distances | Distance from wall | S-Type Pitot distances |
| 1 | 111 | 81 | 73 | 43 |
| 2 | 195 | 165 | 241 | 211 |
| 3 | 292 | 262 | 488 | 458 |
| 4 | 413 | 383 | 1162 | 1132 |
| 5 | 584 | 554 | 1409 | 1379 |
| 6 | 1066 | 1036 | 1577 | 1547 |
| 7 | 1238 | 1208 | | |
| 8 | 1358 | 1328 | | |
| 9 | 1455 | 1425 | | |
| 10 | 1539 | 1509 | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 11-Jun-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: Polycyclic Aromatic Hydrocarbons

Sampling time start: 9:00
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 9:00 | 9 | 19.8 | 0.6 |
| 2 | 9:01 | 9 | 19.8 | 0.6 |
| 3 | 9:02 | 9 | 19.8 | 0.6 |
| 4 | 9:03 | 9 | 19.8 | 0.6 |
| 5 | 9:04 | 9 | 19.8 | 0.6 |
| 6 | 9:05 | 9 | 19.8 | 0.6 |
| 7 | 9:06 | 9 | 19.8 | 0.6 |
| 8 | 9:07 | 9 | 19.8 | 0.6 |
|  | Averages: | 9.0 ppm | 19.8 % | 0.6 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 3.40 %

Measurements

CO: 0.0009 %,(dry)
$CO_2$: 0.6 %,(dry)
$N_2$: 79.6 %,(dry)
$O_2$: 19.8 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0009 %,(wet)
$CO_2$: 0.6 %,(wet)
$H_2O$: 3.40 %(=M2)
$N_2$: 76.9 %,(wet)
$O_2$: 19.1 %,(wet)

Therefore, stack gas density (GD) = 1.27 kg/$m^3$ ($0^oC$, wet, 1 atm pressure)
Therefore, stack gas density (GD) = 1.29 kg/$m^3$ ($0^oC$, dry, 1 atm pressure)

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 11-Jun-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: Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 11:50 | Sampling port No.: | 1 | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 11:50 | 12 | 19.9 | 0.6 |
| 2 | 11:51 | 12 | 19.9 | 0.6 |
| 3 | 11:52 | 12 | 19.9 | 0.6 |
| 4 | 11:53 | 12 | 19.9 | 0.6 |
| 5 | 11:54 | 12 | 19.9 | 0.6 |
| 6 | 11:55 | 12 | 19.9 | 0.6 |
| 7 | 11:56 | 12 | 19.9 | 0.6 |
| 8 | 11:57 | 12 | 19.9 | 0.6 |
| | Averages: | 12.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 1.61 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0012 %,(dry) | $N_2$: | 79.5 %,(dry) |
| $CO_2$: | 0.6 %,(dry) | $O_2$: | 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0012 %,(wet) | $N_2$: | 78.2 %,(wet) |
| $CO_2$: | 0.6 %,(wet) | $O_2$: | 19.6 %,(wet) |
| $H_2O$: | 1.61 %(=M2) | | |

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

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

| | | | | | |
|---|---|---|---|---|---|
| Time : | 9:00 | Barometric Pressure : | | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.27 | $kg/m^3$ |
| Pitot Tube Type : | S | | | | (0 °C, Wet, 1 Atm) |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 43 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/2 | 211 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/3 | 458 | 0.151 | 90.0 | 363.2 | 14.9 |
| 1/4 | 1132 | 0.147 | 90.0 | 363.2 | 14.7 |
| 1/5 | 1379 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/6 | 1547 | 0.156 | 90.0 | 363.2 | 15.2 |
| | | | | | |
| 2/1 | 43 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/2 | 211 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/3 | 458 | 0.133 | 90.0 | 363.2 | 14.0 |
| 2/4 | 1132 | 0.143 | 90.0 | 363.2 | 14.5 |
| 2/5 | 1379 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/6 | 1547 | 0.147 | 90.0 | 363.2 | 14.7 |
| Average | | | 90.0 | 363.2 | 14.8 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | 7 | mm |
| Absolute pressure in stack (hPa) : | 1011.69 | hPa |

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Time : | 9:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.27 | $kg/m^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 81 | 0.162 | 90.0 | 363.2 | 15.5 |
| 1/2 | 165 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/3 | 262 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/4 | 383 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/5 | 554 | 0.151 | 90.0 | 363.2 | 14.9 |
| 1/6 | 1036 | 0.147 | 90.0 | 363.2 | 14.7 |
| 1/7 | 1208 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/8 | 1328 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/9 | 1425 | 0.167 | 90.0 | 363.2 | 15.7 |
| 1/10 | 1509 | 0.142 | 90.0 | 363.2 | 14.5 |
| | | | | | |
| 2/1 | 81 | 0.133 | 90.0 | 363.2 | 14.0 |
| 2/2 | 165 | 0.152 | 90.0 | 363.2 | 15.0 |
| 2/3 | 262 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/4 | 383 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/5 | 554 | 0.133 | 90.0 | 363.2 | 14.0 |
| 2/6 | 1036 | 0.143 | 90.0 | 363.2 | 14.5 |
| 2/7 | 1208 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/8 | 1328 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/9 | 1425 | 0.152 | 90.0 | 363.2 | 15.0 |
| 2/10 | 1509 | 0.150 | 90.0 | 363.2 | 14.9 |
| | | | | | |
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| | | | | | |
| | | | | | |
| Average | | | 90.0 | 363.2 | 14.9 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

AECOM

**STACK ANALYSIS**
**SAMPLING OF FINE PARTICULATE (PM10)**

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: fine6
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 2.32 x $10^{-5}m^2$
Thimble No: T321
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 492.6905 Meter finish: 492.6905
Time start: 10:10 Time finish: 10:11

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 494.0399 Meter finish: 494.0399
Time start: 12:01 Time finish: 12:02

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 492.7320
Time start: 10:17
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:08:45 | 73 | 13.0 | 20.0 | 16.0 | | Yes |
| 1/2 | 0:08:30 | 241 | 13.0 | 29.0 | 17.0 | | Yes |
| 1/3 | 0:08:30 | 488 | 13.0 | 30.0 | 18.0 | | Yes |
| 1/4 | 0:08:15 | 1162 | 13.0 | 31.0 | 19.0 | | Yes |
| 1/5 | 0:08:45 | 1409 | 13.0 | 33.0 | 20.0 | | Yes |
| 1/6 | 0:08:30 | 1577 | 13.0 | 36.0 | 22.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:08:15 | 73 | 13.0 | 36.0 | 22.0 | | Yes |
| 2/2 | 0:08:00 | 241 | 13.0 | 36.0 | 22.0 | | Yes |
| 2/3 | 0:08:00 | 488 | 13.0 | 36.0 | 23.0 | | Yes |
| 2/4 | 0:08:15 | 1162 | 13.0 | 37.0 | 23.0 | | Yes |
| 2/5 | 0:08:15 | 1409 | 13.0 | 37.0 | 24.0 | | Yes |
| 2/6 | 0:08:15 | 1577 | 13.0 | 37.0 | 24.0 | | Yes |
| Averages | | | | 33.2 | 20.8 | no result | |

Meter Finish: 494.0388
Time Finish: 12:00
Total Condensate collected: 4 ml
Silica gel No(s) used: F21

**STACK ANALYSIS**
**SAMPLING OF TOTAL PARTICULATE**

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: T318
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 85.8468 Meter finish: 85.8468
Time start: 10:11 Time finish: 10:12

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 86.9157 Meter finish: 86.9157
Time start: 12:02 Time finish: 12:03

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 85.8475 Time start: 10:17
Meter correction factor (GMf) : 1.0038

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 10.1 | 18.0 | 15.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 9.9 | 21.0 | 15.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 10.0 | 24.0 | 16.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 9.9 | 25.0 | 16.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 9.7 | 26.0 | 17.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 9.6 | 26.0 | 17.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 10.0 | 27.0 | 18.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 9.9 | 28.0 | 18.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 10.2 | 29.0 | 19.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 9.4 | 30.0 | 19.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 9.1 | 30.0 | 19.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 9.8 | 30.0 | 19.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 9.5 | 30.0 | 20.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 9.2 | 30.0 | 20.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 9.1 | 30.0 | 20.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 9.4 | 30.0 | 21.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 9.5 | 31.0 | 21.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 9.6 | 31.0 | 22.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 9.8 | 31.0 | 22.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 9.7 | 31.0 | 22.0 | | Yes |
| Averages | | | | 27.9 | 18.8 | no result | |

Meter Finish: 86.9136 Time Finish: 12:00
Total Condensate collected: 5 ml Silica gel No(s) used: Z6

**STACK ANALYSIS**

**SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS**

| | | | | |
|---|---|---|---|---|
| Date: | 11-Jun-15 | | | |
| Client: | Weston Aluminium | | | |
| AECOM's Project No: | 60341673 | | | |
| Stack Description No.: | Stack 1 | | | |
| Sample Nozzle No.: | g08 | Sample Nozzle Area (An): | 1.59 | x $10^{-5}m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | DAU030615D | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

**Leak Check (Pre-Sampling)**

Meter start: 306.2603 Meter finish: 306.2603

Time start: 10:12 Time finish: 10:13

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Leak Check (Post Sampling)**

Meter start: 307.4069 Meter finish: 307.4069

Time start: 12:03 Time finish: 12:04

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)

Meter start: 306.2610 Time start: 10:17

Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 11.9 | 18.0 | 16.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 11.7 | 22.0 | 16.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 11.8 | 25.0 | 16.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 11.7 | 25.0 | 16.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 11.4 | 26.0 | 17.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 11.3 | 27.0 | 17.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 11.8 | 28.0 | 17.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 11.7 | 29.0 | 18.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 12.1 | 30.0 | 18.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 11.1 | 31.0 | 19.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 10.8 | 31.0 | 19.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 11.5 | 31.0 | 20.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 11.2 | 32.0 | 20.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 10.9 | 32.0 | 20.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 10.8 | 32.0 | 20.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 11.1 | 32.0 | 20.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 11.2 | 32.0 | 21.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 11.3 | 32.0 | 21.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 11.5 | 33.0 | 21.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 11.4 | 33.0 | 21.0 | | Yes |
| Averages | | | | 29.1 | 18.7 | no result | |

Meter Finish: 307.4055 Time Finish: 12:00

Total Condensate collected: 3 ml Silica gel No(s) used: Z14

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

AECOM

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Fine Particulate (PM10)

| | | | | | |
|---|---|---|---|---|---|
| Time : | 12:00 | Barometric Pressure : | 1011 | hPa | |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | $kg/m^3$ | |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) | |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 43 | 0.158 | 90.0 | 363.2 | 15.2 |
| 1/2 | 211 | 0.149 | 90.0 | 363.2 | 14.8 |
| 1/3 | 458 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/4 | 1132 | 0.152 | 90.0 | 363.2 | 14.9 |
| 1/5 | 1379 | 0.156 | 90.0 | 363.2 | 15.1 |
| 1/6 | 1547 | 0.162 | 90.0 | 363.2 | 15.4 |
| | | | | | |
| 2/1 | 43 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/2 | 211 | 0.145 | 90.0 | 363.2 | 14.6 |
| 2/3 | 458 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/4 | 1132 | 0.139 | 90.0 | 363.2 | 14.3 |
| 2/5 | 1379 | 0.140 | 90.0 | 363.2 | 14.3 |
| 2/6 | 1547 | 0.146 | 90.0 | 363.2 | 14.6 |
| Average | | | 90.0 | 363.2 | 14.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

AECOM

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

Test 2:Total Particulate
Test 3:Polycyclic Aromatic Hydrocarbons

| | | | | | |
|---|---|---|---|---|---|
| Time : | 12:00 | Barometric Pressure : | | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.28 | kg/m$^3$<br>(0 °C, Wet, 1 Atm) |
| Pitot Tube Type : | S | | | | |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 81 | 0.165 | 90.0 | 363.2 | 15.5 |
| 1/2 | 165 | 0.158 | 90.0 | 363.2 | 15.2 |
| 1/3 | 262 | 0.158 | 90.0 | 363.2 | 15.2 |
| 1/4 | 383 | 0.149 | 90.0 | 363.2 | 14.8 |
| 1/5 | 554 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/6 | 1036 | 0.152 | 90.0 | 363.2 | 14.9 |
| 1/7 | 1208 | 0.156 | 90.0 | 363.2 | 15.1 |
| 1/8 | 1328 | 0.162 | 90.0 | 363.2 | 15.4 |
| 1/9 | 1425 | 0.166 | 90.0 | 363.2 | 15.6 |
| 1/10 | 1509 | 0.150 | 90.0 | 363.2 | 14.8 |
| | | | | | |
| 2/1 | 81 | 0.144 | 90.0 | 363.2 | 14.5 |
| 2/2 | 165 | 0.136 | 90.0 | 363.2 | 14.1 |
| 2/3 | 262 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/4 | 383 | 0.145 | 90.0 | 363.2 | 14.6 |
| 2/5 | 554 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/6 | 1036 | 0.139 | 90.0 | 363.2 | 14.3 |
| 2/7 | 1208 | 0.140 | 90.0 | 363.2 | 14.3 |
| 2/8 | 1328 | 0.146 | 90.0 | 363.2 | 14.6 |
| 2/9 | 1425 | 0.154 | 90.0 | 363.2 | 15.0 |
| 2/10 | 1509 | 0.153 | 90.0 | 363.2 | 15.0 |
| Average | | | 90.0 | 363.2 | 14.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

| | |
|---|---|
| Date: | 11-Jun-15 |
| Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 1 |

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | ($\mu g$) | (mg) | ($\mu g/m^3$) | ($mg/m^3$) | ($\mu g/s$) | (mg/s) |
| Naphthalene | 2100 | 2.1 | 0.0021 | 2 | 0.002 | 47 | 0.047 |
| 2 - Methylnapthalene | 790 | 0.79 | 0.00079 | 0.75 | 0.00075 | 18 | 0.018 |
| Acenaphthylene | 42 | 0.042 | 0.000042 | 0.04 | 0.00004 | 0.94 | 0.00094 |
| Acenaphthene | 26 | 0.026 | 0.000026 | 0.025 | 0.000025 | 0.58 | 0.00058 |
| Fluorene | 52 | 0.052 | 0.000052 | 0.049 | 0.000049 | 1.2 | 0.0012 |
| Phenanthrene | 400 | 0.4 | 0.0004 | 0.38 | 0.00038 | 8.9 | 0.0089 |
| Anthracene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Fluoranthene | 280 | 0.28 | 0.00028 | 0.27 | 0.00027 | 6.2 | 0.0062 |
| Pyrene | 170 | 0.17 | 0.00017 | 0.16 | 0.00016 | 3.8 | 0.0038 |
| Benz(a)anthracene | 120 | 0.12 | 0.00012 | 0.11 | 0.00011 | 2.7 | 0.0027 |
| Chrysene | 360 | 0.36 | 0.00036 | 0.34 | 0.00034 | 8 | 0.008 |
| Benzo(b)fluoranthene | 350 | 0.35 | 0.00035 | 0.33 | 0.00033 | 7.8 | 0.0078 |
| Benzo(k)fluoranthene | 190 | 0.19 | 0.00019 | 0.18 | 0.00018 | 4.2 | 0.0042 |
| Benzo(e)pyrene | 150 | 0.15 | 0.00015 | 0.14 | 0.00014 | 3.3 | 0.0033 |
| Benzo(a)pyrene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Perylene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Indeno(123:cd)pyrene | 34 | 0.034 | 0.000034 | 0.032 | 0.000032 | 0.76 | 0.00076 |
| Dibenzo(ah)anthracene | <26 | <0.026 | <0.000026 | 0.025 | <0.000025 | <0.58 | <0.00058 |
| Benzo(ghi)perylene | <20 | <0.02 | <0.00002 | 0.019 | <0.000019 | <0.45 | <0.00045 |
| Sum of reported PAH's | 5100 | 5.1 | 0.0051 | 4.9 | 0.0048 | 110 | 0.11 |

## STACK ANALYSIS - PM10 CALCULATIONS

| | | | |
|---|---|---|---|
| Date: | 11-Jun-15 | Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Stack 1 |

### 1. Gas Analysis

| | % | | |
|---|---|---|---|
| %$CO_2$ | 0.6 | | |
| %$O_2$ | 19.9 | | |
| %$N_2$+%CO | 79.6 | | |
| Fraction Moisture Content, Bws | 0.02 | $M_d$= | 0.98 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.89 |
| Mol. Wt. of Stack Gas (wet) | 28.52 |

### 3. Absolute Stack Pressure

| | Pascals | in. Hg |
|---|---|---|
| Barometric Pressure (Pbar) | 101100 | 29.85 |
| Stack Static Pressure (Pg) | 101169 | 29.87 |
| | | |
| Absolute Stack Pressure | | 29.87 |

### 4. Viscosity of Stack Gas

| | °C | °F |
|---|---|---|
| Average Stack Temp. | 90.0 | 194.0 |
| Average Meter Temperature: | 27.0 | |
| Stack Gas Viscosity | | 212.5 |

### 5. Cyclone Flow Rate

| | $ft^3$/min | $m^3$/min | L/min | L/s |
|---|---|---|---|---|
| Cyclone Flow Rate | 0.56 | 0.0197 | 19.69 | 0.33 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.125 | 109.41 | 36.01 | 0.766 | 1.224 | 83.85 | 27.51 | 133.87 | 43.92 |
| 1 | 0.133 | 95.67 | 31.49 | 0.759 | 1.229 | 72.58 | 23.81 | 117.55 | 38.57 |
| 2 | 0.147 | 79.02 | 26.01 | 0.744 | 1.238 | 58.80 | 19.29 | 97.83 | 32.10 |
| 3 | 0.163 | 63.84 | 21.01 | 0.721 | 1.252 | 46.05 | 15.11 | 79.92 | 26.22 |
| 4 | 0.176 | 54.78 | 18.03 | 0.699 | 1.265 | 38.28 | 12.56 | 69.28 | 22.73 |
| 5 | 0.194 | 45.05 | 14.83 | 0.659 | 1.286 | 29.68 | 9.74 | 57.92 | 19.00 |
| 6 | 0.214 | 37.29 | 12.27 | 0.600 | 1.312 | 22.39 | 7.35 | 48.92 | 16.05 |
| 7 | 0.229 | 32.57 | 10.72 | 0.537 | 1.335 | 17.50 | 5.74 | 43.49 | 14.27 |
| 8 | 0.260 | 25.16 | 8.28 | #NUM! | 1.392 | 12.58 | 4.13 | 35.04 | 11.50 |
| 9 | 0.294 | 19.65 | 6.47 | #NUM! | 1.467 | 9.83 | 3.22 | 28.83 | 9.46 |
| 10 | 0.339 | 14.87 | 4.89 | #NUM! | 1.581 | 7.43 | 2.44 | 22.30 | 7.32 |
| 11 | 0.390 | 11.22 | 3.69 | #NUM! | 1.737 | 5.61 | 1.84 | 16.83 | 5.52 |

| | Nozzle Diameter | Nozzle Diameter | Nozzle Area | Sample Rate |
|---|---|---|---|---|
| Selected Nozzle | (inches) | (m) | ($m^2$) | (L/min) |
| 6 | 0.214 | 0.005 | 0.000023 | 14 |

### STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

| | | | |
|---|---|---|---|
| Date: | 11-Jun-15 | Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Stack 1 |

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

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 157.94 | 0.63 | 0.80 | 8.6 |
| 149.11 | 0.60 | 0.77 | 8.3 |
| 153.04 | 0.61 | 0.78 | 8.5 |
| 152.06 | 0.61 | 0.78 | 8.4 |
| 155.98 | 0.63 | 0.79 | 8.5 |
| 161.87 | 0.65 | 0.81 | 8.7 |
| | | | |
| 147.15 | 0.59 | 0.77 | 8.3 |
| 145.19 | 0.58 | 0.76 | 8.2 |
| 137.34 | 0.55 | 0.74 | 8.0 |
| 139.30 | 0.56 | 0.75 | 8.1 |
| 140.28 | 0.56 | 0.75 | 8.1 |
| 146.17 | 0.59 | 0.77 | 8.3 |
| | Average | 0.77 | 100.00 |
| | Square | 0.60 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 8.8 | 0 | 8 | 45 |
| 17.3 | 0 | 17 | 15 |
| 25.8 | 0 | 25 | 45 |
| 34.0 | 0 | 34 | 0 |
| 42.8 | 0 | 42 | 45 |
| 51.3 | 0 | 51 | 15 |
| | | | |
| 59.5 | 0 | 59 | 30 |
| 67.5 | 1 | 7 | 30 |
| 75.5 | 1 | 15 | 30 |
| 83.8 | 1 | 23 | 45 |
| 92.0 | 1 | 32 | 0 |
| 100.3 | 1 | 40 | 15 |

**Aerodynamic Cut Size ($u_{cyc}$)**
211.9

**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_s$)**
0.0151

**Actual $D_{50}$**
10.3

## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 1.3200 $m^3$
Average gas meter temp. ($T_{M,2}$): 27.0 °C
300.2 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 1.1974 $m^3$

(B) PM10 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: T321
Blank weight: g
PM10 Weight 0.0016 g
Final PM10 Weight (Mp1): 0.00160 g
PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.0013 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 1.3 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.026 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 26 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.016 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 16 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: F21
$V_v$ = 11.2 g (from laboratory report)
$V_w$ = 4 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0053
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0150

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

$B_{ws}$ = 1.67 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

(i) Initial gas density for sampling: 1.27 $kg/m^3$ (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c):
1.26 $kg/m^3$ ($0^oC$, wet, 1 atm pressure)
1.29 $kg/m^3$ ($0^oC$, dry, 1 atm pressure)

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

= 0.946 $kg/m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.78 m/s

(ii) Average of post-sampling velocities: 14.76 m/s

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

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

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

Qstack = Vs x A = 31.58 $m^3/s$ (stack conditions)

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

Qstd = 23.3 $m^3/s$ ($0^oC$, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | | |
|---|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.03 | g/s ($0^oC$, dry gas, 1 atm pressure | | | ) |
| | = | 30 | mg/s ($0^oC$, dry gas, 1 atm pressure | | | ) |
| | $C_{1a}$ x Qstd = | 0.61 | g/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ | ) |
| | = | 610 | mg/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ | ) |
| | $C_{1a}$ x Qstd = | 0.37 | g/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ | ) |
| | = | 370 | mg/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ | ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 11-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

| | | | |
|---|---|---|---|
| Metered volume ($MV_3$): | 1.0702 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1010 hPa |
| Average gas meter temp. ($T_{M,2}$): | 23.4 °C | | |
| | 296.6 K | Average pressure at meter ($P_{M,2}$) | 1010.00 hPa |
| Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): | 0.9826 $m^3$ | | |

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA Blank weight: g

Thimble No. used: T318 Total Particulate Weight 0.0095 g

Final Total Particulate Weight (Mp1): 0.00950 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0097 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 9.7 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.19 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 190 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.12 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 120 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z6

$V_v$ = 8.9 g (from laboratory report) $V_w$ = 5 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0067

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0119

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

$B_{ws}$ = 1.85 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

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

= 0.946 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.86 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):
14.85 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 = 31.75 m$^3$/s (stack conditions)

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

Qstd = 23.4 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | | |
|---|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.23 | g/s (0°C, dry gas, 1 atm pressure | | | ) |
| | = | 230 | mg/s (0°C, dry gas, 1 atm pressure | | | ) |
| | $C_{1a}$ x Qstd = | 4.5 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ | ) |
| | = | 4500 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ | ) |
| | $C_{1a}$ x Qstd = | 2.8 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ | ) |
| | = | 2800 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ | ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Polycyclic Aromatic Hydrocarbons**

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 1.1517 $m^3$
Average gas meter temp. ($T_{M,2}$): 23.9 $^oC$
297.1 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); ($0^oC$, dry gas, 1 atm pressure): 1.0557 $m^3$

(B) PAH concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: DAU030615D
Blank weight: g
PAH Weight 0.0000051 g
Final PAH Weight (Mp1): 0.00001 g
PAH Concentration (C1): $=M_{p1}/MV_4=$ 0.0000048 $g/m^3$ ($0^oC$, dry gas, 1atm pressure)

;and $C_2$ = 0.0048 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.000096 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.096 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000058 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 0.058 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: Z14
$V_v$ = 7.4 g (from laboratory report)
$V_w$ = 3 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0099

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

$B_{ws}$ = 1.30 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Polycyclic Aromatic Hydrocarbons**

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

(i) Initial gas density for sampling: 1.27 kg/$m^3$ (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c):

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

(iii) Gas density at stack conditions =

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

= 0.946 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.86 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):
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

14.85 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)

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

Qstack = Vs x A = 31.75 $m^3/s$ (stack conditions)

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

Qstd = 23.5 $m^3/s$ ($0^oC$, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.00011 | g/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | = | 0.11 | mg/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0023 | g/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 2.3 | mg/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.0014 | g/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1.4 | mg/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

**EMISSION MONITORING RESULTS, STACK 1**
**WESTON ALUMINIUM**
11-Jun-15
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
POLYCYCLIC AROMATIC HYDROCARBONS

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1650 mm | | |
| Stack gas temperature (average) | 90.0 °C | | 363.2 K |
| Stack pressure (average) | 1012 hPa | | |
| Stack gas velocity (average, stack conditions) | 15 m/s | | |
| Stack gas flowrate (stack conditions) | 32 $m^3/s$ | | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 23 $m^3/s$ | | |
| **Fine Particulate (PM10) Testing** | | | |
| Test Period | 10:17 | - | 12:00 |
| Fine Particulate (PM10) Mass | 1.6 mg | | |
| Gas Volume Sampled | 1.2 $m^3$ | | |
| Fine Particulate (PM10) Emission*1 | 1.3 $mg/m^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 30 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 10:17 | - | 12:00 |
| Total Particulate Mass | 9.5 mg | | |
| Gas Volume Sampled | 0.983 $m^3$ | | |
| Total Particulate Emission*1 | 9.7 $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 | 230 mg/s | | |
| Regulatory Limit | 25 $mg/m^3$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | |
| Test Period | 10:17 | - | 12:00 |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0051 mg | | |
| Gas Volume Sampled | 1.06 $m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0048 $mg/m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.11 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 1.6 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.9 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

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**Weston Aluminium**

| | |
|---|---|
| AECOM's Project Number: | 60341673 |
| Emission Source: | Stack 1 |
| Date Sampled: | 11-Jun-15 |

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

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

**ANZ**

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

### Measurement/Observations

Stack Internal Dimensions:

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

Cross Sectional Area : 2.14 $m^2$

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

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

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

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

| | A | B | PM10/2.5 A | PM2.5/10 B |
|---|---|---|---|---|
| No. | Distance from wall | S-type Pitot distances | Distance from wall | S-Type Pitot distances |
| 1 | 111 | 81 | | |
| 2 | 195 | 165 | | |
| 3 | 292 | 262 | | |
| 4 | 413 | 383 | | |
| 5 | 584 | 554 | | |
| 6 | 1066 | 1036 | | |
| 7 | 1238 | 1208 | | |
| 8 | 1358 | 1328 | | |
| 9 | 1455 | 1425 | | |
| 10 | 1539 | 1509 | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..................................

Checked: ..............................

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

Sampling time start: 11:50
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 11:50 | 12 | 19.9 | 0.6 |
| 2 | 11:51 | 12 | 19.9 | 0.6 |
| 3 | 11:52 | 12 | 19.9 | 0.6 |
| 4 | 11:53 | 12 | 19.9 | 0.6 |
| 5 | 11:54 | 12 | 19.9 | 0.6 |
| 6 | 11:55 | 12 | 19.9 | 0.6 |
| 7 | 11:56 | 12 | 19.9 | 0.6 |
| 8 | 11:57 | 12 | 19.9 | 0.6 |
| | Averages: | 12.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 3.40 %

Measurements

| | |
|---|---|
| CO: 0.0012 %,(dry) | $N_2$: 79.5 %,(dry) |
| $CO_2$: 0.6 %,(dry) | $O_2$: 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0012 %,(wet) | $N_2$: 76.8 %,(wet) |
| $CO_2$: 0.6 %,(wet) | $O_2$: 19.2 %,(wet) |
| $H_2O$: 3.40 %(=M2) | |

Therefore, stack gas density (GD) = 1.27 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)
Therefore, stack gas density (GD) = 1.29 kg/m$^3$ (0$^o$C, dry, 1 atm pressure)

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Sulfuric Acid Mist (H2SO4 as SO3)
Test 2: Sulfur Dioxide (SO2 as SO3)
Test 3: Hydrogen Chloride
Test 4: Chlorine

Sampling time start: 13:50
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 13:50 | 8 | 19.9 | 0.6 |
| 2 | 13:51 | 8 | 19.9 | 0.6 |
| 3 | 13:52 | 8 | 19.9 | 0.6 |
| 4 | 13:53 | 8 | 19.9 | 0.6 |
| 5 | 13:54 | 8 | 19.9 | 0.6 |
| 6 | 13:55 | 8 | 19.9 | 0.6 |
| 7 | 13:56 | 8 | 19.9 | 0.6 |
| 8 | 13:57 | 8 | 19.9 | 0.6 |
|  | Averages: | 8.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 3.42 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0008 %,(dry) | $N_2$: | 79.5 %,(dry) |
| $CO_2$: | 0.6 %,(dry) | $O_2$: | 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0008 %,(wet) | $N_2$: | 76.8 %,(wet) |
| $CO_2$: | 0.6 %,(wet) | $O_2$: | 19.2 %,(wet) |
| $H_2O$: | 3.42 %(=M2) | | |

Therefore, stack gas density (GD) = 1.27 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)
Therefore, stack gas density (GD) = 1.29 kg/m$^3$ (0$^o$C, dry, 1 atm pressure)

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Sulfuric Acid Mist (H2SO4 as SO3)
Test 2:Sulfur Dioxide (SO2 as SO3)
Test 3:Hydrogen Chloride
Test 4:Chlorine

| | | | | |
|---|---|---|---|---|
| Time : | 12:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.27 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 81 | 0.165 | 90.0 | 363.2 | 15.6 |
| 1/2 | 165 | 0.158 | 90.0 | 363.2 | 15.3 |
| 1/3 | 262 | 0.158 | 90.0 | 363.2 | 15.3 |
| 1/4 | 383 | 0.149 | 90.0 | 363.2 | 14.8 |
| 1/5 | 554 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/6 | 1036 | 0.152 | 90.0 | 363.2 | 15.0 |
| 1/7 | 1208 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/8 | 1328 | 0.162 | 90.0 | 363.2 | 15.5 |
| 1/9 | 1425 | 0.166 | 90.0 | 363.2 | 15.6 |
| 1/10 | 1509 | 0.150 | 90.0 | 363.2 | 14.9 |
| | | | | | |
| 2/1 | 81 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/2 | 165 | 0.136 | 90.0 | 363.2 | 14.2 |
| 2/3 | 262 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/4 | 383 | 0.145 | 90.0 | 363.2 | 14.6 |
| 2/5 | 554 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/6 | 1036 | 0.139 | 90.0 | 363.2 | 14.3 |
| 2/7 | 1208 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/8 | 1328 | 0.146 | 90.0 | 363.2 | 14.7 |
| 2/9 | 1425 | 0.154 | 90.0 | 363.2 | 15.1 |
| 2/10 | 1509 | 0.153 | 90.0 | 363.2 | 15.0 |
| Average | | | 90.0 | 363.2 | 14.9 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

## STACK ANALYSIS
## SAMPLING OF SULFUR DIOXIDE (SO2 AS SO3)

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.35 $\times 10^{-5} m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 494.1104 Meter finish: 494.1104
Time start: 12:15 Time finish: 12:16

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 495.0955 Meter finish: 495.0955
Time start: 14:01 Time finish: 14:02

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 494.1135 Time start: 12:20
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 10.2 | 31.0 | 24.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 10.0 | 32.0 | 24.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 10.0 | 33.0 | 24.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 9.7 | 34.0 | 24.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 9.8 | 36.0 | 24.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 9.8 | 37.0 | 24.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 10.0 | 37.0 | 24.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 10.1 | 37.0 | 25.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 10.2 | 38.0 | 25.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 9.8 | 39.0 | 25.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 9.6 | 39.0 | 25.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 9.3 | 39.0 | 25.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 9.6 | 39.0 | 26.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 9.6 | 40.0 | 26.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 9.3 | 40.0 | 26.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 9.4 | 40.0 | 27.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 9.4 | 40.0 | 27.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 9.6 | 40.0 | 27.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 9.9 | 40.0 | 27.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 9.8 | 40.0 | 27.0 | | Yes |
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| | | | | | | | |
| Averages | | | | 37.6 | 25.3 | no result | |

Meter Finish: 495.0932 Time Finish: 14:00
Total Condensate collected: 0 ml Silica gel No(s) used: I01

**STACK ANALYSIS**

**SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)**

| | | | | |
|---|---|---|---|---|
| Date: | 11-Jun-15 | | | |
| Client: | Weston Aluminium | | | |
| AECOM's Project No: | 60341673 | | | |
| Stack Description No.: | Stack 1 | | | |
| Sample Nozzle No.: | s16 | Sample Nozzle Area (An): | 1.35 | x $10^{-5}m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | NA | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

| **Leak Check (Pre-Sampling)** | | | | **Leak Check (Post Sampling)** | | | |
|---|---|---|---|---|---|---|---|
| Meter start: | 494.1104 | Meter finish: | 494.1104 | Meter start: | 495.0955 | Meter finish: | 495.0955 |
| Time start: | 12:15 | Time finish: | 12:16 | Time start: | 14:01 | Time finish: | 14:02 |
| 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: | 1010 hPa (start); | | 1010 hPa (finish) | |
| Meter start: | 494.1135 | | Time start: | 12:20 |
| Meter correction factor (GMf) : | | 1.0101 | | |

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 10.2 | 31.0 | 24.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 10.0 | 32.0 | 24.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 10.0 | 33.0 | 24.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 9.7 | 34.0 | 24.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 9.8 | 36.0 | 24.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 9.8 | 37.0 | 24.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 10.0 | 37.0 | 24.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 10.1 | 37.0 | 25.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 10.2 | 38.0 | 25.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 9.8 | 39.0 | 25.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 9.6 | 39.0 | 25.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 9.3 | 39.0 | 25.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 9.6 | 39.0 | 26.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 9.6 | 40.0 | 26.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 9.3 | 40.0 | 26.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 9.4 | 40.0 | 27.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 9.4 | 40.0 | 27.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 9.6 | 40.0 | 27.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 9.9 | 40.0 | 27.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 9.8 | 40.0 | 27.0 | | Yes |
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| Averages | | | | 37.6 | 25.3 | no result | |

| | | | |
|---|---|---|---|
| Meter Finish: | 495.0932 | Time Finish: | 14:00 |
| Total Condensate collected: | 0 ml | Silica gel No(s) used: | I01 |

AECOM

## STACK ANALYSIS
## SAMPLING OF HYDROGEN CHLORIDE AND CHLORINE

Date: 11-Jun-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): 1.16 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 86.9205 Meter finish: 86.9205
Time start: 12:16 Time finish: 12:17

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 87.7682 Meter finish: 87.7682
Time start: 14:02 Time finish: 14:03

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 86.9210 Time start: 12:20
Meter correction factor (GMf) : 1.0038

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 8.7 | 26.0 | 22.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 8.6 | 27.0 | 22.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 8.6 | 28.0 | 22.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 8.3 | 29.0 | 22.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 8.4 | 29.0 | 22.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 8.4 | 30.0 | 22.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 8.5 | 31.0 | 22.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 8.7 | 31.0 | 23.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 8.7 | 31.0 | 23.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 8.3 | 32.0 | 23.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 8.2 | 32.0 | 23.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 7.9 | 32.0 | 23.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 8.2 | 32.0 | 24.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 8.2 | 32.0 | 24.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 7.9 | 32.0 | 24.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 8.0 | 32.0 | 24.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 8.1 | 31.0 | 24.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 8.2 | 31.0 | 24.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 8.4 | 31.0 | 24.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 8.4 | 31.0 | 24.0 | | Yes |
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| Averages | | | | 30.5 | 23.1 | no result | |

Meter Finish: 87.7655 Time Finish: 14:00
Total Condensate collected: 1 ml Silica gel No(s) used: M99

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Sulfuric Acid Mist (H2SO4 as SO3)
Test 2:Sulfur Dioxide (SO2 as SO3)
Test 3:Hydrogen Chloride
Test 4:Chlorine

| | | | | |
|---|---|---|---|---|
| Time : | 14:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.27 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 81 | 0.152 | 90.0 | 363.2 | 15.0 |
| 1/2 | 165 | 0.155 | 90.0 | 363.2 | 15.1 |
| 1/3 | 262 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/4 | 383 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/5 | 554 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/6 | 1036 | 0.161 | 90.0 | 363.2 | 15.4 |
| 1/7 | 1208 | 0.150 | 90.0 | 363.2 | 14.9 |
| 1/8 | 1328 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/9 | 1425 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/10 | 1509 | 0.146 | 90.0 | 363.2 | 14.7 |
| | | | | | |
| 2/1 | 81 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/2 | 165 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/3 | 262 | 0.150 | 90.0 | 363.2 | 14.9 |
| 2/4 | 383 | 0.153 | 90.0 | 363.2 | 15.0 |
| 2/5 | 554 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/6 | 1036 | 0.142 | 90.0 | 363.2 | 14.5 |
| 2/7 | 1208 | 0.146 | 90.0 | 363.2 | 14.7 |
| 2/8 | 1328 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/9 | 1425 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/10 | 1509 | 0.156 | 90.0 | 363.2 | 15.2 |
| Average | | | 90.0 | 363.2 | 14.9 |

| | |
|---|---|
| Static Pressure (Dwyer) (Pa): | kPa |
| Static Pressure (U-tube, if required) : | 7.5 mm |
| Absolute pressure in stack (hPa) : | 1011.74 hPa |

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

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

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.9896 $m^3$
Average gas meter temp. ($T_{M,2}$): 31.4 $^oC$
304.6 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); (0$^o$C, dry gas, 1 atm pressure): 0.8847 $m^3$

(B) H2SO4 as SO3 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
H2SO4 as SO3 Weight <0.002 g
Final H2SO4 as SO3 Weight (Mp1): <0.002 g
H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0023 $g/m^3$ (0$^o$C, dry gas, 1atm pressure)

;and $C_2$ = <2.3 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.046 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <46 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.029 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <29 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: I01
$V_v$ = 28.9 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0386

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

$B_{ws}$ = 4.18 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

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

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.27 kg/$m^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.28 kg/$m^3$ ($0^oC$, wet, 1 atm pressure)<br>1.29 kg/$m^3$ ($0^oC$, dry, 1 atm pressure) |

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

= 0.961 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 14.90 m/s |
| (ii) Average of post-sampling velocities: | 14.91 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 14.91 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 31.88 $m^3/s$ (stack conditions)

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

Qstd = 22.9 $m^3/s$ ($0^oC$, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.053 | g/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | = | <53 | mg/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <1.1 | g/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <1100 | mg/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <0.67 | g/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <670 | mg/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Sulfur Dioxide (SO2 as SO3)**

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.9896 $m^3$
Average gas meter temp. ($T_{M,2}$): 31.4 °C
304.6 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.8847 $m^3$

(B) SO2 as SO3 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
SO2 as SO3 Weight <0.01 g
Final SO2 as SO3 Weight (Mp1): <0.01 g
SO2 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.011 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = <11 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.22 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <220 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.14 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <140 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: I01
$V_v$ = 28.9 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0386

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

$B_{ws}$ = 4.18 %

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Sulfur Dioxide (SO2 as SO3)**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

(iii) Gas density at stack conditions =

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

= 0.961 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.90 m/s

(ii) Average of post-sampling velocities: 14.91 m/s

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

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

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

Qstack = Vs x A = 31.88 m$^3$/s (stack conditions)

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

Qstd = 22.9 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.25 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | <250 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <5 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <5000 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <3.2 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <3200 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Hydrogen Chloride**

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

Date: 11-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8477 $m^3$

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

300.0 K

Average barometric pressure ($P_{BARO}$) 1010 hPa

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

Sample gas volume ($MV_4$); (0$^o$C, dry gas, 1 atm pressure): 0.7695 $m^3$

(B) Hydrogen Chloride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Hydrogen Chloride Weight <0.002 g

Final Hydrogen Chloride Weight (Mp1): <0.002 g

Hydrogen Chloride Concentration (C1): $=M_{p1}/MV_4=$ <0.0026 g/$m^3$ (0$^o$C, dry gas, 1atm pressure)

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

$CO_2$ Basis 12 %

Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.052 g/$m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <52 mg/$m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.033 g/$m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <33 mg/$m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: M99

$V_v$ = 10.2 g (from laboratory report)

$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0136

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 1.91 %

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# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Hydrogen Chloride**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

(iii) Gas density at stack conditions =

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

= 0.946 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.90 m/s

(ii) Average of post-sampling velocities: 14.91 m/s

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

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

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

Qstack = Vs x A = 31.88 m$^3$/s (stack conditions)

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

Qstd = 23.5 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = $C_{1a}$ x Qstd = <0.061 g/s (0$^o$C, dry gas, 1 atm pressure )
= <61 mg/s (0$^o$C, dry gas, 1 atm pressure )

$C_{1a}$ x Qstd = <1.2 g/s (0$^o$C, dry gas, 1 atm pressure 12% $CO_2$)
= <1200 mg/s (0$^o$C, dry gas, 1 atm pressure 12% $CO_2$)

$C_{1a}$ x Qstd = <0.78 g/s (0$^o$C, dry gas, 1 atm pressure 7% $O_2$)
= <780 mg/s (0$^o$C, dry gas, 1 atm pressure 7% $O_2$)

## STACK ANALYSIS - FINAL CALCULATIONS

**Chlorine**

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

Date: 11-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8477 $m^3$

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

300.0 K

Average barometric pressure ($P_{BARO}$) 1010 hPa

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

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7695 $m^3$

(B) Chlorine concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Chlorine Weight <0.002 g

Final Chlorine Weight (Mp1): <0.002 g

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

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

$CO_2$ Basis 12 %

Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.052 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <52 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.033 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

;and $C_{b1}$ = <33 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

(C) Moisture content

Silica Gel Number: M99

$V_v$ = 10.2 g (from laboratory report)

$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0136

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

$B_{ws}$ = 1.91 %

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# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Chlorine**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

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

= 0.946 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.90 m/s

(ii) Average of post-sampling velocities: 14.91 m/s

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

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

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

Qstack = Vs x A = 31.88 m$^3$/s (stack conditions)

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

Qstd = 23.5 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.061 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | <61 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <1.2 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <1200 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <0.78 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <780 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## EMISSION MONITORING RESULTS, STACK 1
## WESTON ALUMINIUM

11-Jun-15
SULFURIC ACID MIST (H2SO4 AS SO3)
SULFUR DIOXIDE (SO2 AS SO3)
HYDROGEN CHLORIDE
CHLORINE

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1650 mm | | |
| Stack gas temperature (average) | 90.0 °C | | 363.2 K |
| Stack pressure (average) | 1012 hPa | | |
| Stack gas velocity (average, stack conditions) | 15 m/s | | |
| Stack gas flowrate (stack conditions) | 32 $m^3/s$ | | |
| Stack gas flowrate ($0^0$C, dry gas, 1 atm pressure) | 23 $m^3/s$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | |
| Test Period | 12:20 | - | 14:00 |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 mg | | |
| Gas Volume Sampled | 0.885 $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <2.3 $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <53 mg/s | | |
| Regulatory Limit | 100 $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | |
| Test Period | 12:20 | - | 14:00 |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 mg | | |
| Gas Volume Sampled | 0.885 $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <11 $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <250 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Hydrogen Chloride Testing** | | | |
| Test Period | 12:20 | - | 14:00 |
| Hydrogen Chloride Mass | <2 mg | | |
| Gas Volume Sampled | 0.769 $m^3$ | | |
| Hydrogen Chloride Emission*1 | <2.6 $mg/m^3$ | | |
| Hydrogen Chloride Mass Emission Rate*2 | <61 mg/s | | |
| Regulatory Limit | 400 $mg/m^3$ | | |
| **Chlorine Testing** | | | |
| Test Period | 12:20 | - | 14:00 |
| Chlorine Mass | <2 mg | | |
| Gas Volume Sampled | 0.769 $m^3$ | | |
| Chlorine Emission*1 | <2.6 $mg/m^3$ | | |
| Chlorine Mass Emission Rate*2 | <61 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 3.4 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.9 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 11-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Cyanide | USEPA OTM - 29 |
| Gaseous Fluoride | NSW EPA TM - 9 |
| Particulate Fluoride | NSW EPA TM - 9 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

## STACK ANALYSIS - PRE-SAMPLING

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Cyanide
Test 2: Gaseous Fluoride
Test 3: Particulate Fluoride

Measurement/Observations

Stack Internal Dimensions:

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

Cross Sectional Area : 2.14 $m^2$

Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

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

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

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

| | A | B | PM10/2.5 A | PM2.5/10 B |
|---|---|---|---|---|
| No. | Distance from wall | S-type Pitot distances | Distance from wall | S-Type Pitot distances |
| 1 | 111 | 81 | | |
| 2 | 195 | 165 | | |
| 3 | 292 | 262 | | |
| 4 | 413 | 383 | | |
| 5 | 584 | 554 | | |
| 6 | 1066 | 1036 | | |
| 7 | 1238 | 1208 | | |
| 8 | 1358 | 1328 | | |
| 9 | 1455 | 1425 | | |
| 10 | 1539 | 1509 | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ...............................

Checked: ...............................

# Emission Measurement Calculations Spreadsheet

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Cyanide
Test 2: Gaseous Fluoride
Test 3: Particulate Fluoride

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 13:50 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 13:50 | 8 | 19.9 | 0.6 |
| 2 | 13:51 | 8 | 19.9 | 0.6 |
| 3 | 13:52 | 8 | 19.9 | 0.6 |
| 4 | 13:53 | 8 | 19.9 | 0.6 |
| 5 | 13:54 | 8 | 19.9 | 0.6 |
| 6 | 13:55 | 8 | 19.9 | 0.6 |
| 7 | 13:56 | 8 | 19.9 | 0.6 |
| 8 | 13:57 | 8 | 19.9 | 0.6 |
| | Averages: | 8.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 3.40 %

Measurements

| | |
|---|---|
| CO: 0.0008 %,(dry) | $N_2$: 79.5 %,(dry) |
| $CO_2$: 0.6 %,(dry) | $O_2$: 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0008 %,(wet) | $N_2$: 76.8 %,(wet) |
| $CO_2$: 0.6 %,(wet) | $O_2$: 19.2 %,(wet) |
| $H_2O$: 3.40 %(=M2) | |

| | | |
|---|---|---|
| Therefore, stack gas density (GD) = | 1.27 kg/$m^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = | 1.29 kg/$m^3$ | (0°C, dry, 1 atm pressure) |

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Cyanide
Test 2: Gaseous Fluoride
Test 3: Particulate Fluoride

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 16:00 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 16:00 | 7 | 19.9 | 0.6 |
| 2 | 16:01 | 7 | 19.9 | 0.6 |
| 3 | 16:02 | 7 | 19.9 | 0.6 |
| 4 | 16:03 | 7 | 19.9 | 0.6 |
| 5 | 16:04 | 7 | 19.9 | 0.6 |
| 6 | 16:05 | 7 | 19.9 | 0.6 |
| 7 | 16:06 | 7 | 19.9 | 0.6 |
| 8 | 16:07 | 7 | 19.9 | 0.6 |
| | Averages: | 7.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 2.13 %

Measurements

| | |
|---|---|
| CO: 0.0007 %,(dry)<br>$CO_2$: 0.6 %,(dry)<br>Gas Compositions converted to wet basis: | $N_2$: 79.5 %,(dry)<br>$O_2$: 19.9 %,(dry) |
| CO: 0.0007 %,(wet)<br>$CO_2$: 0.6 %,(wet)<br>$H_2O$: 2.13 %(=M2) | $N_2$: 77.8 %,(wet)<br>$O_2$: 19.5 %,(wet) |
| Therefore, stack gas density (GD) = 1.28 $kg/m^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 $kg/m^3$ | (0°C, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Cyanide
Test 2:Gaseous Fluoride
Test 3:Particulate Fluoride

| | | | | | |
|---|---|---|---|---|---|
| Time : | 14:00 | Barometric Pressure : | | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.27 | kg/m$^3$ |
| Pitot Tube Type : | S | | | | (0 °C, Wet, 1 Atm) |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 81 | 0.152 | 90.0 | 363.2 | 15.0 |
| 1/2 | 165 | 0.155 | 90.0 | 363.2 | 15.1 |
| 1/3 | 262 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/4 | 383 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/5 | 554 | 0.160 | 90.0 | 363.2 | 15.4 |
| 1/6 | 1036 | 0.161 | 90.0 | 363.2 | 15.4 |
| 1/7 | 1208 | 0.150 | 90.0 | 363.2 | 14.9 |
| 1/8 | 1328 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/9 | 1425 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/10 | 1509 | 0.146 | 90.0 | 363.2 | 14.7 |
| | | | | | |
| 2/1 | 81 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/2 | 165 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/3 | 262 | 0.150 | 90.0 | 363.2 | 14.9 |
| 2/4 | 383 | 0.153 | 90.0 | 363.2 | 15.0 |
| 2/5 | 554 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/6 | 1036 | 0.142 | 90.0 | 363.2 | 14.5 |
| 2/7 | 1208 | 0.146 | 90.0 | 363.2 | 14.7 |
| 2/8 | 1328 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/9 | 1425 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/10 | 1509 | 0.156 | 90.0 | 363.2 | 15.2 |
| Average | | | 90.0 | 363.2 | 14.9 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | 7.5 | mm |
| Absolute pressure in stack (hPa) : | 1011.74 | hPa |

AECOM

**STACK ANALYSIS**
**SAMPLING OF CYANIDE**

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 1
Sample Nozzle No.: g08
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.59 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 87.7851 Meter finish: 87.7851
Time start: 14:06 Time finish: 14:07

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 88.9395 Meter finish: 88.9395
Time start: 15:52 Time finish: 15:53

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 87.7865 Time start: 14:10
Meter correction factor (GMf) : 1.0038

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 11.5 | 29.0 | 24.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 11.6 | 30.0 | 24.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 11.5 | 30.0 | 24.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 11.6 | 31.0 | 24.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 11.8 | 31.0 | 24.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 11.8 | 31.0 | 24.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 11.4 | 31.0 | 24.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 11.6 | 31.0 | 24.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 11.6 | 31.0 | 24.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 11.3 | 31.0 | 24.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 11.3 | 31.0 | 24.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 11.0 | 31.0 | 24.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 11.4 | 32.0 | 24.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 11.5 | 32.0 | 24.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 11.2 | 32.0 | 24.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 11.1 | 32.0 | 24.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 11.3 | 32.0 | 24.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 11.0 | 33.0 | 24.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 11.3 | 33.0 | 24.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 11.6 | 33.0 | 24.0 | | Yes |
| Averages | | | | 31.4 | 24.0 | no result | |

Meter Finish: 88.9365 Time Finish: 15:50
Total Condensate collected: 7 ml Silica gel No(s) used: P3

AECOM

## STACK ANALYSIS
## SAMPLING OF GASEOUS FLUORIDE

Date: 11-Jun-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): 1.16 x $10^{-5}$$m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 308.8401 Meter finish: 308.8401
Time start: 14:07 Time finish: 14:08

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 309.6923 Meter finish: 309.6923
Time start: 15:53 Time finish: 15:54

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 308.8410
Time start: 14:10
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 8.4 | 29.0 | 22.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 8.5 | 30.0 | 22.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 8.4 | 31.0 | 22.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 8.5 | 32.0 | 22.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 8.6 | 32.0 | 22.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 8.6 | 32.0 | 22.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 8.4 | 33.0 | 23.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 8.5 | 33.0 | 23.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 8.5 | 33.0 | 23.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 8.2 | 33.0 | 23.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 8.2 | 33.0 | 23.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 8.1 | 33.0 | 23.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 8.4 | 33.0 | 23.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 8.4 | 33.0 | 23.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 8.2 | 33.0 | 23.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 8.1 | 33.0 | 23.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 8.2 | 34.0 | 24.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 8.1 | 34.0 | 24.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 8.2 | 34.0 | 24.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 8.5 | 34.0 | 24.0 | | Yes |
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| | | | | | | | |
| Averages | | | | 32.6 | 22.9 | no result | |

Meter Finish: 309.6855
Time Finish: 15:50
Total Condensate collected: 8 ml
Silica gel No(s) used: B66

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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## STACK ANALYSIS
## SAMPLING OF CYANIDE

Date: 11-Jun-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): 1.16 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 308.8401 Meter finish: 308.8401
Time start: 14:07 Time finish: 14:08

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 309.6923 Meter finish: 309.6923
Time start: 15:53 Time finish: 15:54

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 308.8410 Time start: 14:10
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 8.4 | 29.0 | 22.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 8.5 | 30.0 | 22.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 8.4 | 31.0 | 22.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 8.5 | 32.0 | 22.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 8.6 | 32.0 | 22.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 8.6 | 32.0 | 22.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 8.4 | 33.0 | 23.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 8.5 | 33.0 | 23.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 8.5 | 33.0 | 23.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 8.2 | 33.0 | 23.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 8.2 | 33.0 | 23.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 8.1 | 33.0 | 23.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 8.4 | 33.0 | 23.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 8.4 | 33.0 | 23.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 8.2 | 33.0 | 23.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 8.1 | 33.0 | 23.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 8.2 | 34.0 | 24.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 8.1 | 34.0 | 24.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 8.2 | 34.0 | 24.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 8.5 | 34.0 | 24.0 | | Yes |
| Averages | | | | 32.6 | 22.9 | no result | |

Meter Finish: 309.6855 Time Finish: 15:50
Total Condensate collected: 8 ml Silica gel No(s) used: B66

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

AECOM

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Cyanide
Test 2:Gaseous Fluoride
Test 3:Particulate Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 16:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 81 | 0.152 | 89.0 | 362.2 | 14.9 |
| 1/2 | 165 | 0.155 | 90.0 | 363.2 | 15.1 |
| 1/3 | 262 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/4 | 383 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/5 | 554 | 0.160 | 91.0 | 364.2 | 15.3 |
| 1/6 | 1036 | 0.161 | 91.0 | 364.2 | 15.4 |
| 1/7 | 1208 | 0.150 | 91.0 | 364.2 | 14.9 |
| 1/8 | 1328 | 0.156 | 90.0 | 363.2 | 15.1 |
| 1/9 | 1425 | 0.157 | 90.0 | 363.2 | 15.2 |
| 1/10 | 1509 | 0.146 | 90.0 | 363.2 | 14.6 |
| | | | | | |
| 2/1 | 81 | 0.147 | 89.0 | 362.2 | 14.7 |
| 2/2 | 165 | 0.140 | 90.0 | 363.2 | 14.3 |
| 2/3 | 262 | 0.150 | 90.0 | 363.2 | 14.8 |
| 2/4 | 383 | 0.153 | 90.0 | 363.2 | 15.0 |
| 2/5 | 554 | 0.144 | 90.0 | 363.2 | 14.5 |
| 2/6 | 1036 | 0.142 | 90.0 | 363.2 | 14.4 |
| 2/7 | 1208 | 0.146 | 90.0 | 363.2 | 14.6 |
| 2/8 | 1328 | 0.140 | 91.0 | 364.2 | 14.4 |
| 2/9 | 1425 | 0.147 | 91.0 | 364.2 | 14.7 |
| 2/10 | 1509 | 0.156 | 91.0 | 364.2 | 15.2 |
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| | | | | | |
| Average | | | 90.2 | 363.4 | 14.9 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Cyanide**

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

Date: 11-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 1.1544 $m^3$
Average gas meter temp. ($T_{M,2}$): 27.7 $^oC$
300.9 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); (0$^o$C, dry gas, 1 atm pressure): 1.0448 $m^3$

(B) Cyanide concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
Cyanide Weight <0.00001 g
Final Cyanide Weight (Mp1): <0.00001 g
Cyanide Concentration (C1): $=M_{p1}/MV_4=$ <0.0000096 $g/m^3$ (0$^o$C, dry gas, 1atm pressure)

;and $C_2$ = <0.0096 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.00019 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <0.19 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.00012 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <0.12 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: P3
$V_v$ = 5.8 g (from laboratory report)
$V_w$ = 7 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0093
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0077

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

$B_{ws}$ = 1.61 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Cyanide**

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.27 kg/m$^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.26 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)<br>1.29 kg/m$^3$ (0$^o$C, dry, 1 atm pressure) |

(iii) Gas density at stack conditions =

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

= 0.946 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 14.91 m/s |
| (ii) Average of post-sampling velocities: | 14.87 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 14.89 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 31.84 m$^3$/s (stack conditions)

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

Qstd = 23.5 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.00023 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | <0.23 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.0045 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | = | <4.5 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | $C_{1a}$ x Qstd = | <0.0029 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$) |
| | = | <2.9 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$) |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Gaseous Fluoride**

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

Date: 11-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8498 $m^3$
Average gas meter temp. ($T_{M,2}$): 27.8 °C
301.0 K
Average barometric pressure ($P_{BARO}$) 1010 hPa
Average pressure at meter ($P_{M,2}$) 1010.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7688 $m^3$

(B) Gaseous Fluoride concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
Gaseous Fluoride Weight 0.00006 g
Final Gaseous Fluoride Weight (Mp1): 0.00006 g
Gaseous Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.000078 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 0.078 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0016 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ 1.6 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00099 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ 0.99 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: B66
$V_v =$ 6.1 g (from laboratory report)
$V_w =$ 8 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0107
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0081

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 2.39 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Gaseous Fluoride**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

(iii) Gas density at stack conditions =

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

= 0.954 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 14.91 m/s |
| (ii) Average of post-sampling velocities: | 14.87 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 14.89 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 31.84 m$^3$/s (stack conditions)

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

Qstd = 23.3 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0018 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 1.8 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.036 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 36 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.023 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 23 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Particulate Fluoride**

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

Date: 11-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8498 $m^3$

Average gas meter temp. ($T_{M,2}$): 27.8 °C

301.0 K

Average barometric pressure ($P_{BARO}$) 1010 hPa

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

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7688 $m^3$

(B) Particulate Fluoride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Particulate Fluoride Weight 0.000014 g

Final Particulate Fluoride Weight (Mp1): 0.00001 g

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

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

$CO_2$ Basis 12 %

Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00036 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.36 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 19.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00023 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 0.23 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: B66

$V_v$ = 6.1 g (from laboratory report)

$V_w$ = 8 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0081

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

$B_{ws}$ = 2.39 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Particulate Fluoride**

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

(i) Initial gas density for sampling: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

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

= 0.954 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.91 m/s

(ii) Average of post-sampling velocities: 14.87 m/s

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

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

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

Qstack = Vs x A = 31.84 m$^3$/s (stack conditions)

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

Qstd = 23.3 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.00042 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 0.42 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0084 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 8.4 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.0053 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 5.3 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## EMISSION MONITORING RESULTS, STACK 1
## WESTON ALUMINIUM

11-Jun-15
CYANIDE
GASEOUS FLUORIDE
PARTICULATE FLUORIDE

| | | |
|---|---|---|
| **Sampling Conditions:** | | |
| Stack internal diameter at test location | 1650 mm | |
| Stack gas temperature (average) | 90.1 $^{\circ}$C | 363.3 K |
| Stack pressure (average) | 1012 hPa | |
| Stack gas velocity (average, stack conditions) | 15 m/s | |
| Stack gas flowrate (stack conditions) | 32 m$^3$/s | |
| Stack gas flowrate (0$^{\circ}$C, dry gas, 1 atm pressure) | 23 m$^3$/s | |
| **Cyanide Testing** | | |
| Test Period | 14:10 - | 15:50 |
| Cyanide Mass | <0.01 mg | |
| Gas Volume Sampled | 1.04 m$^3$ | |
| Cyanide Emission*1 | <0.0096 mg/m$^3$ | |
| Cyanide Mass Emission Rate*2 | <0.23 mg/s | |
| Regulatory Limit | 0.5 mg/m$^3$ | |
| **Gaseous Fluoride Testing** | | |
| Test Period | 14:10 - | 15:50 |
| Gaseous Fluoride Mass | 0.06 mg | |
| Gas Volume Sampled | 0.769 m$^3$ | |
| Gaseous Fluoride Emission*1 | 0.078 mg/m$^3$ | |
| Gaseous Fluoride Mass Emission Rate*2 | 1.8 mg/s | |
| Regulatory Limit | 2 mg/m$^3$ | |
| **Particulate Fluoride Testing** | | |
| Test Period | 14:10 - | 15:50 |
| Particulate Fluoride Mass | 0.014 mg | |
| Gas Volume Sampled | 0.769 m$^3$ | |
| Particulate Fluoride Emission*1 | 0.018 mg/m$^3$ | |
| Particulate Fluoride Mass Emission Rate*2 | 0.42 mg/s | |
| Regulatory Limit | NA mg/m$^3$ | |
| **Moisture Content (%)** | 2.1 | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 kg/m$^3$ | |
| **Dry Molecular Weight** | 28.9 g/g-mole | |

Notes *1 Emission concentration at Standard conditions of 0$^{\circ}$C, 1 atm, dry gas

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

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 1

Date Sampled: 11-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Hazardous Substances (Metals) | NSW EPA TM - 12, 13 & 14 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)

Measurement/Observations

Stack Internal Dimensions:

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

Cross Sectional Area : 2.14 $m^2$
Minimum No. of sampling points= 16

Distance from sampling plane to nearest disturbances:

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

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

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

| | A | B | PM10/2.5 A | PM2.5/10 B |
|---|---|---|---|---|
| No. | Distance from wall | S-type Pitot distances | Distance from wall | S-Type Pitot distances |
| 1 | 111 | 81 | | |
| 2 | 195 | 165 | | |
| 3 | 292 | 262 | | |
| 4 | 413 | 383 | | |
| 5 | 584 | 554 | | |
| 6 | 1066 | 1036 | | |
| 7 | 1238 | 1208 | | |
| 8 | 1358 | 1328 | | |
| 9 | 1455 | 1425 | | |
| 10 | 1539 | 1509 | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)

| Sampling time start: | 11:50 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 11:50 | 12 | 19.9 | 0.6 |
| 2 | 11:51 | 12 | 19.9 | 0.6 |
| 3 | 11:52 | 12 | 19.9 | 0.6 |
| 4 | 11:53 | 12 | 19.9 | 0.6 |
| 5 | 11:54 | 12 | 19.9 | 0.6 |
| 6 | 11:55 | 12 | 19.9 | 0.6 |
| 7 | 11:56 | 12 | 19.9 | 0.6 |
| 8 | 11:57 | 12 | 19.9 | 0.6 |
| | Averages: | 12.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 3.40 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0012 %,(dry) | $N_2$: | 79.5 %,(dry) |
| $CO_2$: | 0.6 %,(dry) | $O_2$: | 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0012 %,(wet) | $N_2$: | 76.8 %,(wet) |
| $CO_2$: | 0.6 %,(wet) | $O_2$: | 19.2 %,(wet) |
| $H_2O$: | 3.40 %(=M2) | | |

| | | |
|---|---|---|
| Therefore, stack gas density (GD) = | 1.27 kg/$m^3$ | ($0^oC$, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = | 1.29 kg/$m^3$ | ($0^oC$, dry, 1 atm pressure) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1: Hazardous Substances (Metals)

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 13:50 | Sampling port No.: | 1 | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 13:50 | 8 | 19.9 | 0.6 |
| 2 | 13:51 | 8 | 19.9 | 0.6 |
| 3 | 13:52 | 8 | 19.9 | 0.6 |
| 4 | 13:53 | 8 | 19.9 | 0.6 |
| 5 | 13:54 | 8 | 19.9 | 0.6 |
| 6 | 13:55 | 8 | 19.9 | 0.6 |
| 7 | 13:56 | 8 | 19.9 | 0.6 |
| 8 | 13:57 | 8 | 19.9 | 0.6 |
| | Averages: | 8.0 ppm | 19.9 % | 0.6 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 0.83 %

Measurements

| | |
|---|---|
| CO: 0.0008 %,(dry) | $N_2$: 79.5 %,(dry) |
| $CO_2$: 0.6 %,(dry) | $O_2$: 19.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0008 %,(wet) | $N_2$: 78.8 %,(wet) |
| $CO_2$: 0.6 %,(wet) | $O_2$: 19.7 %,(wet) |
| $H_2O$: 0.83 %(=M2) | |

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

AECOM

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

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)

| | | | | |
|---|---|---|---|---|
| Time : | 12:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.27 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure $\Delta$P, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 81 | 0.165 | 90.0 | 363.2 | 15.6 |
| 1/2 | 165 | 0.158 | 90.0 | 363.2 | 15.3 |
| 1/3 | 262 | 0.158 | 90.0 | 363.2 | 15.3 |
| 1/4 | 383 | 0.149 | 90.0 | 363.2 | 14.8 |
| 1/5 | 554 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/6 | 1036 | 0.152 | 90.0 | 363.2 | 15.0 |
| 1/7 | 1208 | 0.156 | 90.0 | 363.2 | 15.2 |
| 1/8 | 1328 | 0.162 | 90.0 | 363.2 | 15.5 |
| 1/9 | 1425 | 0.166 | 90.0 | 363.2 | 15.6 |
| 1/10 | 1509 | 0.150 | 90.0 | 363.2 | 14.9 |
| | | | | | |
| 2/1 | 81 | 0.144 | 90.0 | 363.2 | 14.6 |
| 2/2 | 165 | 0.136 | 90.0 | 363.2 | 14.2 |
| 2/3 | 262 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/4 | 383 | 0.145 | 90.0 | 363.2 | 14.6 |
| 2/5 | 554 | 0.137 | 90.0 | 363.2 | 14.2 |
| 2/6 | 1036 | 0.139 | 90.0 | 363.2 | 14.3 |
| 2/7 | 1208 | 0.140 | 90.0 | 363.2 | 14.4 |
| 2/8 | 1328 | 0.146 | 90.0 | 363.2 | 14.7 |
| 2/9 | 1425 | 0.154 | 90.0 | 363.2 | 15.1 |
| 2/10 | 1509 | 0.153 | 90.0 | 363.2 | 15.0 |
| Average | | | 90.0 | 363.2 | 14.9 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7 mm
Absolute pressure in stack (hPa) : 1011.69 hPa

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS
## SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

| | | | | |
|---|---|---|---|---|
| Date: | 11-Jun-15 | | | |
| Client: | Weston Aluminium | | | |
| AECOM's Project No: | 60341673 | | | |
| Stack Description No.: | Stack 1 | | | |
| Sample Nozzle No.: | Q6 | Sample Nozzle Area (An): | 1.96 | x $10^{-5} m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | NA | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

| **Leak Check (Pre-Sampling)** | | | | **Leak Check (Post Sampling)** | | | |
|---|---|---|---|---|---|---|---|
| Meter start: | 307.4065 | Meter finish: | 307.4065 | Meter start: | 308.8341 | Meter finish: | 308.8341 |
| Time start: | 12:17 | Time finish: | 12:18 | Time start: | 14:03 | Time finish: | 14:04 |

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

### Sampling Record Table

Barometric Pressure: 1010 hPa (start); 1010 hPa (finish)
Meter start: 307.4075 Time start: 12:20
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 111 | 14.8 | 25.0 | 21.0 | | Yes |
| 1/2 | 0:10:00 | 195 | 14.5 | 27.0 | 21.0 | | Yes |
| 1/3 | 0:15:00 | 292 | 14.5 | 27.0 | 21.0 | | Yes |
| 1/4 | 0:20:00 | 413 | 14.0 | 28.0 | 21.0 | | Yes |
| 1/5 | 0:25:00 | 584 | 14.2 | 28.0 | 21.0 | | Yes |
| 1/6 | 0:30:00 | 1066 | 14.2 | 29.0 | 21.0 | | Yes |
| 1/7 | 0:35:00 | 1238 | 14.4 | 29.0 | 21.0 | | Yes |
| 1/8 | 0:40:00 | 1358 | 14.7 | 30.0 | 21.0 | | Yes |
| 1/9 | 0:45:00 | 1455 | 14.8 | 30.0 | 22.0 | | Yes |
| 1/10 | 0:50:00 | 1539 | 14.1 | 30.0 | 22.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:55:00 | 111 | 13.8 | 30.0 | 22.0 | | Yes |
| 2/2 | 1:00:00 | 195 | 13.4 | 30.0 | 22.0 | | Yes |
| 2/3 | 1:05:00 | 292 | 13.9 | 30.0 | 22.0 | | Yes |
| 2/4 | 1:10:00 | 413 | 13.8 | 30.0 | 22.0 | | Yes |
| 2/5 | 1:15:00 | 584 | 13.4 | 30.0 | 22.0 | | Yes |
| 2/6 | 1:20:00 | 1066 | 13.5 | 31.0 | 22.0 | | Yes |
| 2/7 | 1:25:00 | 1238 | 13.6 | 31.0 | 22.0 | | Yes |
| 2/8 | 1:30:00 | 1358 | 13.9 | 30.0 | 22.0 | | Yes |
| 2/9 | 1:35:00 | 1455 | 14.3 | 30.0 | 22.0 | | Yes |
| 2/10 | 1:40:00 | 1539 | 14.2 | 30.0 | 22.0 | | Yes |
| Averages | | | | 29.3 | 21.6 | no result | |

Meter Finish: 308.8265 Time Finish: 14:00
Total Condensate collected: 2 ml Silica gel No(s) used: F26

# Emission Measurement Calculations Spreadsheet

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

AECOM

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1
Test 1:Hazardous Substances (Metals)

| | | | | | |
|---|---|---|---|---|---|
| Time : | 14:00 | Barometric Pressure : | | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.29 | kg/m$^3$ |
| Pitot Tube Type : | S | | | | (0 °C, Wet, 1 Atm) |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 81 | 0.152 | 90.0 | 363.2 | 14.9 |
| 1/2 | 165 | 0.155 | 90.0 | 363.2 | 15.0 |
| 1/3 | 262 | 0.153 | 90.0 | 363.2 | 15.0 |
| 1/4 | 383 | 0.157 | 90.0 | 363.2 | 15.1 |
| 1/5 | 554 | 0.160 | 90.0 | 363.2 | 15.3 |
| 1/6 | 1036 | 0.161 | 90.0 | 363.2 | 15.3 |
| 1/7 | 1208 | 0.150 | 90.0 | 363.2 | 14.8 |
| 1/8 | 1328 | 0.156 | 90.0 | 363.2 | 15.1 |
| 1/9 | 1425 | 0.157 | 90.0 | 363.2 | 15.1 |
| 1/10 | 1509 | 0.146 | 90.0 | 363.2 | 14.6 |
| | | | | | |
| 2/1 | 81 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/2 | 165 | 0.140 | 90.0 | 363.2 | 14.3 |
| 2/3 | 262 | 0.150 | 90.0 | 363.2 | 14.8 |
| 2/4 | 383 | 0.153 | 90.0 | 363.2 | 15.0 |
| 2/5 | 554 | 0.144 | 90.0 | 363.2 | 14.5 |
| 2/6 | 1036 | 0.142 | 90.0 | 363.2 | 14.4 |
| 2/7 | 1208 | 0.146 | 90.0 | 363.2 | 14.6 |
| 2/8 | 1328 | 0.140 | 90.0 | 363.2 | 14.3 |
| 2/9 | 1425 | 0.147 | 90.0 | 363.2 | 14.7 |
| 2/10 | 1509 | 0.156 | 90.0 | 363.2 | 15.1 |
| Average | | | 90.0 | 363.2 | 14.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1011.74 hPa

AECOM

## Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 11-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 1

| | Particulate Metals Results | Gaseous Metals Results | Oixdisable Mercury Results | | |
|---|---|---|---|---|---|
| Metal | Front Half, Filter, Acetone Rinses and Acid Rinses (mg). **Containers 1, 2 and 3** | Back Half, Impingers + Acid Rinses (mg) **Container 4** | KO Impinger + Acid Rinses (mg) **(5A)** | $KMnO_4$/ $H_2SO_4$ + Rinses (mg) **(5B)** | Residue Rinse 8N HCl (mg) (If Required) **(5C)** |
| Antimony | <0.0002 | <0.0001 | | | |
| Arsenic | <0.0002 | <0.0001 | | | |
| Beryllium | <0.0002 | <0.0001 | | | |
| Cadmium | 0.0013 | 0.0003 | | | |
| Chromium | 0.0002 | 0.0074 | | | |
| Cobalt | <0.0002 | <0.0001 | | | |
| Copper | 0.0017 | 0.0018 | | | |
| Lead | 0.017 | 0.0012 | | | |
| Magnesium | <0.02 | <0.0001 | | | |
| Manganese | 0.0085 | 0.00058 | | | |
| Mercury | <0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Nickel | <0.004 | 0.013 | | | |
| Selenium | <0.0002 | 0.00055 | | | |
| Thallium | <0.0002 | <0.0001 | | | |
| Tin | <0.0002 | <0.0001 | | | |
| Vanadium | 0.0007 | <0.0001 | | | |
| Zinc | 1.4 | 0.0019 | | | |

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

| Sample | Total Particulate Metals (mg) | Total Particulate Metals ($mg/m^3$) | Total Gaseous Metals (mg) | Total Gaseous Metals ($mg/m^3$) | Total Oxidisable Mercury (mg) | Total Oxidisable Mercury ($mg/m^3$) | Total (mg) | Total ($mg/m^3$) | Mass Emission Rate (mg/s) |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Arsenic | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Beryllium | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Cadmium | 0.0013 | 0.001 | 0.0003 | 0.00023 | | | 0.002 | 0.0015 | 0.036 |
| Chromium | 0.0002 | 0.00015 | 0.0074 | 0.0057 | | | 0.008 | 0.0061 | 0.14 |
| Cobalt | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Copper | 0.0017 | 0.0013 | 0.0018 | 0.0014 | | | 0.004 | 0.0031 | 0.073 |
| Lead | 0.017 | 0.013 | 0.0012 | 0.00092 | | | 0.02 | 0.015 | 0.36 |
| Magnesium | <0.02 | <0.015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Manganese | 0.0085 | 0.0065 | 0.00058 | 0.00045 | | | 0.009 | 0.0069 | 0.16 |
| Mercury | <0.002 | <0.0015 | <0.0001 | <0.000077 | <0.0001 | <0.000077 | <0.002 | <0.0015 | <0.036 |
| Nickel | <0.004 | <0.0031 | 0.013 | 0.01 | | | 0.013 | 0.01 | 0.24 |
| Selenium | <0.0002 | <0.00015 | 0.00055 | 0.00042 | | | 0.00055 | 0.00042 | 0.0099 |
| Thallium | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Tin | <0.0002 | <0.00015 | <0.0001 | <0.000077 | | | <0.0002 | <0.00015 | <0.0036 |
| Vanadium | 0.0007 | 0.00054 | <0.0001 | <0.000077 | | | 0.0007 | 0.00054 | 0.013 |
| Zinc | 1.4 | 1.1 | 0.0019 | 0.0015 | | | 1 | 0.77 | 18 |
| Total Hazardous Metals* | 0.028 | 0.021 | 0.023 | 0.018 | <0.0001 | <0.000077 | 0.053 | 0.041 | 0.97 |
| Total Metals | 1.4 | 1.1 | 0.027 | 0.021 | | | 1.1 | 0.81 | 19 |

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

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Hazardous Substances (Metals)**

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

Date: 11-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 1

(A) Sample gas volume at standard conditions

| | | | |
|---|---|---|---|
| Metered volume ($MV_3$): | 1.4279 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1010 hPa |
| Average gas meter temp. ($T_{M,2}$): | 25.4 $^{o}C$ | | |
| | 298.6 K | Average pressure at meter ($P_{M,2}$) | 1010.00 hPa |
| Sample gas volume ($MV_4$); ($0^oC$, dry gas, 1 atm pressure): | 1.3022 $m^3$ | | |

(B) Metals concentration at standard conditions

| | | | |
|---|---|---|---|
| Blank thimble No.: | NA | Blank weight: | g |
| Thimble No. used: | NA | Metals Weight | 0.000053 g |

Final Metals Weight (Mp1): 0.00005 g

Metals Concentration (C1): $=M_{p1}/MV_4=$ 0.000041 $g/m^3$ ($0^oC$, dry gas, 1atm pressure)

;and $C_2$ = 0.041 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.6 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00082 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.82 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 19.9 %

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

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

(C) Moisture content

Silica Gel Number: F26

$V_v$ = 6.2 g (from laboratory report) $V_w$ = 2 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0083

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 0.83 %

# 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: 1.27 kg/m$^3$ (from Laboratory Form 107)

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

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

= 0.939 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.90 m/s

(ii) Average of post-sampling velocities: 14.83 m/s

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

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

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

Qstack = Vs x A = 31.80 m$^3$/s (stack conditions)

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

Qstd = 23.7 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = $C_{1a}$ x Qstd = 0.00097 g/s (0$^o$C, dry gas, 1 atm pressure )
= 0.97 mg/s (0$^o$C, dry gas, 1 atm pressure )

$C_{1a}$ x Qstd = 0.019 g/s (0$^o$C, dry gas, 1 atm pressure 12% $CO_2$ )
= 19 mg/s (0$^o$C, dry gas, 1 atm pressure 12% $CO_2$ )

$C_{1a}$ x Qstd = 0.012 g/s (0$^o$C, dry gas, 1 atm pressure 7% $O_2$ )
= 12 mg/s (0$^o$C, dry gas, 1 atm pressure 7% $O_2$ )

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 1**
**WESTON ALUMINIUM**
11-Jun-15
HAZARDOUS SUBSTANCES (METALS)

| | | |
|---|---|---|
| **Sampling Conditions:** | | |
| Stack internal diameter at test location | 1650 mm | |
| Stack gas temperature (average) | 90.0 °C | 363.2 K |
| Stack pressure (average) | 1012 hPa | |
| Stack gas velocity (average, stack conditions) | 15 m/s | |
| Stack gas flowrate (stack conditions) | 32 $m^3/s$ | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 24 $m^3/s$ | |
| **Hazardous Substances (Metals) Testing** | | |
| Test Period | 12:20 - | 14:00 |
| Hazardous Substances (Metals) Mass | 0.053 mg | |
| Gas Volume Sampled | 1.3 $m^3$ | |
| Hazardous Substances (Metals) Emission*1 | 0.041 $mg/m^3$ | |
| Hazardous Substances (Metals) Mass Emission Rate*2 | 0.97 mg/s | |
| Regulatory Limit | 10 $mg/m^3$ | |
| **Moisture Content (%)** | 0.8 | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | |
| **Dry Molecular Weight** | 28.9 g/g-mole | |

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

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

AECOM

**Weston**

AECOM's Project Number: 60341673

Emission Source: Baghouse 2

Date Sampled: 1-Jun-15

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

Observations made during testing period:

Sampling Performed By:

Colin Clarke

Vilai Kelemete-Manua

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 2
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Measurement/Observations

Stack Internal Dimensions:

Diameter 1265 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.26 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 7
No. Diameters = 5.5
Type of Upstream Disturbance: Fan
Downstream (m) = 7
No. Diameters = 5.5
Type of Down Stream Disturbance: Stack Exit

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

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 | 56 | 26 | 56 | 26 |
| 2 | 185 | 155 | 185 | 155 |
| 3 | 374 | 344 | 374 | 344 |
| 4 | 891 | 861 | 891 | 861 |
| 5 | 1080 | 1050 | 1080 | 1050 |
| 6 | 1209 | 1179 | 1209 | 1179 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ........................

Checked: ........................

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 2
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Sampling time start: 9:00
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 9:00 | 0 | 20.9 | 0.0 |
| 2 | 9:01 | 0 | 20.9 | 0.0 |
| 3 | 9:02 | 0 | 20.9 | 0.0 |
| 4 | 9:03 | 0 | 20.9 | 0.0 |
| 5 | 9:04 | 0 | 20.9 | 0.0 |
| 6 | 9:05 | 0 | 20.9 | 0.0 |
| 7 | 9:06 | 0 | 20.9 | 0.0 |
| 8 | 9:07 | 0 | 20.9 | 0.0 |
|  | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 0.90 %

Measurements

CO: 0.0000 %,(dry)
$CO_2$: 0.0 %,(dry)
$N_2$: 79.1 %,(dry)
$O_2$: 20.9 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0000 %,(wet)
$CO_2$: 0.0 %,(wet)
$H_2O$: 0.90 %(=M2)
$N_2$: 78.4 %,(wet)
$O_2$: 20.7 %,(wet)

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

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 2
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| Sampling time start: | 11:05 | Sampling port No.: | 1 | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 11:05 | 0 | 20.9 | 0.0 |
| 2 | 11:06 | 0 | 20.9 | 0.0 |
| 3 | 11:07 | 0 | 20.9 | 0.0 |
| 4 | 11:08 | 0 | 20.9 | 0.0 |
| 5 | 11:09 | 0 | 20.9 | 0.0 |
| 6 | 11:10 | 0 | 20.9 | 0.0 |
| 7 | 11:11 | 0 | 20.9 | 0.0 |
| 8 | 11:12 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.13 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0000 %,(dry) | $N_2$: | 79.1 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0000 %,(wet) | $N_2$: | 78.2 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 20.7 %,(wet) |
| $H_2O$: | 1.13 %(=M2) | | |

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

AECOM

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 2
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 9:30 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 26 | 0.129 | 30.0 | 303.2 | 12.6 |
| 1/2 | 155 | 0.135 | 30.0 | 303.2 | 12.9 |
| 1/3 | 344 | 0.123 | 30.0 | 303.2 | 12.3 |
| 1/4 | 861 | 0.103 | 30.0 | 303.2 | 11.2 |
| 1/5 | 1050 | 0.114 | 30.0 | 303.2 | 11.8 |
| 1/6 | 1179 | 0.088 | 30.0 | 303.2 | 10.4 |
| | | | | | |
| 2/1 | 26 | 0.113 | 30.0 | 303.2 | 11.8 |
| 2/2 | 155 | 0.123 | 30.0 | 303.2 | 12.3 |
| 2/3 | 344 | 0.114 | 30.0 | 303.2 | 11.8 |
| 2/4 | 861 | 0.108 | 30.0 | 303.2 | 11.5 |
| 2/5 | 1050 | 0.107 | 30.0 | 303.2 | 11.4 |
| 2/6 | 1179 | 0.106 | 30.0 | 303.2 | 11.4 |
| Average | | | 30.0 | 303.2 | 11.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -10.8 mm
Absolute pressure in stack (hPa) : 1009.94 hPa

## STACK ANALYSIS
## SAMPLING OF FINE PARTICULATE (PM10)

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 2
Sample Nozzle No.: fine5
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.81 x $10^{-5}m^2$
Thimble No: T302
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 171.8642 Meter finish: 171.8642
Time start: 9:55 Time finish: 9:56

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 172.7043 Meter finish: 172.7043
Time start: 11:15 Time finish: 11:16

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: 171.8712
Time start: 10:14
Meter correction factor (GMf) : 1.0033

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:15 | 56 | 13.6 | 21.0 | 17.0 | | Yes |
| 1/2 | 0:05:30 | 185 | 13.6 | 26.0 | 18.0 | | Yes |
| 1/3 | 0:05:15 | 374 | 13.6 | 28.0 | 19.0 | | Yes |
| 1/4 | 0:04:45 | 891 | 13.6 | 30.0 | 20.0 | | Yes |
| 1/5 | 0:05:00 | 1080 | 13.6 | 31.0 | 21.0 | | Yes |
| 1/6 | 0:04:30 | 1209 | 13.6 | 33.0 | 22.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:05:00 | 56 | 13.6 | 34.0 | 22.0 | | Yes |
| 2/2 | 0:05:15 | 185 | 13.6 | 35.0 | 23.0 | | Yes |
| 2/3 | 0:05:00 | 374 | 13.6 | 35.0 | 24.0 | | Yes |
| 2/4 | 0:05:00 | 891 | 13.6 | 36.0 | 25.0 | | Yes |
| 2/5 | 0:04:45 | 1080 | 13.6 | 36.0 | 25.0 | | Yes |
| 2/6 | 0:04:45 | 1209 | 13.6 | 36.0 | 25.0 | | Yes |
| Averages | | | | 31.8 | 21.8 | no result | |

Meter Finish: 172.7000
Time Finish: 11:15
Total Condensate collected: 0 ml
Silica gel No(s) used: Z8

**STACK ANALYSIS**
**SAMPLING OF TOTAL PARTICULATE**

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 2
Sample Nozzle No.: s9
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: T306
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 486.4565 Meter finish: 486.4565
Time start: 9:56 Time finish: 9:57

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 487.0505 Meter finish: 487.0505
Time start: 11:16 Time finish: 11:17

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: 486.4584 Time start: 10:14
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 56 | 10.1 | 25.0 | 24.0 | | Yes |
| 1/2 | 0:10:00 | 185 | 10.4 | 27.0 | 25.0 | | Yes |
| 1/3 | 0:15:00 | 374 | 9.9 | 28.0 | 26.0 | | Yes |
| 1/4 | 0:20:00 | 891 | 9.0 | 30.0 | 27.0 | | Yes |
| 1/5 | 0:25:00 | 1080 | 9.5 | 30.0 | 28.0 | | Yes |
| 1/6 | 0:30:00 | 1209 | 8.4 | 31.0 | 28.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 56 | 9.5 | 31.0 | 28.0 | | Yes |
| 2/2 | 0:40:00 | 185 | 9.9 | 31.0 | 28.0 | | Yes |
| 2/3 | 0:45:00 | 374 | 9.5 | 31.0 | 29.0 | | Yes |
| 2/4 | 0:50:00 | 891 | 9.2 | 32.0 | 29.0 | | Yes |
| 2/5 | 0:55:00 | 1080 | 9.2 | 32.0 | 29.0 | | Yes |
| 2/6 | 1:00:00 | 1209 | 9.2 | 32.0 | 29.0 | | Yes |
| Averages | | | | 30.0 | 27.5 | no result | |

Meter Finish: 487.0443 Time Finish: 11:15
Total Condensate collected: 1 ml Silica gel No(s) used: Z13

AECOM

**STACK ANALYSIS**

**SAMPLING OF TOTAL FLUORIDE**

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 2
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 298.7215 Meter finish: 298.7215
Time start: 9:57 Time finish: 9:58

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 299.3105 Meter finish: 299.3105
Time start: 11:17 Time finish: 11:18

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: 298.7225 Time start: 10:14
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 56 | 10.1 | 27.0 | 27.0 | | Yes |
| 1/2 | 0:10:00 | 185 | 10.3 | 29.0 | 27.0 | | Yes |
| 1/3 | 0:15:00 | 374 | 9.8 | 30.0 | 28.0 | | Yes |
| 1/4 | 0:20:00 | 891 | 9.0 | 32.0 | 29.0 | | Yes |
| 1/5 | 0:25:00 | 1080 | 9.4 | 32.0 | 29.0 | | Yes |
| 1/6 | 0:30:00 | 1209 | 8.3 | 32.0 | 30.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 56 | 9.4 | 32.0 | 30.0 | | Yes |
| 2/2 | 0:40:00 | 185 | 9.8 | 32.0 | 30.0 | | Yes |
| 2/3 | 0:45:00 | 374 | 9.4 | 32.0 | 30.0 | | Yes |
| 2/4 | 0:50:00 | 891 | 9.2 | 32.0 | 31.0 | | Yes |
| 2/5 | 0:55:00 | 1080 | 9.1 | 32.0 | 31.0 | | Yes |
| 2/6 | 1:00:00 | 1209 | 9.1 | 32.0 | 31.0 | | Yes |
| Averages | | | | 31.2 | 29.4 | no result | |

Meter Finish: 299.3026
Time Finish: 11:15
Total Condensate collected: 0 ml
Silica gel No(s) used: P31

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 2
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

Time : 11:20
Page No. : 1 of 1
Sampling Port No: 1 to 2
Pitot Tube Type : S
Barometric Pressure : 1011 hPa
Pitot Correction Factor : 0.84
Stack Gas Density: 1.28 kg/m$^3$ (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 | 26 | 0.134 | 30.0 | 303.2 | 12.8 |
| 1/2 | 155 | 0.125 | 30.0 | 303.2 | 12.4 |
| 1/3 | 344 | 0.117 | 30.0 | 303.2 | 12.0 |
| 1/4 | 861 | 0.115 | 30.0 | 303.2 | 11.9 |
| 1/5 | 1050 | 0.103 | 30.0 | 303.2 | 11.2 |
| 1/6 | 1179 | 0.104 | 30.0 | 303.2 | 11.3 |
| | | | | | |
| 2/1 | 26 | 0.118 | 30.0 | 303.2 | 12.0 |
| 2/2 | 155 | 0.117 | 30.0 | 303.2 | 12.0 |
| 2/3 | 344 | 0.115 | 30.0 | 303.2 | 11.9 |
| 2/4 | 861 | 0.106 | 30.0 | 303.2 | 11.4 |
| 2/5 | 1050 | 0.102 | 30.0 | 303.2 | 11.2 |
| 2/6 | 1179 | 0.114 | 30.0 | 303.2 | 11.8 |
| Average | | | 30.0 | 303.2 | 11.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -11 mm
Absolute pressure in stack (hPa) : 1009.92 hPa

## STACK ANALYSIS - PM10 CALCULATIONS

| | | | | |
|---|---|---|---|---|
| Date: | 1-Jun-15 | Client: | Weston | |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | | Baghouse 2 |

### 1. Gas Analysis

| | % | | |
|---|---|---|---|
| $\%CO_2$ | 0.0 | | |
| $\%O_2$ | 20.9 | | |
| $\%N_2+\%CO$ | 79.1 | | |
| Fraction Moisture Content, Bws | 0.01 | $M_s$= | 0.99 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.84 |
| Mol. Wt. of Stack Gas (wet) | 28.74 |

### 3. Absolute Stack Pressure

| | Pascals | in. Hg |
|---|---|---|
| Barometric Pressure (Pbar) | 101100 | 29.85 |
| Stack Static Pressure (Pg) | 100992 | 29.81 |
| Absolute Stack Pressure | | 29.81 |

### 4. Viscosity of Stack Gas

| | °C | °F |
|---|---|---|
| Average Stack Temp. | 30.0 | 86.0 |
| Average Meter Temperature: | 26.8 | |
| Stack Gas Viscosity | | 185.0 |

### 5. Cyclone Flow Rate

| | $ft^3$/min | $m^3$/min | L/min | L/s |
|---|---|---|---|---|
| Cyclone Flow Rate | 0.46 | 0.0162 | 16.23 | 0.27 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.000 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| 1 | 0.134 | 78.36 | 25.79 | 0.756 | 1.231 | 59.22 | 19.43 | 96.43 | 31.64 |
| 2 | 0.152 | 61.11 | 20.12 | 0.734 | 1.244 | 44.89 | 14.73 | 76.03 | 24.94 |
| 3 | 0.177 | 44.73 | 14.72 | 0.691 | 1.269 | 30.90 | 10.14 | 56.77 | 18.63 |
| 4 | 0.177 | 44.73 | 14.72 | 0.691 | 1.269 | 30.90 | 10.14 | 56.77 | 18.63 |
| 5 | 0.189 | 39.32 | 12.94 | 0.664 | 1.283 | 26.10 | 8.56 | 50.45 | 16.55 |
| 6 | 0.217 | 29.95 | 9.86 | 0.574 | 1.322 | 17.20 | 5.64 | 39.59 | 12.99 |
| 7 | 0.236 | 25.16 | 8.28 | 0.466 | 1.355 | 12.58 | 4.13 | 34.10 | 11.19 |
| 8 | 0.260 | 20.80 | 6.85 | #NUM! | 1.401 | 10.40 | 3.41 | 29.14 | 9.56 |
| 9 | 0.295 | 16.10 | 5.30 | #NUM! | 1.482 | 8.05 | 2.64 | 23.87 | 7.83 |
| 10 | 0.339 | 12.25 | 4.03 | #NUM! | 1.599 | 6.12 | 2.01 | 18.37 | 6.03 |
| 11 | 0.386 | 9.43 | 3.10 | #NUM! | 1.748 | 4.72 | 1.55 | 14.15 | 4.64 |

| Selected Nozzle | Nozzle Diameter (inches) | Nozzle Diameter (m) | Nozzle Area ($m^2$) | Sample Rate (L/min) |
|---|---|---|---|---|
| 5 | 0.189 | 0.005 | 0.000018 | 13.7 |

## STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 1-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 2

**7.Sampling Time** Total Run Time 60 Number of points 12

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 134.40 | 0.54 | 0.73 | 5.4 |
| 124.59 | 0.50 | 0.71 | 5.2 |
| 116.74 | 0.47 | 0.68 | 5.1 |
| 114.78 | 0.46 | 0.68 | 5.0 |
| 103.01 | 0.41 | 0.64 | 4.8 |
| 103.99 | 0.42 | 0.65 | 4.8 |
| | | | |
| 117.72 | 0.47 | 0.69 | 5.1 |
| 116.74 | 0.47 | 0.68 | 5.1 |
| 114.78 | 0.46 | 0.68 | 5.0 |
| 105.95 | 0.43 | 0.65 | 4.8 |
| 102.02 | 0.41 | 0.64 | 4.7 |
| 113.80 | 0.46 | 0.68 | 5.0 |
| | Average | 0.68 | 60.00 |
| | Square | 0.46 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 5.3 | 0 | 5 | 15 |
| 10.8 | 0 | 10 | 45 |
| 16.0 | 0 | 16 | 0 |
| 20.8 | 0 | 20 | 45 |
| 25.8 | 0 | 25 | 45 |
| 30.3 | 0 | 30 | 15 |
| | | | |
| 35.3 | 0 | 35 | 15 |
| 40.5 | 0 | 40 | 30 |
| 45.5 | 0 | 45 | 30 |
| 50.5 | 0 | 50 | 30 |
| 55.3 | 0 | 55 | 15 |
| 60.0 | 1 | 0 | 0 |

**Aerodynamic Cut Size ($u_{cyc}$)**
185.4

**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_s$)**
0.0132

**Actual $D_{50}$**
9.9

## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 1-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 2

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8315 $m^3$
Average gas meter temp. ($T_{M,2}$): 26.8 °C
300.0 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7578 $m^3$

(B) PM10 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: T302
Blank weight: g
PM10 Weight 0.0002 g
Final PM10 Weight (Mp1): 0.00020 g
PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.00026 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.26 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00026 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.26 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.036 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 36 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: Z8
$V_v$ = 5.8 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0077

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

$B_{ws}$ = 1.01 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

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

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

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

= 1.150 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 11.78 m/s

(ii) Average of post-sampling velocities: 11.83 m/s

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

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

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

Qstack = Vs x A = 14.83 m$^3$/s (stack conditions)

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

Qstd = 13.2 m$^3$/s (0$^\circ$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0034 | g/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | = | 3.4 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0034 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 3.4 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.48 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 480 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 1-Jun-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 2

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.5918 $m^3$

Average gas meter temp. ($T_{M,2}$): 28.8 °C

302.0 K

Average barometric pressure ($P_{BARO}$) 1014 hPa

Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.5358 $m^3$

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T306

Blank weight: g

Total Particulate Weight 0.0003 g

Final Total Particulate Weight (Mp1): 0.00030 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.00056 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.56 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00056 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.56 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.078 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 78 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z13

$V_v$ = 4.1 g (from laboratory report)

$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0055

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

$B_{ws}$ = 1.25 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

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

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

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

= 1.159 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 11.78 m/s

(ii) Average of post-sampling velocities: 11.83 m/s

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

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

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

Qstack = Vs x A = 14.83 m$^3$/s (stack conditions)

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

Qstd = 13.2 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0074 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 7.4 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0074 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 7.4 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 1 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1000 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 1-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 2

(A) Sample gas volume at standard conditions

| | | | |
|---|---|---|---|
| Metered volume ($MV_3$): | 0.5838 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1014 hPa |
| Average gas meter temp. ($T_{M,2}$): | 30.3 $^oC$ | | |
| | 303.5 K | Average pressure at meter ($P_{M,2}$) | 1014.00 hPa |
| Sample gas volume ($MV_4$); (0$^o$C, dry gas, 1 atm pressure): | 0.5259 $m^3$ | | |

(B) Total Fluoride concentration at standard conditions

Blank thimble No.: NA
Blank weight: g
Thimble No. used: 0
Total Fluoride Weight 0.00006 g
Final Total Fluoride Weight (Mp1): 0.00006 g
Total Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00011 $g/m^3$ (0$^o$C, dry gas, 1atm pressure)

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

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00011 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.11 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.015 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 15 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: P31
$V_v$ = 4.5 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0060

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 1.13 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.28 kg/m$^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.29 kg/m$^3$ (0°C, wet, 1 atm pressure)<br>1.29 kg/m$^3$ (0°C, dry, 1 atm pressure) |

(iii) Gas density at stack conditions =

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

= 1.159 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 11.78 m/s |
| (ii) Average of post-sampling velocities: | 11.83 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 11.80 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 14.83 m$^3$/s (stack conditions)

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

Qstd = 13.2 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0014 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 1.4 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0014 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 1.4 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.2 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 200 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

**EMISSION MONITORING RESULTS, BAGHOUSE 2**
**WESTON**
1-Jun-15
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
TOTAL FLUORIDE

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1265 mm | | |
| Stack gas temperature (average) | 30.0 $^{\circ}$C | | 303.2 K |
| Stack pressure (average) | 1010 hPa | | |
| Stack gas velocity (average, stack conditions) | 12 m/s | | |
| Stack gas flowrate (stack conditions) | 15 m$^3$/s | | |
| Stack gas flowrate (0$^0$C, dry gas, 1 atm pressure) | 13 m$^3$/s | | |
| **Fine Particulate (PM10) Testing** | | | |
| Test Period | 10:14 | - | 11:15 |
| Fine Particulate (PM10) Mass | 0.2 mg | | |
| Gas Volume Sampled | 0.758 m$^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.26 mg/m$^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 3.4 mg/s | | |
| Regulatory Limit | N/A mg/m$^3$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 10:14 | - | 11:15 |
| Total Particulate Mass | 0.3 mg | | |
| Gas Volume Sampled | 0.536 m$^3$ | | |
| Total Particulate Emission*1 | 0.56 mg/m$^3$ | | |
| Total Particulate Mass Emission Rate*2 | 7.4 mg/s | | |
| Regulatory Limit | 35 mg/m$^3$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 10:14 | - | 11:15 |
| Total Fluoride Mass | 0.06 mg | | |
| Gas Volume Sampled | 0.526 m$^3$ | | |
| Total Fluoride Emission*1 | 0.11 mg/m$^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 1.4 mg/s | | |
| Regulatory Limit | N/A mg/m$^3$ | | |
| **Moisture Content (%)** | 1.2 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 kg/m$^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

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**Weston**

AECOM's Project Number: 60341673

Emission Source: Baghouse 3

Date Sampled: 1-Jun-15

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

Observations made during testing period:

Sampling Performed By:

Colin Clarke

Vilai Kelemete-Manua

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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## STACK ANALYSIS - PRE-SAMPLING

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Measurement/Observations

Stack Internal Dimensions:

Diameter 1000 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.79 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 6
No. Diameters = 6.0
Type of Upstream Disturbance: Fan
Downstream (m) = 3
No. Diameters = 3.0
Type of Down Stream Disturbance: Stack Exit

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

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 | 44 | 14 | 44 | 14 |
| 2 | 146 | 116 | 146 | 116 |
| 3 | 296 | 266 | 296 | 266 |
| 4 | 704 | 674 | 704 | 674 |
| 5 | 854 | 824 | 854 | 824 |
| 6 | 956 | 926 | 956 | 926 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

# Emission Measurement Calculations Spreadsheet

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| Sampling time start: | 11:00 | Sampling port No.: | 1 | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 11:00 | 0 | 20.9 | 0.0 |
| 2 | 11:01 | 0 | 20.9 | 0.0 |
| 3 | 11:02 | 0 | 20.9 | 0.0 |
| 4 | 11:03 | 0 | 20.9 | 0.0 |
| 5 | 11:04 | 0 | 20.9 | 0.0 |
| 6 | 11:05 | 0 | 20.9 | 0.0 |
| 7 | 11:06 | 0 | 20.9 | 0.0 |
| 8 | 11:07 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 2.30 %

Measurements

| | |
|---|---|
| CO: 0.0000 %,(dry) | $N_2$: 79.1 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0000 %,(wet) | $N_2$: 77.3 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 20.4 %,(wet) |
| $H_2O$: 2.30 %(=M2) | |
| Therefore, stack gas density (GD) = 1.28 kg/m$^3$ | (0$^o$C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0$^o$C, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| Sampling time start: | 12:55 | Sampling port No.: | 1 | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 12:55 | 0 | 20.9 | 0.0 |
| 2 | 12:56 | 0 | 20.9 | 0.0 |
| 3 | 12:57 | 0 | 20.9 | 0.0 |
| 4 | 12:58 | 0 | 20.9 | 0.0 |
| 5 | 12:59 | 0 | 20.9 | 0.0 |
| 6 | 13:00 | 0 | 20.9 | 0.0 |
| 7 | 13:01 | 0 | 20.9 | 0.0 |
| 8 | 13:02 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.22 %

Measurements

| | |
|---|---|
| CO: 0.0000 %,(dry) | $N_2$: 79.1 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0000 %,(wet) | $N_2$: 78.1 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 20.6 %,(wet) |
| $H_2O$: 1.22 %(=M2) | |
| Therefore, stack gas density (GD) = 1.28 kg/m$^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0°C, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 11:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 14 | 0.116 | 30.0 | 303.2 | 11.9 |
| 1/2 | 116 | 0.129 | 30.0 | 303.2 | 12.6 |
| 1/3 | 266 | 0.135 | 30.0 | 303.2 | 12.9 |
| 1/4 | 674 | 0.123 | 30.0 | 303.2 | 12.3 |
| 1/5 | 824 | 0.131 | 30.0 | 303.2 | 12.7 |
| 1/6 | 926 | 0.114 | 30.0 | 303.2 | 11.8 |
| | | | | | |
| 2/1 | 14 | 0.119 | 30.0 | 303.2 | 12.1 |
| 2/2 | 116 | 0.123 | 30.0 | 303.2 | 12.3 |
| 2/3 | 266 | 0.133 | 30.0 | 303.2 | 12.8 |
| 2/4 | 674 | 0.134 | 30.0 | 303.2 | 12.8 |
| 2/5 | 824 | 0.136 | 30.0 | 303.2 | 12.9 |
| 2/6 | 926 | 0.129 | 30.0 | 303.2 | 12.6 |
| Average | | | 30.0 | 303.2 | 12.5 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 8.3 mm
Absolute pressure in stack (hPa) : 1011.81 hPa

# Emission Measurement Calculations Spreadsheet

AECOM

## STACK ANALYSIS
## SAMPLING OF FINE PARTICULATE (PM10)

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 3
Sample Nozzle No.: fine5
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.81 x $10^{-5}m^2$
Thimble No: T309
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 172.7060 Meter finish: 172.7060
Time start: 11:40 Time finish: 11:41

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 173.5045 Meter finish: 173.5045
Time start: 12:49 Time finish: 12:50

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: 172.7075 Time start: 11:47
Meter correction factor (GMf) : 1.0033

| 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 | 0:04:45 | 44 | 13.1 | 32.0 | 29.0 | | Yes |
| 1/2 | 0:05:00 | 146 | 13.1 | 35.0 | 30.0 | | Yes |
| 1/3 | 0:05:15 | 296 | 13.1 | 37.0 | 30.0 | | Yes |
| 1/4 | 0:05:00 | 704 | 13.1 | 40.0 | 31.0 | | Yes |
| 1/5 | 0:05:00 | 854 | 13.1 | 41.0 | 32.0 | | Yes |
| 1/6 | 0:04:45 | 956 | 13.1 | 43.0 | 33.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:04:45 | 44 | 13.1 | 43.0 | 33.0 | | Yes |
| 2/2 | 0:05:00 | 146 | 13.1 | 43.0 | 34.0 | | Yes |
| 2/3 | 0:05:15 | 296 | 13.1 | 43.0 | 34.0 | | Yes |
| 2/4 | 0:05:15 | 704 | 13.1 | 44.0 | 35.0 | | Yes |
| 2/5 | 0:05:15 | 854 | 13.1 | 44.0 | 35.0 | | Yes |
| 2/6 | 0:05:00 | 956 | 13.1 | 44.0 | 35.0 | | Yes |
| Averages | | | | 40.8 | 32.6 | no result | |

Meter Finish: 173.4972 Time Finish: 12:48
Total Condensate collected: 1 ml Silica gel No(s) used: G57

## STACK ANALYSIS
## SAMPLING OF TOTAL PARTICULATE

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 3
Sample Nozzle No.: s9
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: T299
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 487.0535 Meter finish: 487.0535
Time start: 11:41 Time finish: 11:42

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 487.6353 Meter finish: 487.6353
Time start: 12:50 Time finish: 12:51

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: 487.0555 Time start: 11:47
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 44 | 9.4 | 33.0 | 32.0 | | Yes |
| 1/2 | 0:10:00 | 146 | 10.0 | 33.0 | 32.0 | | Yes |
| 1/3 | 0:15:00 | 296 | 10.2 | 34.0 | 32.0 | | Yes |
| 1/4 | 0:20:00 | 704 | 9.8 | 35.0 | 33.0 | | Yes |
| 1/5 | 0:25:00 | 854 | 10.1 | 35.0 | 33.0 | | Yes |
| 1/6 | 0:30:00 | 956 | 9.4 | 36.0 | 33.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 44 | 9.6 | 35.0 | 33.0 | | Yes |
| 2/2 | 0:40:00 | 146 | 9.8 | 35.0 | 32.0 | | Yes |
| 2/3 | 0:45:00 | 296 | 10.2 | 34.0 | 32.0 | | Yes |
| 2/4 | 0:50:00 | 704 | 10.2 | 34.0 | 32.0 | | Yes |
| 2/5 | 0:55:00 | 854 | 10.2 | 34.0 | 32.0 | | Yes |
| 2/6 | 1:00:00 | 956 | 10.0 | 33.0 | 32.0 | | Yes |
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| | | | | | | | |
| Averages | | | | 34.3 | 32.3 | no result | |

Meter Finish: 487.6325 Time Finish: 12:48
Total Condensate collected: 1 ml Silica gel No(s) used: P33

## STACK ANALYSIS
## SAMPLING OF TOTAL FLUORIDE

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Baghouse 3
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 299.3118 Meter finish: 299.3118
Time start: 11:42 Time finish: 11:43

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 299.9155 Meter finish: 299.9155
Time start: 12:51 Time finish: 12:52

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: 299.3130 Time start: 11:47
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 44 | 9.4 | 30.0 | 29.0 | | Yes |
| 1/2 | 0:10:00 | 146 | 10.0 | 30.0 | 29.0 | | Yes |
| 1/3 | 0:15:00 | 296 | 10.2 | 30.0 | 28.0 | | Yes |
| 1/4 | 0:20:00 | 704 | 9.7 | 30.0 | 28.0 | | Yes |
| 1/5 | 0:25:00 | 854 | 10.0 | 30.0 | 27.0 | | Yes |
| 1/6 | 0:30:00 | 956 | 9.3 | 30.0 | 27.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 44 | 9.6 | 29.0 | 26.0 | | Yes |
| 2/2 | 0:40:00 | 146 | 9.7 | 29.0 | 26.0 | | Yes |
| 2/3 | 0:45:00 | 296 | 10.1 | 29.0 | 26.0 | | Yes |
| 2/4 | 0:50:00 | 704 | 10.1 | 28.0 | 26.0 | | Yes |
| 2/5 | 0:55:00 | 854 | 10.2 | 28.0 | 26.0 | | Yes |
| 2/6 | 1:00:00 | 956 | 10.0 | 28.0 | 26.0 | | Yes |
| Averages | | | | 29.3 | 27.0 | no result | |

Meter Finish: 299.9100 Time Finish: 12:48
Total Condensate collected: 2 ml Silica gel No(s) used: F24

# Emission Measurement Calculations Spreadsheet

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | | |
|---|---|---|---|---|---|
| Time : | 12:55 | Barometric Pressure : | 1011 | hPa | |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | $kg/m^3$ | |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) | |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 14 | 0.118 | 31.0 | 304.2 | 12.0 |
| 1/2 | 116 | 0.133 | 31.0 | 304.2 | 12.8 |
| 1/3 | 266 | 0.132 | 31.0 | 304.2 | 12.8 |
| 1/4 | 674 | 0.129 | 31.0 | 304.2 | 12.6 |
| 1/5 | 824 | 0.127 | 31.0 | 304.2 | 12.5 |
| 1/6 | 926 | 0.118 | 31.0 | 304.2 | 12.0 |
| | | | | | |
| 2/1 | 14 | 0.123 | 31.0 | 304.2 | 12.3 |
| 2/2 | 116 | 0.126 | 31.0 | 304.2 | 12.4 |
| 2/3 | 266 | 0.127 | 31.0 | 304.2 | 12.5 |
| 2/4 | 674 | 0.135 | 31.0 | 304.2 | 12.9 |
| 2/5 | 824 | 0.132 | 31.0 | 304.2 | 12.8 |
| 2/6 | 926 | 0.128 | 31.0 | 304.2 | 12.5 |
| Average | | | 31.0 | 304.2 | 12.5 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.5 mm
Absolute pressure in stack (hPa) : 1011.74 hPa

## STACK ANALYSIS - PM10 CALCULATIONS

| | | | | |
|---|---|---|---|---|
| Date: | 1-Jun-15 | Client: | Weston | |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | | Baghouse 3 |

### 1. Gas Analysis

| | | | |
|---|---|---|---|
| | % | | |
| $\%CO_2$ | 0.0 | | |
| $\%O_2$ | 20.9 | | |
| $\%N_2+\%CO$ | 79.1 | | |
| Fraction Moisture Content, Bws | 0.01 | $M_3$= | 0.99 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.84 |
| Mol. Wt. of Stack Gas (wet) | 28.59 |

### 3. Absolute Stack Pressure

| | | |
|---|---|---|
| | Pascals | in. Hg |
| Barometric Pressure (Pbar) | 101100 | 29.85 |
| Stack Static Pressure (Pg) | 101174 | 29.87 |
| Absolute Stack Pressure | | 29.87 |

### 4. Viscosity of Stack Gas

| | | |
|---|---|---|
| | °C | °F |
| Average Stack Temp. | 31.0 | 87.8 |
| Average Meter Temperature: | 36.7 | |
| Stack Gas Viscosity | | 185.3 |

### 5. Cyclone Flow Rate

| | | | | |
|---|---|---|---|---|
| | $ft^3/min$ | $m^3/min$ | L/min | L/s |
| Cyclone Flow Rate | 0.46 | 0.0163 | 16.29 | 0.27 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.000 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| 1 | 0.134 | 78.67 | 25.90 | 0.756 | 1.231 | 59.46 | 19.51 | 96.81 | 31.76 |
| 2 | 0.152 | 61.36 | 20.20 | 0.735 | 1.244 | 45.07 | 14.79 | 76.32 | 25.04 |
| 3 | 0.177 | 44.91 | 14.78 | 0.691 | 1.269 | 31.04 | 10.18 | 56.99 | 18.70 |
| 4 | 0.177 | 44.91 | 14.78 | 0.691 | 1.269 | 31.04 | 10.18 | 56.99 | 18.70 |
| 5 | 0.189 | 39.47 | 12.99 | 0.664 | 1.283 | 26.22 | 8.60 | 50.64 | 16.62 |
| 6 | 0.217 | 30.06 | 9.90 | 0.575 | 1.322 | 17.29 | 5.67 | 39.74 | 13.04 |
| 7 | 0.236 | 25.26 | 8.32 | 0.467 | 1.355 | 12.63 | 4.14 | 34.23 | 11.23 |
| 8 | 0.260 | 20.88 | 6.87 | #NUM! | 1.401 | 10.44 | 3.42 | 29.25 | 9.60 |
| 9 | 0.295 | 16.17 | 5.32 | #NUM! | 1.482 | 8.08 | 2.65 | 23.95 | 7.86 |
| 10 | 0.339 | 12.30 | 4.05 | #NUM! | 1.598 | 6.15 | 2.02 | 18.44 | 6.05 |
| 11 | 0.386 | 9.47 | 3.12 | #NUM! | 1.747 | 4.73 | 1.55 | 14.20 | 4.66 |

| | Nozzle Diameter | Nozzle Diameter | Nozzle Area | Sample Rate |
|---|---|---|---|---|
| Selected Nozzle | (inches) | (m) | $(m^2)$ | (L/min) |
| 5 | 0.189 | 0.005 | 0.000018 | 14.2 |

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### STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

| | | | |
|---|---|---|---|
| Date: | 1-Jun-15 | Client: | Weston |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Baghouse 3 |

**7.Sampling Time** Total Run Time 60 Number of points 12

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 117.72 | 0.47 | 0.69 | 4.8 |
| 133.42 | 0.54 | 0.73 | 5.1 |
| 132.44 | 0.53 | 0.73 | 5.1 |
| 129.49 | 0.52 | 0.72 | 5.0 |
| 126.55 | 0.51 | 0.71 | 5.0 |
| 117.72 | 0.47 | 0.69 | 4.8 |
| | | | |
| 122.63 | 0.49 | 0.70 | 4.9 |
| 125.57 | 0.50 | 0.71 | 5.0 |
| 126.55 | 0.51 | 0.71 | 5.0 |
| 135.38 | 0.54 | 0.74 | 5.2 |
| 132.44 | 0.53 | 0.73 | 5.1 |
| 127.53 | 0.51 | 0.72 | 5.0 |
| | Average | 0.71 | 60.00 |
| | Square | 0.51 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 4.8 | 0 | 4 | 45 |
| 9.8 | 0 | 9 | 45 |
| 15.0 | 0 | 15 | 0 |
| 20.0 | 0 | 20 | 0 |
| 25.0 | 0 | 25 | 0 |
| 29.8 | 0 | 29 | 45 |
| | | | |
| 34.5 | 0 | 34 | 30 |
| 39.5 | 0 | 39 | 30 |
| 44.8 | 0 | 44 | 45 |
| 50.0 | 0 | 50 | 0 |
| 55.3 | 0 | 55 | 15 |
| 60.3 | 1 | 0 | 15 |

**Aerodynamic Cut Size ($u_{cyc}$)**
186.0

**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_s$)**
0.0122

**Actual $D_{50}$**
10.5

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## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 1-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Baghouse 3

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7923 $m^3$
Average gas meter temp. ($T_{M,2}$): 36.7 $^oC$
309.9 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); ($0^oC$, dry gas, 1 atm pressure): 0.6990 $m^3$

(B) PM10 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: T309
Blank weight: g
PM10 Weight <0.0002 g
Final PM10 Weight (Mp1): <0.0002 g
PM10 Concentration (C1): $=M_{p1}/MV_4=$ <0.00029 $g/m^3$ ($0^oC$, dry gas, 1atm pressure)

;and $C_2$ = <0.29 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.00029 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <0.29 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.041 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <41 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: G57
$V_v$ = 5.1 g (from laboratory report)
$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0013
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0068

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

$B_{ws}$ = 1.15 %

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.141 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.48 m/s

(ii) Average of post-sampling velocities: 12.51 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
12.49 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 = 9.81 m$^3$/s (stack conditions)

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

Qstd = 8.7 m$^3$/s (0$^\circ$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.0025 | g/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | = | <2.5 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.0025 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <2.5 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <0.35 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <350 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 1-Jun-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 3

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.5828 $m^3$

Average gas meter temp. ($T_{M,2}$): 33.3 °C

306.5 K

Average barometric pressure ($P_{BARO}$) 1014 hPa

Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.5199 $m^3$

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T299

Blank weight: g

Total Particulate Weight 0.0002 g

Final Total Particulate Weight (Mp1): 0.00020 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.00038 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.38 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00038 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.38 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.053 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 53 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: P33

$V_v$ = 2.9 g (from laboratory report)

$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0039

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

$B_{ws}$ = 0.99 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

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

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

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

= 1.141 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.48 m/s

(ii) Average of post-sampling velocities: 12.51 m/s

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

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

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

Qstack = Vs x A = 9.81 m$^3$/s (stack conditions)

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

Qstd = 8.7 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = $C_{1a}$ x Qstd = 0.0033 g/s (0°C, dry gas, 1 atm pressure )
= 3.3 mg/s (0°C, dry gas, 1 atm pressure )

$C_{1a}$ x Qstd = 0.0033 g/s (0°C, dry gas, 1 atm pressure 12% $CO_2$)
= 3.3 mg/s (0°C, dry gas, 1 atm pressure 12% $CO_2$)

$C_{1a}$ x Qstd = 0.46 g/s (0°C, dry gas, 1 atm pressure 7% $O_2$)
= 460 mg/s (0°C, dry gas, 1 atm pressure 7% $O_2$)

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 1-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Baghouse 3

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.6008 $m^3$
Average gas meter temp. ($T_{M,2}$): 28.1 °C
301.3 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.5452 $m^3$

(B) Total Fluoride concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: 0
Blank weight: g
Total Fluoride Weight 0.00005 g
Final Total Fluoride Weight (Mp1): 0.00005 g
Total Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.000092 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 0.092 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.000092 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ 0.092 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.013 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ 13 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: F24
$V_v =$ 4.3 g (from laboratory report)
$V_w =$ 2 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0027
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0057

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

$B_{ws} =$ 1.52 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

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

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

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

= 1.141 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.48 m/s

(ii) Average of post-sampling velocities: 12.51 m/s

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

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

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

Qstack = Vs x A = 9.81 m$^3$/s (stack conditions)

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

Qstd = 8.7 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0008 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 0.8 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0008 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | = | 0.8 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | $C_{1a}$ x Qstd = | 0.11 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$) |
| | = | 110 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$) |

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

| EMISSION MONITORING RESULTS, BAGHOUSE 3<br>WESTON<br>1-Jun-15<br>FINE PARTICULATE (PM10)<br>TOTAL PARTICULATE<br>TOTAL FLUORIDE | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1000 mm | | |
| Stack gas temperature (average) | 30.5 °C | | 303.7 K |
| Stack pressure (average) | 1012 hPa | | |
| Stack gas velocity (average, stack conditions) | 12 m/s | | |
| Stack gas flowrate (stack conditions) | 9.8 $m^3/s$ | | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 8.7 $m^3/s$ | | |
| **Fine Particulate (PM10) Testing** | | | |
| Test Period | 11:47 | - | 12:48 |
| Fine Particulate (PM10) Mass | <0.2 mg | | |
| Gas Volume Sampled | 0.699 $m^3$ | | |
| Fine Particulate (PM10) Emission*1 | <0.29 $mg/m^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | <2.5 mg/s | | |
| Regulatory Limit | N/A $mg/m^3$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 11:47 | - | 12:48 |
| Total Particulate Mass | 0.2 mg | | |
| Gas Volume Sampled | 0.52 $m^3$ | | |
| Total Particulate Emission*1 | 0.38 $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 | 3.3 mg/s | | |
| Regulatory Limit | 50 $mg/m^3$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 11:47 | - | 12:48 |
| Total Fluoride Mass | 0.05 mg | | |
| Gas Volume Sampled | 0.545 $m^3$ | | |
| Total Fluoride Emission*1 | 0.092 $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 0.8 mg/s | | |
| Regulatory Limit | N/A $mg/m^3$ | | |
| **Moisture Content (%)** | 1.3 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 4

Date Sampled: 12-Jun-15

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

Observations made during testing period:

Sampling Performed By: Vilai Kelemete-Manua

Dylan Turnbull

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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## STACK ANALYSIS - PRE-SAMPLING

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Measurement/Observations

Stack Internal Dimensions:

Diameter 1395 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.53 m$^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 8
No. Diameters = 5.7
Type of Upstream Disturbance: Fan
Downstream (m) = 5
No. Diameters = 3.6
Type of Down Stream Disturbance: Stack Exit

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

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 | 61 | 31 | 61 | 31 |
| 2 | 204 | 174 | 204 | 174 |
| 3 | 413 | 383 | 413 | 383 |
| 4 | 982 | 952 | 982 | 952 |
| 5 | 1191 | 1161 | 1191 | 1161 |
| 6 | 1334 | 1304 | 1334 | 1304 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| Sampling time start: | 9:00 | Sampling port No.: | 1 | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 9:00 | 0 | 20.9 | 0.0 |
| 2 | 9:01 | 0 | 20.9 | 0.0 |
| 3 | 9:02 | 0 | 20.9 | 0.0 |
| 4 | 9:03 | 0 | 20.9 | 0.0 |
| 5 | 9:04 | 0 | 20.9 | 0.0 |
| 6 | 9:05 | 0 | 20.9 | 0.0 |
| 7 | 9:06 | 0 | 20.9 | 0.0 |
| 8 | 9:07 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 2.10 %

Measurements

| | |
|---|---|
| CO: 0.0000 %,(dry) | $N_2$: 79.1 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0000 %,(wet) | $N_2$: 77.4 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 20.5 %,(wet) |
| $H_2O$: 2.10 %(=M2) | |
| Therefore, stack gas density (GD) = 1.28 kg/m$^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0°C, dry, 1 atm pressure) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Sampling time start: 10:50
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 10:50 | 0 | 20.9 | 0.0 |
| 2 | 10:51 | 0 | 20.9 | 0.0 |
| 3 | 10:52 | 0 | 20.9 | 0.0 |
| 4 | 10:53 | 0 | 20.9 | 0.0 |
| 5 | 10:54 | 0 | 20.9 | 0.0 |
| 6 | 10:55 | 0 | 20.9 | 0.0 |
| 7 | 10:56 | 0 | 20.9 | 0.0 |
| 8 | 10:57 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 2.61 %

Measurements

CO: 0.0000 %,(dry)
$CO_2$: 0.0 %,(dry)
$N_2$: 79.1 %,(dry)
$O_2$: 20.9 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0000 %,(wet)
$CO_2$: 0.0 %,(wet)
$H_2O$: 2.61 %(=M2)
$N_2$: 77.0 %,(wet)
$O_2$: 20.4 %,(wet)

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

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 9:15 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 31 | 0.146 | 44.0 | 317.2 | 13.7 |
| 1/2 | 174 | 0.162 | 44.0 | 317.2 | 14.4 |
| 1/3 | 383 | 0.190 | 44.0 | 317.2 | 15.6 |
| 1/4 | 952 | 0.231 | 44.0 | 317.2 | 17.2 |
| 1/5 | 1161 | 0.195 | 44.0 | 317.2 | 15.8 |
| 1/6 | 1304 | 0.192 | 44.0 | 317.2 | 15.7 |
| | | | | | |
| 2/1 | 31 | 0.234 | 44.0 | 317.2 | 17.4 |
| 2/2 | 174 | 0.238 | 44.0 | 317.2 | 17.5 |
| 2/3 | 383 | 0.176 | 44.0 | 317.2 | 15.0 |
| 2/4 | 952 | 0.181 | 44.0 | 317.2 | 15.3 |
| 2/5 | 1161 | 0.205 | 44.0 | 317.2 | 16.2 |
| 2/6 | 1304 | 0.193 | 44.0 | 317.2 | 15.8 |
| Average | | | 44.0 | 317.2 | 15.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 7.4 mm
Absolute pressure in stack (hPa) : 1011.73 hPa

**STACK ANALYSIS**

**SAMPLING OF FINE PARTICULATE (PM10)**

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 4
Sample Nozzle No.: fine6
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 2.32 x $10^{-5}m^2$
Thimble No: T323
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 495.1178 Meter finish: 495.1178
Time start: 9:41 Time finish: 9:42

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 495.9417 Meter finish: 495.9417
Time start: 11:05 Time finish: 11:06

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: 495.1199
Time start: 10:03
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:15 | 61 | 13.5 | 25.0 | 16.0 | | Yes |
| 1/2 | 0:05:15 | 204 | 13.5 | 26.0 | 16.0 | | Yes |
| 1/3 | 0:05:00 | 413 | 13.5 | 29.0 | 17.0 | | Yes |
| 1/4 | 0:05:00 | 982 | 13.5 | 31.0 | 18.0 | | Yes |
| 1/5 | 0:05:15 | 1191 | 13.5 | 32.0 | 18.0 | | Yes |
| 1/6 | 0:05:15 | 1334 | 13.5 | 33.0 | 19.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:05:00 | 61 | 13.5 | 34.0 | 20.0 | | Yes |
| 2/2 | 0:04:45 | 204 | 13.5 | 35.0 | 20.0 | | Yes |
| 2/3 | 0:04:45 | 413 | 13.5 | 36.0 | 21.0 | | Yes |
| 2/4 | 0:05:00 | 982 | 13.5 | 36.0 | 21.0 | | Yes |
| 2/5 | 0:05:00 | 1191 | 13.5 | 37.0 | 22.0 | | Yes |
| 2/6 | 0:05:00 | 1334 | 13.5 | 37.0 | 22.0 | | Yes |
| Averages | | | | 32.6 | 19.2 | no result | |

Meter Finish: 495.9395
Time Finish: 11:04
Total Condensate collected: 7 ml
Silica gel No(s) used: GO13

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS

## SAMPLING OF TOTAL PARTICULATE

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 4
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 $\times 10^{-5} m^2$
Thimble No: T324
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 89.0308 Meter finish: 89.0308
Time start: 9:42 Time finish: 9:43

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 89.7660 Meter finish: 89.7660
Time start: 11:06 Time finish: 11:07

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: 89.0408 Time start: 10:03
Meter correction factor (GMf) : 1.0038

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 61 | 10.3 | 22.0 | 16.0 | | Yes |
| 1/2 | 0:10:00 | 204 | 10.9 | 23.0 | 16.0 | | Yes |
| 1/3 | 0:15:00 | 413 | 11.8 | 25.0 | 17.0 | | Yes |
| 1/4 | 0:20:00 | 982 | 13.0 | 26.0 | 17.0 | | Yes |
| 1/5 | 0:25:00 | 1191 | 11.9 | 27.0 | 18.0 | | Yes |
| 1/6 | 0:30:00 | 1334 | 11.9 | 27.0 | 18.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 61 | 13.1 | 28.0 | 18.0 | | Yes |
| 2/2 | 0:40:00 | 204 | 13.2 | 29.0 | 19.0 | | Yes |
| 2/3 | 0:45:00 | 413 | 11.3 | 29.0 | 19.0 | | Yes |
| 2/4 | 0:50:00 | 982 | 11.6 | 30.0 | 20.0 | | Yes |
| 2/5 | 0:55:00 | 1191 | 12.2 | 30.0 | 21.0 | | Yes |
| 2/6 | 1:00:00 | 1334 | 11.9 | 30.0 | 21.0 | | Yes |
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| Averages | | | | 27.2 | 18.3 | no result | |

Meter Finish: 89.7600 Time Finish: 11:04
Total Condensate collected: 2 ml Silica gel No(s) used: p26

AECOM

**STACK ANALYSIS**
**SAMPLING OF TOTAL FLUORIDE**

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 4
Sample Nozzle No.: s2
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.16 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 309.7591 Meter finish: 309.7591
Time start: 9:43 Time finish: 9:44

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 310.3906 Meter finish: 310.3906
Time start: 11:07 Time finish: 11:08

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: 309.7610 Time start: 10:03
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 61 | 8.9 | 21.0 | 16.0 | | Yes |
| 1/2 | 0:10:00 | 204 | 9.4 | 21.0 | 16.0 | | Yes |
| 1/3 | 0:15:00 | 413 | 10.1 | 24.0 | 17.0 | | Yes |
| 1/4 | 0:20:00 | 982 | 11.2 | 26.0 | 18.0 | | Yes |
| 1/5 | 0:25:00 | 1191 | 10.3 | 29.0 | 19.0 | | Yes |
| 1/6 | 0:30:00 | 1334 | 10.2 | 31.0 | 20.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 61 | 11.3 | 31.0 | 21.0 | | Yes |
| 2/2 | 0:40:00 | 204 | 11.4 | 31.0 | 21.0 | | Yes |
| 2/3 | 0:45:00 | 413 | 9.8 | 31.0 | 22.0 | | Yes |
| 2/4 | 0:50:00 | 982 | 10.0 | 31.0 | 22.0 | | Yes |
| 2/5 | 0:55:00 | 1191 | 10.5 | 31.0 | 22.0 | | Yes |
| 2/6 | 1:00:00 | 1334 | 10.3 | 31.0 | 23.0 | | Yes |
| Averages | | | | 28.2 | 19.8 | no result | |

Meter Finish: 310.3854 Time Finish: 11:04
Total Condensate collected: 7 ml Silica gel No(s) used: M23

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

AECOM

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 11:10 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | $kg/m^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 31 | 0.146 | 44.0 | 317.2 | 13.7 |
| 1/2 | 174 | 0.162 | 44.0 | 317.2 | 14.4 |
| 1/3 | 383 | 0.190 | 45.0 | 318.2 | 15.7 |
| 1/4 | 952 | 0.231 | 45.0 | 318.2 | 17.3 |
| 1/5 | 1161 | 0.195 | 45.0 | 318.2 | 15.9 |
| 1/6 | 1304 | 0.192 | 45.0 | 318.2 | 15.8 |
| | | | | | |
| 2/1 | 31 | 0.234 | 44.0 | 317.2 | 17.4 |
| 2/2 | 174 | 0.238 | 44.0 | 317.2 | 17.5 |
| 2/3 | 383 | 0.176 | 44.0 | 317.2 | 15.0 |
| 2/4 | 952 | 0.181 | 45.0 | 318.2 | 15.3 |
| 2/5 | 1161 | 0.205 | 45.0 | 318.2 | 16.3 |
| 2/6 | 1304 | 0.193 | 45.0 | 318.2 | 15.8 |
| Average | | | 44.6 | 317.8 | 15.8 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | 7 | mm |
| Absolute pressure in stack (hPa) : | 1011.69 | hPa |

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## STACK ANALYSIS - PM10 CALCULATIONS

| | | | |
|---|---|---|---|
| Date: | 12-Jun-15 | Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Stack 4 |

### 1. Gas Analysis

| | % | | |
|---|---|---|---|
| %$CO_2$ | 0.0 | | |
| %$O_2$ | 20.9 | | |
| %$N_2$+%CO | 79.1 | | |
| Fraction Moisture Content, Bws | 0.02 | $M_s$= | 0.98 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.84 |
| Mol. Wt. of Stack Gas (wet) | 28.61 |

### 3. Absolute Stack Pressure

| | Pascals | in. Hg |
|---|---|---|
| Barometric Pressure (Pbar) | 101100 | 29.85 |
| Stack Static Pressure (Pg) | 101080 | 29.84 |
| Absolute Stack Pressure | | 29.84 |

### 4. Viscosity of Stack Gas

| | °C | °F |
|---|---|---|
| Average Stack Temp. | 44.6 | 112.3 |
| Average Meter Temperature: | 25.9 | |
| Stack Gas Viscosity | | 190.9 |

### 5. Cyclone Flow Rate

| | $ft^3$/min | $m^3$/min | L/min | L/s |
|---|---|---|---|---|
| Cyclone Flow Rate | 0.48 | 0.0170 | 17.00 | 0.28 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.125 | 94.45 | 31.09 | 0.765 | 1.225 | 72.25 | 23.70 | 115.65 | 37.94 |
| 1 | 0.133 | 82.59 | 27.18 | 0.757 | 1.230 | 62.50 | 20.51 | 101.57 | 33.32 |
| 2 | 0.147 | 68.22 | 22.45 | 0.742 | 1.240 | 50.59 | 16.60 | 84.56 | 27.74 |
| 3 | 0.163 | 55.11 | 18.14 | 0.718 | 1.254 | 39.56 | 12.98 | 69.10 | 22.67 |
| 4 | 0.176 | 47.29 | 15.57 | 0.694 | 1.267 | 32.83 | 10.77 | 59.93 | 19.66 |
| 5 | 0.194 | 38.89 | 12.80 | 0.652 | 1.289 | 25.35 | 8.32 | 50.13 | 16.45 |
| 6 | 0.214 | 32.19 | 10.60 | 0.590 | 1.316 | 18.98 | 6.23 | 42.37 | 13.90 |
| 7 | 0.229 | 28.12 | 9.25 | 0.521 | 1.340 | 14.65 | 4.81 | 37.68 | 12.36 |
| 8 | 0.260 | 21.72 | 7.15 | #NUM! | 1.399 | 10.86 | 3.56 | 30.40 | 9.97 |
| 9 | 0.294 | 16.96 | 5.58 | #NUM! | 1.476 | 8.48 | 2.78 | 25.05 | 8.22 |
| 10 | 0.339 | 12.83 | 4.22 | #NUM! | 1.594 | 6.42 | 2.11 | 19.25 | 6.32 |
| 11 | 0.390 | 9.68 | 3.19 | #NUM! | 1.755 | 4.84 | 1.59 | 14.53 | 4.77 |

| Selected Nozzle | Nozzle Diameter (inches) | Nozzle Diameter (m) | Nozzle Area ($m^2$) | Sample Rate (L/min) |
|---|---|---|---|---|
| 6 | 0.214 | 0.005 | 0.000023 | 13.5 |

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## STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 12-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 4

**7.Sampling Time** Total Run Time 60 Number of points 12

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 147.15 | 0.59 | 0.77 | 4.4 |
| 155.98 | 0.63 | 0.79 | 4.5 |
| 191.30 | 0.77 | 0.88 | 5.0 |
| 219.74 | 0.88 | 0.94 | 5.3 |
| 196.20 | 0.79 | 0.89 | 5.1 |
| 196.20 | 0.79 | 0.89 | 5.1 |
| | | | |
| 219.74 | 0.88 | 0.94 | 5.3 |
| 234.46 | 0.94 | 0.97 | 5.5 |
| 178.54 | 0.72 | 0.85 | 4.8 |
| 182.47 | 0.73 | 0.86 | 4.9 |
| 197.18 | 0.79 | 0.89 | 5.1 |
| 197.18 | 0.79 | 0.89 | 5.1 |
| | Average | 0.88 | 60.00 |
| | Square | 0.77 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 5.3 | 0 | 5 | 15 |
| 10.5 | 0 | 10 | 30 |
| 15.5 | 0 | 15 | 30 |
| 20.5 | 0 | 20 | 30 |
| 25.8 | 0 | 25 | 45 |
| 31.0 | 0 | 31 | 0 |
| | | | |
| 36.0 | 0 | 36 | 0 |
| 40.8 | 0 | 40 | 45 |
| 45.5 | 0 | 45 | 30 |
| 50.5 | 0 | 50 | 30 |
| 55.5 | 0 | 55 | 30 |
| 60.5 | 1 | 0 | 30 |

**Aerodynamic Cut Size ($u_{cvc}$)**
192.7

**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_e$)**
0.0150

**Actual $D_{50}$**
9.5

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8279 $m^3$
Average gas meter temp. ($T_{M,2}$): 25.9 °C
299.1 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7568 $m^3$

(B) PM10 concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: T323
Blank weight: g
PM10 Weight 0.0005 g
Final PM10 Weight (Mp1): 0.00050 g
PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.00066 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.66 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00066 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.66 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.092 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 92 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: GO13
$V_v$ = 6 g (from laboratory report)
$V_w$ = 7 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0093
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0080

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

$B_{ws}$ = 2.24 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.025 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 14.75 m/s

(ii) Average of post-sampling velocities: 15.76 m/s

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

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

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

Qstack = Vs x A = 23.31 m$^3$/s (stack conditions)

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

Qstd = 18.3 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.012 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 12 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.012 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 12 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 1.7 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1700 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7219 $m^3$
Average gas meter temp. ($T_{M,2}$): 22.8 °C
296.0 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.6668 $m^3$

(B) Total Particulate concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: T324
Blank weight: g
Total Particulate Weight 0.0014 g
Final Total Particulate Weight (Mp1): 0.00140 g
Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0021 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 2.1 $mg/m^3$ (0°C, dry gas. 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0021 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 2.1 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

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

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

(C) Moisture content
Silica Gel Number: p26
$V_v$ = 7.9 g (from laboratory report)
$V_w$ = 2 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0027
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0105

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

$B_{ws}$ = 1.94 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

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

(ii) Re-calculated gas density based on moisture content in (c):

1.28 kg/m$^3$ (0$^\circ$C, wet, 1 atm pressure)
1.29 kg/m$^3$ (0$^\circ$C, dry, 1 atm pressure)

(iii) Gas density at stack conditions =

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

= 1.100 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

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

(ii) Average of post-sampling velocities: 15.84 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

15.82 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)

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

Qstack = Vs x A = 24.18 m$^3$/s (stack conditions)

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

Qstd = 20.4 m$^3$/s (0$^\circ$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.043 | g/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | = | 43 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.043 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 43 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 6 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 6000 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 12-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 4

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.6283 $m^3$
Average gas meter temp. ($T_{M,2}$): 24.0 °C
297.2 K
Average barometric pressure ($P_{BARO}$) 1014 hPa
Average pressure at meter ($P_{M,2}$) 1014.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.5780 $m^3$

(B) Total Fluoride concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: 0
Blank weight: g
Total Fluoride Weight 0.00023 g
Final Total Fluoride Weight (Mp1): 0.00023 g
Total Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.0004 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.40 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0004 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.40 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.9 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.056 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 56 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: M23
$V_v$ = 9.4 g (from laboratory report)
$V_w$ = 7 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0093
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0125

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

$B_{ws}$ = 3.65 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

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

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

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

= 1.108 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

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

(ii) Average of post-sampling velocities: 15.84 m/s

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

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

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

Qstack = Vs x A = 24.18 m$^3$/s (stack conditions)

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

Qstd = 20.0 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.008 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 8 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.008 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 8 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 1.1 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1100 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

**EMISSION MONITORING RESULTS, STACK 4**
**WESTON ALUMINIUM**
12-Jun-15
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
TOTAL FLUORIDE

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1395 mm | | |
| Stack gas temperature (average) | 52.0 °C | | 325.2 K |
| Stack pressure (average) | 1012 hPa | | |
| Stack gas velocity (average, stack conditions) | 16 m/s | | |
| Stack gas flowrate (stack conditions) | 24 $m^3/s$ | | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 20 $m^3/s$ | | |
| **Fine Particulate (PM10) Testing** | | | |
| Test Period | 10:03 | - | 11:04 |
| Fine Particulate (PM10) Mass | 0.5 mg | | |
| Gas Volume Sampled | 0.757 $m^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.66 $mg/m^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 12 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 10:03 | - | 11:04 |
| Total Particulate Mass | 1.4 mg | | |
| Gas Volume Sampled | 0.667 $m^3$ | | |
| Total Particulate Emission*1 | 2.1 $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 | 43 mg/s | | |
| Regulatory Limit | 24 $mg/m^3$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 10:03 | - | 11:04 |
| Total Fluoride Mass | 0.23 mg | | |
| Gas Volume Sampled | 0.578 $m^3$ | | |
| Total Fluoride Emission*1 | 0.40 $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 8 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 2.8 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

**Weston**

AECOM's Project Number: 60341673

Emission Source: Stack 5

Date Sampled: 14-Aug-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Fine Particulate (PM10) | NSW EPA OM - 5 |
| Total Particulate | NSW EPA TM - 15 |

Observations made during testing period:

Sampling Performed By:

James Lang

Dylan Turnbull

AECOM

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - PRE-SAMPLING

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate

### Measurement/Observations

Stack Internal Dimensions:

Diameter 1490 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.74 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Junction
Downstream (m) = 10
No. Diameters = 6.7
Type of Down Stream Disturbance: Stack exit

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

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 | 66 | 36 | 66 | 36 |
| 2 | 218 | 188 | 218 | 188 |
| 3 | 441 | 411 | 441 | 411 |
| 4 | 1049 | 1019 | 1049 | 1019 |
| 5 | 1272 | 1242 | 1272 | 1242 |
| 6 | 1424 | 1394 | 1424 | 1394 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..................................

Checked: ..................................

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate

Sampling time start: 10:00
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 10:00 | 20 | 20.0 | 0.0 |
| 2 | 10:01 | 20 | 20.0 | 0.0 |
| 3 | 10:02 | 20 | 20.0 | 0.0 |
| 4 | 10:03 | 20 | 20.0 | 0.0 |
| 5 | 10:04 | 20 | 20.0 | 0.0 |
| 6 | 10:05 | 20 | 20.0 | 0.0 |
| 7 | 10:06 | 20 | 20.0 | 0.0 |
| 8 | 10:07 | 20 | 20.0 | 0.0 |
| | Averages: | 20.0 ppm | 20.0 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0020 %,(dry) | $N_2$: | 80.0 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.0 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0020 %,(wet) | $N_2$: | 78.8 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 19.7 %,(wet) |
| $H_2O$: | 1.50 %(=M2) | | |

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

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate

| Sampling time start: | 11:45 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 11:45 | 3 | 20.3 | 0.0 |
| 2 | 11:46 | 3 | 20.3 | 0.0 |
| 3 | 11:47 | 3 | 20.3 | 0.0 |
| 4 | 11:48 | 3 | 20.3 | 0.0 |
| 5 | 11:49 | 3 | 20.3 | 0.0 |
| 6 | 11:50 | 3 | 20.3 | 0.0 |
| 7 | 11:51 | 3 | 20.3 | 0.0 |
| 8 | 11:52 | 3 | 20.3 | 0.0 |
| | Averages: | 3.0 ppm | 20.3 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.09 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0003 %,(dry) | $N_2$: | 79.7 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.3 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0003 %,(wet) | $N_2$: | 78.8 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 20.1 %,(wet) |
| $H_2O$: | 1.09 %(=M2) | | |

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

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate

| | | | | |
|---|---|---|---|---|
| Time : | 10:00 | Barometric Pressure : | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.214 | 48.0 | 321.2 | 16.7 |
| 1/2 | 188 | 0.277 | 48.0 | 321.2 | 19.0 |
| 1/3 | 411 | 0.256 | 49.0 | 322.2 | 18.3 |
| 1/4 | 1019 | 0.241 | 49.0 | 322.2 | 17.7 |
| 1/5 | 1242 | 0.020 | 49.0 | 322.2 | 5.1 |
| 1/6 | 1394 | 0.232 | 49.0 | 322.2 | 17.4 |
| | | | | | |
| 2/1 | 36 | 0.304 | 49.0 | 322.2 | 19.9 |
| 2/2 | 188 | 0.333 | 49.0 | 322.2 | 20.8 |
| 2/3 | 411 | 0.288 | 49.0 | 322.2 | 19.4 |
| 2/4 | 1019 | 0.261 | 50.0 | 323.2 | 18.5 |
| 2/5 | 1242 | 0.222 | 50.0 | 323.2 | 17.0 |
| 2/6 | 1394 | 0.222 | 50.0 | 323.2 | 17.0 |
| Average | | | 49.1 | 322.3 | 17.2 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -10.4 mm
Absolute pressure in stack (hPa) : 1009.98 hPa

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS
## SAMPLING OF FINE PARTICULATE (PM10)

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 5
Sample Nozzle No.: fine3
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.31 x $10^{-5}m^2$
Thimble No: T13
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 326.0321 Meter finish: 326.0321
Time start: 10:25 Time finish: 10:26

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 326.7981 Meter finish: 326.7981
Time start: 10:24 Time finish: 10:25

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1011 hPa (start); 1011 hPa (finish)
Meter start: 326.0341
Time start: 10:31
Meter correction factor (GMf) : 1.0055

| 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 | 0:04:45 | 66 | 13.3 | 16.0 | 11.0 | | Yes |
| 1/2 | 0:05:30 | 218 | 13.3 | 19.0 | 12.0 | | Yes |
| 1/3 | 0:05:15 | 441 | 13.3 | 24.0 | 13.0 | | Yes |
| 1/4 | 0:05:15 | 1049 | 13.3 | 28.0 | 14.0 | | Yes |
| 1/5 | 0:01:30 | 1272 | 13.3 | 29.0 | 15.0 | | Yes |
| 1/6 | 0:05:00 | 1424 | 13.3 | 29.0 | 15.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:05:45 | 66 | 13.3 | 30.0 | 16.0 | | Yes |
| 2/2 | 0:06:00 | 218 | 13.3 | 31.0 | 17.0 | | Yes |
| 2/3 | 0:05:45 | 441 | 13.3 | 32.0 | 17.0 | | Yes |
| 2/4 | 0:05:15 | 1049 | 13.3 | 32.0 | 18.0 | | Yes |
| 2/5 | 0:05:00 | 1272 | 13.3 | 33.0 | 18.0 | | Yes |
| 2/6 | 0:05:00 | 1424 | 13.3 | 33.0 | 19.0 | | Yes |
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| | | | | | | | |
| Averages | | | | 28.0 | 15.4 | no result | |

Meter Finish: 326.7966
Time Finish: 11:33
Total Condensate collected: 0 ml
Silica gel No(s) used: P29

# Emission Measurement Calculations Spreadsheet

**STACK ANALYSIS**

**SAMPLING OF TOTAL PARTICULATE**

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 5
Sample Nozzle No.: S9
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.39 x $10^{-5} m^2$
Thimble No: S03
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 219.7911 Meter finish: 219.7911
Time start: 10:27 Time finish: 10:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 220.5811 Meter finish: 220.5811
Time start: 10:27 Time finish: 10:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1011 hPa (start); 1011 hPa (finish)
Meter start: 219.7928 Time start: 10:31
Meter correction factor (GMf) : 0.9991

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 12.6 | 20.0 | 11.0 | | Yes |
| 1/2 | 0:10:00 | 218 | 14.3 | 22.0 | 12.0 | | Yes |
| 1/3 | 0:15:00 | 441 | 13.8 | 25.0 | 13.0 | | Yes |
| 1/4 | 0:20:00 | 1049 | 13.3 | 29.0 | 14.0 | | Yes |
| 1/5 | 0:25:00 | 1272 | 3.8 | 30.0 | 15.0 | | Yes |
| 1/6 | 0:30:00 | 1424 | 13.1 | 30.0 | 16.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 66 | 15.0 | 30.0 | 16.0 | | Yes |
| 2/2 | 0:40:00 | 218 | 15.7 | 30.0 | 17.0 | | Yes |
| 2/3 | 0:45:00 | 441 | 14.6 | 30.0 | 17.0 | | Yes |
| 2/4 | 0:50:00 | 1049 | 13.9 | 31.0 | 18.0 | | Yes |
| 2/5 | 0:55:00 | 1272 | 12.8 | 31.0 | 18.0 | | Yes |
| 2/6 | 1:00:00 | 1424 | 12.8 | 32.0 | 19.0 | | Yes |
| Averages | | | | 28.3 | 15.5 | no result | |

Meter Finish: 220.5802
Total Condensate collected: 0 ml
Time Finish: 11:33
Silica gel No(s) used: G012

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate

| | | | | | |
|---|---|---|---|---|---|
| Time : | 11:45 | Barometric Pressure : | | 1011 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | | (0 °C, Wet, 1 Atm) |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 36 | 0.232 | 35.0 | 308.2 | 17.0 |
| 1/2 | 188 | 0.270 | 35.0 | 308.2 | 18.3 |
| 1/3 | 411 | 0.243 | 36.0 | 309.2 | 17.4 |
| 1/4 | 1019 | 0.253 | 36.0 | 309.2 | 17.8 |
| 1/5 | 1242 | 0.253 | 36.0 | 309.2 | 17.8 |
| 1/6 | 1394 | 0.276 | 36.0 | 309.2 | 18.6 |
| | | | | | |
| 2/1 | 36 | 0.285 | 35.0 | 308.2 | 18.9 |
| 2/2 | 188 | 0.348 | 36.0 | 309.2 | 20.9 |
| 2/3 | 411 | 0.308 | 36.0 | 309.2 | 19.6 |
| 2/4 | 1019 | 0.265 | 37.0 | 310.2 | 18.2 |
| 2/5 | 1242 | 0.227 | 37.0 | 310.2 | 16.9 |
| 2/6 | 1394 | 0.225 | 37.0 | 310.2 | 16.8 |
| Average | | | 36.0 | 309.2 | 18.2 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -11.6 mm
Absolute pressure in stack (hPa) : 1009.86 hPa

## STACK ANALYSIS - PM10 CALCULATIONS

| | | | |
|---|---|---|---|
| Date: | 14-Aug-15 | Client: | Weston |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Stack 5 |

### 1. Gas Analysis

| | % | | |
|---|---|---|---|
| %$CO_2$ | 0.0 | | |
| %$O_2$ | 20.3 | | |
| %$N_2$+%CO | 80.0 | | |
| Fraction Moisture Content, Bws | 0.01 | $M_d$= | 0.99 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.80 |
| Mol. Wt. of Stack Gas (wet) | 28.64 |

### 3. Absolute Stack Pressure

| | Pascals | in. Hg |
|---|---|---|
| Barometric Pressure (Pbar) | 101100 | 29.85 |
| Stack Static Pressure (Pg) | 100986 | 29.81 |
| Absolute Stack Pressure | | 29.81 |

### 4. Viscosity of Stack Gas

| | °C | °F |
|---|---|---|
| Average Stack Temp. | 36.0 | 96.8 |
| Average Meter Temperature: | 21.7 | |
| Stack Gas Viscosity | | 187.4 |

### 5. Cyclone Flow Rate

| | $ft^3$/min | $m^3$/min | L/min | L/s |
|---|---|---|---|---|
| Cyclone Flow Rate | 0.47 | 0.0165 | 16.55 | 0.28 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.000 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| 1 | 0.133 | 80.40 | 26.46 | 0.756 | 1.230 | 60.82 | 19.95 | 98.90 | 32.45 |
| 2 | 0.152 | 62.01 | 20.41 | 0.734 | 1.244 | 45.54 | 14.94 | 77.14 | 25.31 |
| 3 | 0.161 | 55.23 | 18.18 | 0.721 | 1.252 | 39.82 | 13.06 | 69.16 | 22.69 |
| 4 | 0.185 | 41.65 | 13.71 | 0.673 | 1.278 | 28.05 | 9.20 | 53.24 | 17.47 |
| 5 | 0.198 | 36.66 | 12.07 | 0.642 | 1.294 | 23.53 | 7.72 | 47.44 | 15.56 |
| 6 | 0.225 | 28.24 | 9.30 | 0.537 | 1.335 | 15.16 | 4.97 | 37.71 | 12.37 |
| 7 | 0.237 | 25.49 | 8.39 | 0.464 | 1.356 | 12.75 | 4.18 | 34.57 | 11.34 |
| 8 | 0.262 | 20.89 | 6.88 | #NUM! | 1.404 | 10.45 | 3.43 | 29.34 | 9.62 |
| 9 | 0.303 | 15.62 | 5.14 | #NUM! | 1.499 | 7.81 | 2.56 | 23.42 | 7.68 |
| 10 | 0.341 | 12.35 | 4.06 | #NUM! | 1.603 | 6.17 | 2.03 | 18.52 | 6.08 |
| 11 | 0.390 | 9.41 | 3.10 | #NUM! | 1.759 | 4.70 | 1.54 | 14.11 | 4.63 |
| | Nozzle Diameter | Nozzle Diameter | Nozzle Area | Sample Rate | | | | | |
| Selected Nozzle | (inches) | (m) | ($m^2$) | (L/min) | | | | | |
| 3 | 0.161 | 0.004 | 0.000013 | 13.5 | | | | | |

## STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 14-Aug-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

**7.Sampling Time** Total Run Time 60 Number of points 12

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 231.52 | 0.93 | 0.96 | 4.7 |
| 269.78 | 1.08 | 1.04 | 5.1 |
| 243.29 | 0.98 | 0.99 | 4.8 |
| 253.10 | 1.02 | 1.01 | 4.9 |
| 253.10 | 1.02 | 1.01 | 4.9 |
| 275.66 | 1.11 | 1.05 | 5.1 |
| | | | |
| 285.47 | 1.15 | 1.07 | 5.2 |
| 348.26 | 1.40 | 1.18 | 5.7 |
| 308.03 | 1.24 | 1.11 | 5.4 |
| 264.87 | 1.06 | 1.03 | 5.0 |
| 226.61 | 0.91 | 0.95 | 4.6 |
| 224.65 | 0.90 | 0.95 | 4.6 |
| | Average | 1.03 | 60.00 |
| | Square | 1.06 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 4.8 | 0 | 4 | 45 |
| 10.3 | 0 | 10 | 15 |
| 15.5 | 0 | 15 | 30 |
| 20.8 | 0 | 20 | 45 |
| 22.3 | 0 | 22 | 15 |
| 27.3 | 0 | 27 | 15 |
| | | | |
| 33.0 | 0 | 33 | 0 |
| 39.0 | 0 | 39 | 0 |
| 44.8 | 0 | 44 | 45 |
| 50.0 | 0 | 50 | 0 |
| 55.0 | 0 | 55 | 0 |
| 60.0 | 1 | 0 | 0 |

**Aerodynamic Cut Size ($u_{cyc}$)**
187.8
**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_a$)**
0.0129
**Actual $D_{50}$**
10.2

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 14-Aug-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

|  |  |  |  |
|---|---|---|---|
| Metered volume ($MV_3$): | 0.7667 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1011 hPa |
| Average gas meter temp. ($T_{M,2}$): | 21.7 °C |  |  |
|  | 294.9 K | Average pressure at meter ($P_{M,2}$) | 1011.00 hPa |
| Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): | 0.7087 $m^3$ |  |  |

(B) PM10 concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: T13

Blank weight: g

PM10 Weight 0.0017 g

Final PM10 Weight (Mp1): 0.00170 g

PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.0024 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 2.4 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0024 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 2.4 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 20.2 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.04 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 40 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: P29

$V_v$ = 6.1 g (from laboratory report)

$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0081

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

$B_{ws}$ = 1.14 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.104 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 17.23 m/s

(ii) Average of post-sampling velocities: 18.18 m/s

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

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

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

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

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.063 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 63 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.063 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 63 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 1 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1000 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 14-Aug-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7867 $m^3$
Average gas meter temp. ($T_{M,2}$): 21.9 $^oC$
295.1 K
Average barometric pressure ($P_{BARO}$) 1011 hPa
Average pressure at meter ($P_{M,2}$) 1011.00 hPa

Sample gas volume ($MV_4$); ($0^oC$, dry gas, 1 atm pressure): 0.7267 $m^3$

(B) Total Particulate concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: S03
Blank weight: g
Total Particulate Weight 0.0059 g
Final Total Particulate Weight (Mp1): 0.00590 g
Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0081 $g/m^3$ ($0^oC$, dry gas, 1atm pressure)

;and $C_2$ = 8.1 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0081 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 8.1 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.2 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.13 $g/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$ )

;and $C_{b1}$ = 130 $mg/m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$ )

(C) Moisture content

Silica Gel Number: G012
$V_v$ = 5.7 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0076

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

$B_{ws}$ = 1.04 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.28 kg/m$^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.28 kg/m$^3$ (0°C, wet, 1 atm pressure)<br>1.29 kg/m$^3$ (0°C, dry, 1 atm pressure) |

(iii) Gas density at stack conditions =

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

= 1.104 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 17.23 m/s |
| (ii) Average of post-sampling velocities: | 18.18 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 17.71 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 30.88 m$^3$/s (stack conditions)

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

Qstd = 26.4 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.21 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 210 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.21 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | = | 210 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$) |
| | $C_{1a}$ x Qstd = | 3.5 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$) |
| | = | 3500 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$) |

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 5**
**WESTON**
14-Aug-15
FINE PARTICULATE (PM10)
TOTAL PARTICULATE

| | | |
|---|---|---|
| **Sampling Conditions:** | | |
| Stack internal diameter at test location | 1490 mm | |
| Stack gas temperature (average) | 42.5 °C | 315.7 K |
| Stack pressure (average) | 1010 hPa | |
| Stack gas velocity (average, stack conditions) | 18 m/s | |
| Stack gas flowrate (stack conditions) | 31 $m^3/s$ | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 26 $m^3/s$ | |
| **Fine Particulate (PM10) Testing** | | |
| Test Period | 10:31 - | 11:33 |
| Fine Particulate (PM10) Mass | 1.7 mg | |
| Gas Volume Sampled | 0.709 $m^3$ | |
| Fine Particulate (PM10) Emission*1 | 2.4 $mg/m^3$ | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 63 mg/s | |
| Regulatory Limit | NA $mg/m^3$ | |
| **Total Particulate Testing** | | |
| Test Period | 10:31 - | 11:33 |
| Total Particulate Mass | 5.9 mg | |
| Gas Volume Sampled | 0.727 $m^3$ | |
| Total Particulate Emission*1 | 8.1 $mg/m^3$ | |
| Total Particulate Mass Emission Rate*2 | 210 mg/s | |
| Regulatory Limit | 10 $mg/m^3$ | |
| **Moisture Content (%)** | 1.0 | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | |
| **Dry Molecular Weight** | 28.8 g/g-mole | |

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

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

AECOM

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 5

Date Sampled: 17-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Total Fluoride | NSW EPA TM - 9 |
| Hydrogen Chloride | NSW EPA TM - 7 & 8 |
| Chlorine | NSW EPA TM - 7 & 8 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Total Fluoride
Test 2: Hydrogen Chloride
Test 3: Chlorine

**Measurement/Observations**

Stack Internal Dimensions:

Diameter 1490 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.74 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Junction
Downstream (m) = 10
No. Diameters = 6.7
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
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 | 66 | 36 |  |  |
| 2 | 218 | 188 |  |  |
| 3 | 441 | 411 |  |  |
| 4 | 1049 | 1019 |  |  |
| 5 | 1272 | 1242 |  |  |
| 6 | 1424 | 1394 |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| 11 |  |  |  |  |
| 12 |  |  |  |  |
| 13 |  |  |  |  |
| 14 |  |  |  |  |
| 15 |  |  |  |  |
| 16 |  |  |  |  |
| 17 |  |  |  |  |
| 18 |  |  |  |  |
| 19 |  |  |  |  |
| 20 |  |  |  |  |

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

General Comments:

Signed: ..............................

Checked: ..............................

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Total Fluoride
Test 2: Hydrogen Chloride
Test 3: Chlorine

| Sampling time start: | 8:45 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 8:45 | 30 | 20.0 | 0.0 |
| 2 | 8:46 | 30 | 20.0 | 0.0 |
| 3 | 8:47 | 30 | 20.0 | 0.0 |
| 4 | 8:48 | 30 | 20.0 | 0.0 |
| 5 | 8:49 | 30 | 20.0 | 0.0 |
| 6 | 8:50 | 30 | 20.0 | 0.0 |
| 7 | 8:51 | 30 | 20.0 | 0.0 |
| 8 | 8:52 | 30 | 20.0 | 0.0 |
| | Averages: | 30.0 ppm | 20.0 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0030 %,(dry) | $N_2$: | 80.0 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.0 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0030 %,(wet) | $N_2$: | 78.8 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 19.7 %,(wet) |
| $H_2O$: | 1.50 %(=M2) | | |
| Therefore, stack gas density (GD) = | 1.28 kg/m$^3$ | (0°C, wet, 1 atm pressure) | |
| Therefore, stack gas density (GD) = | 1.29 kg/m$^3$ | (0°C, dry, 1 atm pressure) | |

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Total Fluoride
Test 2: Hydrogen Chloride
Test 3: Chlorine

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 12:15 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 12:15 | 0 | 20.9 | 0.0 |
| 2 | 12:16 | 0 | 20.9 | 0.0 |
| 3 | 12:17 | 0 | 20.9 | 0.0 |
| 4 | 12:18 | 0 | 20.9 | 0.0 |
| 5 | 12:19 | 0 | 20.9 | 0.0 |
| 6 | 12:20 | 0 | 20.9 | 0.0 |
| 7 | 12:21 | 0 | 20.9 | 0.0 |
| 8 | 12:22 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.97
Moisture percentage (M2): 2.97 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0000 %,(dry) | $N_2$: | 79.1 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0000 %,(wet) | $N_2$: | 76.7 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 20.3 %,(wet) |
| $H_2O$: | 2.97 %(=M2) | | |
| Therefore, stack gas density (GD) = | 1.27 kg/m$^3$ | (0°C, wet, 1 atm pressure) | |
| Therefore, stack gas density (GD) = | 1.29 kg/m$^3$ | (0°C, dry, 1 atm pressure) | |

AECOM

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Total Fluoride
Test 2:Hydrogen Chloride
Test 3:Chlorine

| | | | | |
|---|---|---|---|---|
| Time : | 9:10 | Barometric Pressure : | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | $kg/m^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.251 | 47.0 | 320.2 | 18.0 |
| 1/2 | 188 | 0.266 | 47.0 | 320.2 | 18.5 |
| 1/3 | 411 | 0.242 | 47.0 | 320.2 | 17.7 |
| 1/4 | 1019 | 0.169 | 47.0 | 320.2 | 14.7 |
| 1/5 | 1242 | 0.200 | 47.0 | 320.2 | 16.1 |
| 1/6 | 1394 | 0.186 | 47.0 | 320.2 | 15.5 |
| | | | | | |
| 2/1 | 36 | 0.206 | 47.0 | 320.2 | 16.3 |
| 2/2 | 188 | 0.204 | 47.0 | 320.2 | 16.2 |
| 2/3 | 411 | 0.200 | 47.0 | 320.2 | 16.1 |
| 2/4 | 1019 | 0.213 | 47.0 | 320.2 | 16.6 |
| 2/5 | 1242 | 0.229 | 47.0 | 320.2 | 17.2 |
| 2/6 | 1394 | 0.213 | 47.0 | 320.2 | 16.6 |
| Average | | | 47.0 | 320.2 | 16.6 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 15.7 mm
Absolute pressure in stack (hPa) : 1016.54 hPa

AECOM

**STACK ANALYSIS**
**SAMPLING OF TOTAL FLUORIDE**

| | | | | |
|---|---|---|---|---|
| Date: 17-Jun-15 | | | | |
| Client: Weston Aluminium | | | | |
| AECOM's Project No: 60341673 | | | | |
| Stack Description No.: | Stack 5 | | | |
| Sample Nozzle No.: | s9 | Sample Nozzle Area (An): | 1.35 | x $10^{-5}m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | NA | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

**Leak Check (Pre-Sampling)**
Meter start: 90.5046 Meter finish: 90.5046
Time start: 11:14 Time finish: 11:15

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 91.2205 Meter finish: 91.2205
Time start: 12:20 Time finish: 12:21

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 90.5053 Time start: 11:19
Meter correction factor (GMf) : 1.0038

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 13.3 | 32.0 | 20.0 | | Yes |
| 1/2 | 0:10:00 | 218 | 13.7 | 34.0 | 20.0 | | Yes |
| 1/3 | 0:15:00 | 441 | 13.1 | 35.0 | 20.0 | | Yes |
| 1/4 | 0:20:00 | 1049 | 10.9 | 35.0 | 20.0 | | Yes |
| 1/5 | 0:25:00 | 1272 | 11.9 | 35.0 | 21.0 | | Yes |
| 1/6 | 0:30:00 | 1424 | 11.5 | 36.0 | 21.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 66 | 12.1 | 36.0 | 22.0 | | Yes |
| 2/2 | 0:40:00 | 218 | 12.0 | 37.0 | 22.0 | | Yes |
| 2/3 | 0:45:00 | 441 | 11.9 | 37.0 | 22.0 | | Yes |
| 2/4 | 0:50:00 | 1049 | 12.3 | 37.0 | 22.0 | | Yes |
| 2/5 | 0:55:00 | 1272 | 12.7 | 37.0 | 23.0 | | Yes |
| 2/6 | 1:00:00 | 1424 | 12.3 | 37.0 | 23.0 | | Yes |
| Averages | | | | 35.7 | 21.3 | no result | |

Meter Finish: 91.2185 Time Finish: 12:19
Total Condensate collected: 2 ml Silica gel No(s) used: F99

**STACK ANALYSIS**
**SAMPLING OF HYDROGEN CHLORIDE**

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 5

| | | | | |
|---|---|---|---|---|
| Sample Nozzle No.: | g65 | Sample Nozzle Area (An): | 1.57 | x $10^{-5}m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | NA | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

**Leak Check (Pre-Sampling)**
Meter start: 311.1580 Meter finish: 311.1580
Time start: 11:16 Time finish: 11:17

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 311.9500 Meter finish: 311.9500
Time start: 12:21 Time finish: 12:22

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 311.1590 Time start: 11:19
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 15.5 | 24.0 | 18.0 | | Yes |
| 1/2 | 0:10:00 | 218 | 16.0 | 26.0 | 18.0 | | Yes |
| 1/3 | 0:15:00 | 441 | 15.3 | 26.0 | 18.0 | | Yes |
| 1/4 | 0:20:00 | 1049 | 12.7 | 26.0 | 18.0 | | Yes |
| 1/5 | 0:25:00 | 1272 | 13.9 | 27.0 | 19.0 | | Yes |
| 1/6 | 0:30:00 | 1424 | 13.4 | 27.0 | 19.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 66 | 14.1 | 28.0 | 19.0 | | Yes |
| 2/2 | 0:40:00 | 218 | 14.0 | 28.0 | 19.0 | | Yes |
| 2/3 | 0:45:00 | 441 | 13.9 | 28.0 | 19.0 | | Yes |
| 2/4 | 0:50:00 | 1049 | 14.3 | 28.0 | 19.0 | | Yes |
| 2/5 | 0:55:00 | 1272 | 14.9 | 28.0 | 20.0 | | Yes |
| 2/6 | 1:00:00 | 1424 | 14.3 | 28.0 | 20.0 | | Yes |
| Averages | | | | 27.0 | 18.8 | no result | |

Meter Finish: 311.9468 Time Finish: 12:19
Total Condensate collected: 3 ml Silica gel No(s) used: I66

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

AECOM

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Total Fluoride
Test 2:Hydrogen Chloride
Test 3:Chlorine

| | | | | | |
|---|---|---|---|---|---|
| Time : | 12:22 | Barometric Pressure : | | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | | 1.27 | kg/m$^3$ |
| Pitot Tube Type : | S | | | | (0 $^o$C, Wet, 1 Atm) |
| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. $^o$C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
| 1/1 | 36 | 0.253 | 38.0 | 311.2 | 17.9 |
| 1/2 | 188 | 0.287 | 38.0 | 311.2 | 19.0 |
| 1/3 | 411 | 0.262 | 38.0 | 311.2 | 18.2 |
| 1/4 | 1019 | 0.218 | 38.0 | 311.2 | 16.6 |
| 1/5 | 1242 | 0.267 | 38.0 | 311.2 | 18.4 |
| 1/6 | 1394 | 0.247 | 38.0 | 311.2 | 17.7 |
| | | | | | |
| 2/1 | 36 | 0.245 | 38.0 | 311.2 | 17.6 |
| 2/2 | 188 | 0.281 | 38.0 | 311.2 | 18.8 |
| 2/3 | 411 | 0.274 | 38.0 | 311.2 | 18.6 |
| 2/4 | 1019 | 0.235 | 38.0 | 311.2 | 17.2 |
| 2/5 | 1242 | 0.263 | 38.0 | 311.2 | 18.2 |
| 2/6 | 1394 | 0.250 | 38.0 | 311.2 | 17.8 |
| Average | | | 38.0 | 311.2 | 18.0 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -16.2 mm
Absolute pressure in stack (hPa) : 1013.41 hPa

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 17-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7159 $m^3$

Average gas meter temp. ($T_{M,2}$): 28.5 $^oC$

301.7 K

Average barometric pressure ($P_{BARO}$) 1005 hPa

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

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.6430 $m^3$

(B) Total fluoride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Total fluoride Weight 0.00012 g

Final Total fluoride Weight (Mp1): 0.00012 g

Total fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00019 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.19 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00019 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.19 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0048 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

;and $C_{b1}$ = 4.8 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

(C) Moisture content

Silica Gel Number: F99

$V_v$ = 22 g (from laboratory report)

$V_w$ = 2 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0294

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

$B_{ws}$ = 4.75 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.136 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 16.63 m/s |
| (ii) Average of post-sampling velocities: | 18.00 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 17.31 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 30.18 m$^3$/s (stack conditions)

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

Qstd = 24.9 m$^3$/s (0$^\circ$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0047 | g/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | = | 4.7 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0047 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 4.7 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.12 | g/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 120 | mg/s (0$^\circ$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Hydrogen Chloride**

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

Date: 17-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7928 $m^3$
Average gas meter temp. ($T_{M,2}$): 22.9 °C
296.1 K
Average barometric pressure ($P_{BARO}$) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7255 $m^3$

(B) Hydrogen Chloride concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
Hydrogen Chloride Weight 0.000899 g
Final Hydrogen Chloride Weight (Mp1): 0.00090 g
Hydrogen Chloride Concentration (C1): $=M_{p1}/MV_4=$ 0.0012 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 1.2 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

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

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

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.031 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 31 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: I66
$V_v$ = 8.6 g (from laboratory report)
$V_w$ = 3 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0115

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

$B_{ws}$ = 2.09 %

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Hydrogen Chloride**

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

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

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

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

= 1.110 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.63 m/s

(ii) Average of post-sampling velocities: 18.00 m/s

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

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

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

Qstack = Vs x A = 30.18 m$^3$/s (stack conditions)

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

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

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.031 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 31 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.031 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 31 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.78 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 780 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Chlorine**

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

Date: 17-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7928 $m^3$
Average gas meter temp. ($T_{M,2}$): 22.9 °C
296.1 K
Average barometric pressure ($P_{BARO}$) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7255 $m^3$

(B) Chlorine concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
Chlorine Weight 0.000679 g
Final Chlorine Weight (Mp1): 0.00068 g
Chlorine Concentration (C1): $=M_{p1}/MV_4=$ 0.00094 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 0.94 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00094 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ 0.94 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.024 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

;and $C_{b1} =$ 24 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$ )

(C) Moisture content

Silica Gel Number: I66
$V_v =$ 8.6 g (from laboratory report)
$V_w =$ 3 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0115

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 2.09 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Chlorine**

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.28 kg/m$^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.28 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)<br>1.29 kg/m$^3$ (0$^o$C, dry, 1 atm pressure) |

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

= 1.110 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 16.63 m/s |
| (ii) Average of post-sampling velocities: | 18.00 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 17.31 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 30.18 m$^3$/s (stack conditions)

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

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

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.024 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 24 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.024 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 24 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.61 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 610 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 5**
**WESTON ALUMINIUM**
17-Jun-15
TOTAL FLUORIDE
HYDROGEN CHLORIDE
CHLORINE

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1490 mm | | |
| Stack gas temperature (average) | 42.5 °C | | 315.7 K |
| Stack pressure (average) | 1015 hPa | | |
| Stack gas velocity (average, stack conditions) | 17 m/s | | |
| Stack gas flowrate (stack conditions) | 30 $m^3/s$ | | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 25 $m^3/s$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 11:19 | - | 12:19 |
| Total Fluoride Mass | 0.12 mg | | |
| Gas Volume Sampled | 0.643 $m^3$ | | |
| Total Fluoride Emission*1 | 0.19 $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 4.7 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Hydrogen Chloride Testing** | | | |
| Test Period | 11:19 | - | 12:19 |
| Hydrogen Chloride Mass | 0.899 mg | | |
| Gas Volume Sampled | 0.726 $m^3$ | | |
| Hydrogen Chloride Emission*1 | 1.2 $mg/m^3$ | | |
| Hydrogen Chloride Mass Emission Rate*2 | 31 mg/s | | |
| Regulatory Limit | 10 $mg/m^3$ | | |
| **Chlorine Testing** | | | |
| Test Period | 11:19 | - | 12:19 |
| Chlorine Mass | 0.679 mg | | |
| Gas Volume Sampled | 0.726 $m^3$ | | |
| Chlorine Emission*1 | 0.94 $mg/m^3$ | | |
| Chlorine Mass Emission Rate*2 | 24 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 3.0 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

AECOM

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 5

Date Sampled: 17-Jun-15

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

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Hazardous Substances (Metals)
Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
Test 3: Sulfur Dioxide (SO2 as SO3)

Measurement/Observations

Stack Internal Dimensions:

Diameter 1490 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.74 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Junction
Downstream (m) = 10
No. Diameters = 6.7
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
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 | 66 | 36 | | |
| 2 | 218 | 188 | | |
| 3 | 441 | 411 | | |
| 4 | 1049 | 1019 | | |
| 5 | 1272 | 1242 | | |
| 6 | 1424 | 1394 | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Hazardous Substances (Metals)
Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
Test 3: Sulfur Dioxide (SO2 as SO3)

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 8:45 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 8:45 | 30 | 20.0 | 0.0 |
| 2 | 8:46 | 30 | 20.0 | 0.0 |
| 3 | 8:47 | 30 | 20.0 | 0.0 |
| 4 | 8:48 | 30 | 20.0 | 0.0 |
| 5 | 8:49 | 30 | 20.0 | 0.0 |
| 6 | 8:50 | 30 | 20.0 | 0.0 |
| 7 | 8:51 | 30 | 20.0 | 0.0 |
| 8 | 8:52 | 30 | 20.0 | 0.0 |
| | Averages: | 30.0 ppm | 20.0 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

| | |
|---|---|
| CO: 0.0030 %,(dry)<br>$CO_2$: 0.0 %,(dry)<br>Gas Compositions converted to wet basis: | $N_2$: 80.0 %,(dry)<br>$O_2$: 20.0 %,(dry) |
| CO: 0.0030 %,(wet)<br>$CO_2$: 0.0 %,(wet)<br>$H_2O$: 1.50 %(=M2) | $N_2$: 78.8 %,(wet)<br>$O_2$: 19.7 %,(wet) |
| Therefore, stack gas density (GD) = 1.28 kg/$m^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/$m^3$ | (0°C, dry, 1 atm pressure) |

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Hazardous Substances (Metals)
Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
Test 3: Sulfur Dioxide (SO2 as SO3)

| Sampling time start: | 15:30 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 15:30 | 0 | 20.9 | 0.0 |
| 2 | 15:31 | 0 | 20.9 | 0.0 |
| 3 | 15:32 | 0 | 20.9 | 0.0 |
| 4 | 15:33 | 0 | 20.9 | 0.0 |
| 5 | 15:34 | 0 | 20.9 | 0.0 |
| 6 | 15:35 | 0 | 20.9 | 0.0 |
| 7 | 15:36 | 0 | 20.9 | 0.0 |
| 8 | 15:37 | 0 | 20.9 | 0.0 |
| | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.33 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0000 %,(dry) | $N_2$: | 79.1 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0000 %,(wet) | $N_2$: | 78.1 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 20.6 %,(wet) |
| $H_2O$: | 1.33 %(=M2) | | |

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

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Hazardous Substances (Metals)
Test 2:Sulfuric Acid Mist (H2SO4 as SO3)
Test 3:Sulfur Dioxide (SO2 as SO3)

| | | | | |
|---|---|---|---|---|
| Time : | 9:10 | Barometric Pressure : | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.253 | 69.0 | 342.2 | 18.7 |
| 1/2 | 188 | 0.287 | 69.0 | 342.2 | 19.9 |
| 1/3 | 411 | 0.262 | 69.0 | 342.2 | 19.0 |
| 1/4 | 1019 | 0.218 | 69.0 | 342.2 | 17.3 |
| 1/5 | 1242 | 0.267 | 69.0 | 342.2 | 19.2 |
| 1/6 | 1394 | 0.247 | 68.0 | 341.2 | 18.4 |
| | | | | | |
| 2/1 | 36 | 0.206 | 68.0 | 341.2 | 16.8 |
| 2/2 | 188 | 0.204 | 68.0 | 341.2 | 16.7 |
| 2/3 | 411 | 0.200 | 69.0 | 342.2 | 16.6 |
| 2/4 | 1019 | 0.213 | 69.0 | 342.2 | 17.1 |
| 2/5 | 1242 | 0.229 | 69.0 | 342.2 | 17.7 |
| 2/6 | 1394 | 0.213 | 69.0 | 342.2 | 17.1 |
| Average | | | 68.8 | 342.0 | 17.9 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | 16.2 | mm |
| Absolute pressure in stack (hPa) : | 1016.59 | hPa |

AECOM

## STACK ANALYSIS
## SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 5

| | | | |
|---|---|---|---|
| Sample Nozzle No.: | G08 | Sample Nozzle Area (An): | 1.59 x $10^{-5}$m$^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | 0 |
| Page No: | 1 of 1 | Blank thimble No: | 0 |

| Leak Check (Pre-Sampling) | | | | Leak Check (Post Sampling) | | | |
|---|---|---|---|---|---|---|---|
| Meter start: | 91.2222 | Meter finish: | 91.2222 | Meter start: | 93.3998 | Meter finish: | 93.3998 |
| Time start: | 12:25 | Time finish: | 12:26 | Time start: | 14:45 | Time finish: | 14:46 |

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: 1005 hPa (start); 1005 hPa (finish)
Meter start: 91.2282 Time start: 12:30
Meter correction factor (GMf) : 1.0038

| 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 | 0:10:00 | 66 | 15.3 | 30.0 | 20.0 | | Yes |
| 1/2 | 0:20:00 | 218 | 16.2 | 31.0 | 20.0 | | Yes |
| 1/3 | 0:30:00 | 441 | 15.5 | 33.0 | 21.0 | | Yes |
| 1/4 | 0:40:00 | 1049 | 14.1 | 33.0 | 21.0 | | Yes |
| 1/5 | 0:50:00 | 1272 | 15.7 | 34.0 | 21.0 | | Yes |
| 1/6 | 1:00:00 | 1424 | 15.1 | 34.0 | 21.0 | | Yes |
| | | | | | | | |
| 2/1 | 1:10:00 | 66 | 13.8 | 35.0 | 22.0 | | Yes |
| 2/2 | 1:20:00 | 218 | 13.7 | 35.0 | 23.0 | | Yes |
| 2/3 | 1:30:00 | 441 | 13.6 | 36.0 | 23.0 | | Yes |
| 2/4 | 1:40:00 | 1049 | 14.0 | 36.0 | 23.0 | | Yes |
| 2/5 | 1:50:00 | 1272 | 14.4 | 36.0 | 23.0 | | Yes |
| 2/6 | 2:00:00 | 1424 | 14.0 | 36.0 | 23.0 | | Yes |
| Averages | | | | 34.1 | 21.8 | no result | |

Meter Finish: 93.3964 Time Finish: 14:42
Total Condensate collected: 3 ml Silica gel No(s) used: Z2

### STACK ANALYSIS
### SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 5
Sample Nozzle No.: s9
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.35 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No:

**Leak Check (Pre-Sampling)**
Meter start: 311.9504 Meter finish: 311.9504
Time start: 12:27 Time finish: 12:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 312.6854 Meter finish: 312.6854
Time start: 13:40 Time finish: 13:41

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1005 hPa (start); 1005 hPa (finish)
Meter start: 311.9584 Time start: 12:30
Meter correction factor (GMf) : 1.0063

| 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 | 0:10:00 | 66 | 13.0 | 24.0 | 19.0 | | Yes |
| 1/2 | 0:20:00 | 218 | 13.8 | 25.0 | 19.0 | | Yes |
| 1/3 | 0:30:00 | 441 | 13.2 | 26.0 | 19.0 | | Yes |
| 1/4 | 0:40:00 | 1049 | 12.0 | 26.0 | 19.0 | | Yes |
| 1/5 | 0:50:00 | 1272 | 13.3 | 26.0 | 19.0 | | Yes |
| 1/6 | 1:00:00 | 1424 | 12.8 | 26.0 | 20.0 | | Yes |
| | | | | | | | |
| 2/1 | 1:10:00 | 66 | 11.7 | 27.0 | 20.0 | | Yes |
| 2/2 | 1:20:00 | 218 | 11.6 | 27.0 | 21.0 | | Yes |
| 2/3 | 1:30:00 | 441 | 11.5 | 28.0 | 21.0 | | Yes |
| 2/4 | 1:40:00 | 1049 | 11.9 | 28.0 | 21.0 | | Yes |
| 2/5 | 1:50:00 | 1272 | 12.3 | 28.0 | 21.0 | | Yes |
| 2/6 | 2:00:00 | 1424 | 11.9 | 28.0 | 21.0 | | Yes |
| Averages | | | | 26.6 | 20.0 | no result | |

Meter Finish: 312.6820 Time Finish: 13:34
Total Condensate collected: 0 ml Silica gel No(s) used: G050

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

AECOM

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Hazardous Substances (Metals)
Test 2:Sulfuric Acid Mist (H2SO4 as SO3)
Test 3:Sulfur Dioxide (SO2 as SO3)

| | | | | |
|---|---|---|---|---|
| Time : | 14:15 | Barometric Pressure : | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.260 | 35.0 | 308.2 | 18.0 |
| 1/2 | 188 | 0.265 | 35.0 | 308.2 | 18.1 |
| 1/3 | 411 | 0.284 | 35.0 | 308.2 | 18.8 |
| 1/4 | 1019 | 0.201 | 35.0 | 308.2 | 15.8 |
| 1/5 | 1242 | 0.207 | 35.0 | 308.2 | 16.0 |
| 1/6 | 1394 | 0.200 | 35.0 | 308.2 | 15.8 |
| | | | | | |
| 2/1 | 36 | 0.270 | 35.0 | 308.2 | 18.3 |
| 2/2 | 188 | 0.255 | 35.0 | 308.2 | 17.8 |
| 2/3 | 411 | 0.278 | 35.0 | 308.2 | 18.6 |
| 2/4 | 1019 | 0.222 | 35.0 | 308.2 | 16.6 |
| 2/5 | 1242 | 0.199 | 35.0 | 308.2 | 15.7 |
| 2/6 | 1394 | 0.194 | 35.0 | 308.2 | 15.5 |
| Average | | | 35.0 | 308.2 | 17.1 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | -15.7 | mm |
| Absolute pressure in stack (hPa) : | 1013.46 | hPa |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 17-Jun-15
AECOM's Project No: 60341673
Client: Weston Aluminium
Stack/Duct Description: Stack 5

| | Particulate Metals Results | Gaseous Metals Results | Oixdisable Mercury Results | | |
|---|---|---|---|---|---|
| Metal | Front Half, Filter, Acetone Rinses and Acid Rinses (mg). **Containers 1, 2 and 3** | Back Half, Impingers + Acid Rinses (mg) **Container 4** | KO Impinger + Acid Rinses (mg) **(5A)** | $KMnO_4$/ $H_2SO_4$ + Rinses (mg) **(5B)** | Residue Rinse 8N HCl (mg) (If Required) **(5C)** |
| Antimony | 0.025 | <0.0001 | | | |
| Arsenic | 0.019 | <0.0001 | | | |
| Beryllium | 0.0003 | <0.0001 | | | |
| Cadmium | 0.0017 | 0.00035 | | | |
| Chromium | 0.57 | 0.0012 | | | |
| Cobalt | 0.055 | <0.0001 | | | |
| Copper | 0.32 | 0.00029 | | | |
| Lead | 0.1 | 0.00045 | | | |
| Magnesium | 4.9 | 0.00094 | | | |
| Manganese | 0.41 | 0.0052 | | | |
| Mercury | <0.002 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Nickel | 0.11 | 0.0099 | | | |
| Selenium | 0.0067 | 0.00055 | | | |
| Thallium | <0.0002 | <0.0001 | | | |
| Tin | 1.1 | 0.00045 | | | |
| Vanadium | 0.05 | <0.0001 | | | |
| Zinc | 17 | 0.0031 | | | |

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: 17-Jun-15
AECOM's Project No: 60341673
Client: Weston Aluminium
Stack/Duct Description: Stack 5

| Sample | Total Particulate Metals (mg) | Total Particulate Metals (mg/m$^3$) | Total Gaseous Metals (mg) | Total Gaseous Metals (mg/m$^3$) | Total Oxidisable Mercury (mg) | Total Oxidisable Mercury (mg/m$^3$) | Total (mg) | Total (mg/m$^3$) | Mass Emission Rate (mg/s) |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | 0.025 | 0.013 | <0.0001 | <0.000051 | | | 0.025 | 0.013 | 0.33 |
| Arsenic | 0.019 | 0.0097 | <0.0001 | <0.000051 | | | 0.019 | 0.0097 | 0.25 |
| Beryllium | 0.0003 | 0.00015 | <0.0001 | <0.000051 | | | 0.0003 | 0.00015 | 0.0038 |
| Cadmium | 0.0017 | 0.00087 | 0.00035 | 0.00018 | | | 0.002 | 0.001 | 0.025 |
| Chromium | 0.57 | 0.29 | 0.0012 | 0.00061 | | | 0.6 | 0.31 | 7.9 |
| Cobalt | 0.055 | 0.028 | <0.0001 | <0.000051 | | | 0.055 | 0.028 | 0.71 |
| Copper | 0.32 | 0.16 | 0.00029 | 0.00015 | | | 0.3 | 0.15 | 3.8 |
| Lead | 0.1 | 0.051 | 0.00045 | 0.00023 | | | 0.1 | 0.051 | 1.3 |
| Magnesium | 4.9 | 2.5 | 0.00094 | 0.00048 | | | 5 | 2.6 | 66 |
| Manganese | 0.41 | 0.21 | 0.0052 | 0.0027 | | | 0.4 | 0.2 | 5.1 |
| Mercury | <0.002 | <0.001 | <0.0001 | <0.000051 | <0.0001 | <0.000051 | <0.002 | <0.001 | <0.025 |
| Nickel | 0.11 | 0.056 | 0.0099 | 0.0051 | | | 0.1 | 0.051 | 1.3 |
| Selenium | 0.0067 | 0.0034 | 0.00055 | 0.00028 | | | 0.007 | 0.0036 | 0.092 |
| Thallium | <0.0002 | <0.0001 | <0.0001 | <0.000051 | | | <0.0002 | <0.0001 | <0.0025 |
| Tin | 1.1 | 0.56 | 0.00045 | 0.00023 | | | 1 | 0.51 | 13 |
| Vanadium | 0.05 | 0.026 | <0.0001 | <0.000051 | | | 0.05 | 0.026 | 0.66 |
| Zinc | 17 | 8.7 | 0.0031 | 0.0016 | | | 17 | 8.7 | 220 |
| Total Hazardous Metals* | 1.3 | 0.69 | 0.018 | 0.0091 | <0.0001 | <0.000051 | 2.4 | 1.2 | 31 |
| Total Metals | 25 | 13 | 0.022 | 0.012 | | | 25 | 13 | 320 |

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

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Hazardous Substances (Metals)**

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

Date: 17-Jun-15 Client: Weston Aluminium
AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 2.1764 $m^3$
Average gas meter temp. ($T_{M,2}$): 27.9 °C
301.1 K
Average barometric pressure ($P_{BARO}$) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 1.9587 $m^3$

(B) Metals concentration at standard conditions
Blank thimble No.: 0
Thimble No. used: 0
Blank weight: g
Metals Weight 0.0024 g
Final Metals Weight (Mp1): 0.00240 g
Metals Concentration (C1): $=M_{p1}/MV_4=$ 0.0012 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 1.2 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

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

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

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.031 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ 31 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: Z2
$V_v =$ 7.4 g (from laboratory report)
$V_w =$ 3 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0040
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0099

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

$B_{ws} =$ 0.70 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Hazardous Substances (Metals)**

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

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

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

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

= 1.069 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 17.88 m/s |
| (ii) Average of post-sampling velocities: | 17.08 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 17.48 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 30.48 m$^3$/s (stack conditions)

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

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

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.031 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 31 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.031 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 31 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.78 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 780 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

## STACK ANALYSIS - FINAL CALCULATIONS

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

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7282 $m^3$
Average gas meter temp. ($T_{M,2}$): 23.3 $^{\circ}C$
296.5 K
Average barometric pressure ($P_{BARO}$) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.6655 $m^3$

(B) H2SO4 as SO3 concentration at standard conditions
Blank thimble No.:
Thimble No. used: 0
Blank weight: g
H2SO4 as SO3 Weight <0.002 g
Final H2SO4 as SO3 Weight (Mp1): <0.002 g
H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.003 $g/m^3$ (0°C, dry gas, 1atm pressure)

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

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.003 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

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

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.076 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <76 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: G050
$V_v$ = 8.3 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0111

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

$B_{ws}$ = 1.64 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$)**

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

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

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

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

= 1.078 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 17.88 m/s

(ii) Average of post-sampling velocities: 17.08 m/s

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

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

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

Qstack = Vs x A = 30.48 m$^3$/s (stack conditions)

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

Qstd = 25.2 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.076 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | <76 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.076 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <76 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <1.9 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <1900 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Sulfur Dioxide (SO2 as SO3)**

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7282 $m^3$
Average gas meter temp. ($T_{M,2}$): 23.3 $^oC$
296.5 K
Average barometric pressure ($P_{BARO}$) 1005 hPa
Average pressure at meter ($P_{M,2}$) 1005.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.6655 $m^3$

(B) SO2 as SO3 concentration at standard conditions
Blank thimble No.:
Blank weight: g
Thimble No. used: 0
SO2 as SO3 Weight <0.01 g
Final SO2 as SO3 Weight (Mp1): <0.01 g
SO2 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.015 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = <15 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.015 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = <15 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.019 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <19 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: G050
$V_v$ = 8.3 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0111

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

$B_{ws}$ = 1.64 %

**STACK ANALYSIS - FINAL CALCULATIONS CONTINUED**

**Sulfur Dioxide (SO2 as SO3)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.078 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 17.88 m/s

(ii) Average of post-sampling velocities: 17.08 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
17.48 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 = 30.48 m$^3$/s (stack conditions)

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

Qstd = 25.2 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.38 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | <380 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.38 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <380 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <9.6 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <9600 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 5**
**WESTON ALUMINIUM**
17-Jun-15
HAZARDOUS SUBSTANCES (METALS)
SULFURIC ACID MIST (H2SO4 AS SO3)
SULFUR DIOXIDE (SO2 AS SO3)

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1490 mm | | |
| Stack gas temperature (average) | 51.9 °C | | 325.1 K |
| Stack pressure (average) | 1015 hPa | | |
| Stack gas velocity (average, stack conditions) | 17 m/s | | |
| Stack gas flowrate (stack conditions) | 30 $m^3/s$ | | |
| Stack gas flowrate (0°C, dry gas, 1 atm pressure) | 25 $m^3/s$ | | |
| **Hazardous Substances (Metals) Testing** | | | |
| Test Period | 12:30 | - | 14:42 |
| Hazardous Substances (Metals) Mass | 2.4 mg | | |
| Gas Volume Sampled | 1.96 $m^3$ | | |
| Hazardous Substances (Metals) Emission*1 | 1.2 $mg/m^3$ | | |
| Hazardous Substances (Metals) Mass Emission Rate*2 | 31 mg/s | | |
| Regulatory Limit | 5 $mg/m^3$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | |
| Test Period | 12:30 | - | 13:34 |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 mg | | |
| Gas Volume Sampled | 0.666 $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <3 $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <76 mg/s | | |
| Regulatory Limit | 100 $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | |
| Test Period | 12:30 | - | 13:34 |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 mg | | |
| Gas Volume Sampled | 0.666 $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <15 $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <380 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 0.7 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

**Weston Aluminium**

AECOM's Project Number: 60341673

Emission Source: Stack 5

Date Sampled: 17-Jun-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:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ
# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
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 1490 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.74 m$^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Junction
Downstream (m) = 10
No. Diameters = 6.7
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
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 | 66 | 36 | | |
| 2 | 218 | 188 | | |
| 3 | 441 | 411 | | |
| 4 | 1049 | 1019 | | |
| 5 | 1272 | 1242 | | |
| 6 | 1424 | 1394 | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

# Emission Measurement Calculations Spreadsheet

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Dioxins and Furans Lower Bound
Test 2: Dioxins and Furans Middle Bound
Test 3: Polycyclic Aromatic Hydrocarbons

| Sampling time start: | 8:45 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 8:45 | 30 | 20.0 | 0.0 |
| 2 | 8:46 | 30 | 20.0 | 0.0 |
| 3 | 8:47 | 30 | 20.0 | 0.0 |
| 4 | 8:48 | 30 | 20.0 | 0.0 |
| 5 | 8:49 | 30 | 20.0 | 0.0 |
| 6 | 8:50 | 30 | 20.0 | 0.0 |
| 7 | 8:51 | 30 | 20.0 | 0.0 |
| 8 | 8:52 | 30 | 20.0 | 0.0 |
| | Averages: | 30.0 ppm | 20.0 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.50 %

Measurements

| | |
|---|---|
| CO: 0.0030 %,(dry) | $N_2$: 80.0 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.0 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0030 %,(wet) | $N_2$: 78.8 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 19.7 %,(wet) |
| $H_2O$: 1.50 %(=M2) | |

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

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1: Dioxins and Furans Lower Bound
Test 2: Dioxins and Furans Middle Bound
Test 3: Polycyclic Aromatic Hydrocarbons

Sampling time start: 15:30
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 15:30 | 0 | 20.9 | 0.0 |
| 2 | 15:31 | 0 | 20.9 | 0.0 |
| 3 | 15:32 | 0 | 20.9 | 0.0 |
| 4 | 15:33 | 0 | 20.9 | 0.0 |
| 5 | 15:34 | 0 | 20.9 | 0.0 |
| 6 | 15:35 | 0 | 20.9 | 0.0 |
| 7 | 15:36 | 0 | 20.9 | 0.0 |
| 8 | 15:37 | 0 | 20.9 | 0.0 |
|  | Averages: | 0.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.99
Moisture percentage (M2): 1.31 %

Measurements

CO: 0.0000 %,(dry)
$CO_2$: 0.0 %,(dry)
$N_2$: 79.1 %,(dry)
$O_2$: 20.9 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0000 %,(wet)
$CO_2$: 0.0 %,(wet)
$H_2O$: 1.31 %(=M2)
$N_2$: 78.1 %,(wet)
$O_2$: 20.6 %,(wet)

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

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5
Test 1:Dioxins and Furans Lower Bound
Test 2:Dioxins and Furans Middle Bound
Test 3:Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Time : | 9:10 | Barometric Pressure : | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 $^o$C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. $^o$C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.223 | 69.0 | 342.2 | 17.5 |
| 1/2 | 188 | 0.262 | 69.0 | 342.2 | 19.0 |
| 1/3 | 411 | 0.242 | 69.0 | 342.2 | 18.3 |
| 1/4 | 1019 | 0.177 | 69.0 | 342.2 | 15.6 |
| 1/5 | 1242 | 0.190 | 69.0 | 342.2 | 16.2 |
| 1/6 | 1394 | 0.175 | 68.0 | 341.2 | 15.5 |
| | | | | | |
| 2/1 | 36 | 0.206 | 68.0 | 341.2 | 16.8 |
| 2/2 | 188 | 0.204 | 68.0 | 341.2 | 16.8 |
| 2/3 | 411 | 0.200 | 69.0 | 342.2 | 16.6 |
| 2/4 | 1019 | 0.213 | 69.0 | 342.2 | 17.1 |
| 2/5 | 1242 | 0.229 | 69.0 | 342.2 | 17.8 |
| 2/6 | 1394 | 0.213 | 69.0 | 342.2 | 17.1 |
| Average | | | 68.8 | 342.0 | 17.0 |

| | | |
|---|---|---|
| Static Pressure (Dwyer) (Pa): | | kPa |
| Static Pressure (U-tube, if required) : | -14.4 | mm |
| Absolute pressure in stack (hPa) : | 1013.59 | hPa |

**STACK ANALYSIS**
**SAMPLING OF DIOXINS AND FURANS**

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 5
Sample Nozzle No.: g65
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.57 x $10^{-5}m^2$
Thimble No: DAU150615A
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 178.4755 Meter finish: 178.4755
Time start: 9:20 Time finish: 9:21

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 183.0546 Meter finish: 183.0546
Time start: 15:24 Time finish: 15:25

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1006 hPa (start); 1006 hPa (finish)
Meter start: 178.4765 Time start: 9:23
Meter correction factor (GMf) : 0.9991

| 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 | 0:30:00 | 66 | 14.0 | 26.0 | 16.0 | | Yes |
| 1/2 | 1:00:00 | 218 | 15.2 | 31.0 | 19.0 | | Yes |
| 1/3 | 1:30:00 | 441 | 14.6 | 33.0 | 21.0 | | Yes |
| 1/4 | 2:00:00 | 1049 | 12.5 | 33.0 | 22.0 | | Yes |
| 1/5 | 2:30:00 | 1272 | 13.0 | 33.0 | 22.0 | | Yes |
| 1/6 | 3:00:00 | 1424 | 12.4 | 33.0 | 22.0 | | Yes |
| | | | | | | | |
| 2/1 | 3:30:00 | 66 | 13.5 | 33.0 | 22.0 | | Yes |
| 2/2 | 4:00:00 | 218 | 13.5 | 33.0 | 22.0 | | Yes |
| 2/3 | 4:30:00 | 441 | 13.3 | 33.0 | 22.0 | | Yes |
| 2/4 | 5:00:00 | 1049 | 13.7 | 33.0 | 23.0 | | Yes |
| 2/5 | 5:30:00 | 1272 | 14.2 | 33.0 | 23.0 | | Yes |
| 2/6 | 6:00:00 | 1424 | 13.7 | 33.0 | 23.0 | | Yes |
| Averages | | | | 32.3 | 21.4 | no result | |

Meter Finish: 183.0510 Time Finish: 15:23
Total Condensate collected: 13 ml Silica gel No(s) used: FA8

**STACK ANALYSIS**
**SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBON**

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack Description No.: Stack 5
Sample Nozzle No.: g65
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 1.57 x 10$^{-5}$m$^2$
Thimble No: DAU150615A
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 178.4755 Meter finish: 178.4755
Time start: 9:20 Time finish: 9:21

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 183.0546 Meter finish: 183.0546
Time start: 15:24 Time finish: 15:25

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1006 hPa (start); 1006 hPa (finish)
Meter start: 178.4765 Time start: 9:23
Meter correction factor (GMf) : 0.9991

| 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 | 0:30:00 | 66 | 14.0 | 26.0 | 16.0 | | Yes |
| 1/2 | 1:00:00 | 218 | 15.2 | 31.0 | 19.0 | | Yes |
| 1/3 | 1:30:00 | 441 | 14.6 | 33.0 | 21.0 | | Yes |
| 1/4 | 2:00:00 | 1049 | 12.5 | 33.0 | 22.0 | | Yes |
| 1/5 | 2:30:00 | 1272 | 13.0 | 33.0 | 22.0 | | Yes |
| 1/6 | 3:00:00 | 1424 | 12.4 | 33.0 | 22.0 | | Yes |
| | | | | | | | |
| 2/1 | 3:30:00 | 66 | 13.5 | 33.0 | 22.0 | | Yes |
| 2/2 | 4:00:00 | 218 | 13.5 | 33.0 | 22.0 | | Yes |
| 2/3 | 4:30:00 | 441 | 13.3 | 33.0 | 22.0 | | Yes |
| 2/4 | 5:00:00 | 1049 | 13.7 | 33.0 | 23.0 | | Yes |
| 2/5 | 5:30:00 | 1272 | 14.2 | 33.0 | 23.0 | | Yes |
| 2/6 | 6:00:00 | 1424 | 13.7 | 33.0 | 23.0 | | Yes |
| Averages | | | | 32.3 | 21.4 | no result | |

Meter Finish: 183.0510 Time Finish: 15:23
Total Condensate collected: 13 ml Silica gel No(s) used: FA8

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

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

| | |
|---|---|
| Date: | 17-Jun-15 |
| Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 5 |

Test 1:Dioxins and Furans Lower Bound
Test 2:Dioxins and Furans Middle Bound
Test 3:Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Time : | 15:25 | Barometric Pressure : | 1015 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | $kg/m^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.198 | 34.0 | 307.2 | 15.7 |
| 1/2 | 188 | 0.198 | 34.0 | 307.2 | 15.7 |
| 1/3 | 411 | 0.218 | 34.0 | 307.2 | 16.4 |
| 1/4 | 1019 | 0.198 | 34.0 | 307.2 | 15.7 |
| 1/5 | 1242 | 0.267 | 34.0 | 307.2 | 18.2 |
| 1/6 | 1394 | 0.233 | 34.0 | 307.2 | 17.0 |
| | | | | | |
| 2/1 | 36 | 0.209 | 34.0 | 307.2 | 16.1 |
| 2/2 | 188 | 0.219 | 34.0 | 307.2 | 16.5 |
| 2/3 | 411 | 0.202 | 34.0 | 307.2 | 15.8 |
| 2/4 | 1019 | 0.252 | 34.0 | 307.2 | 17.7 |
| 2/5 | 1242 | 0.194 | 34.0 | 307.2 | 15.5 |
| 2/6 | 1394 | 0.236 | 34.0 | 307.2 | 17.1 |
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| | | | | | |
| Average | | | 34.0 | 307.2 | 16.5 |

| | |
|---|---|
| Static Pressure (Dwyer) (Pa): | kPa |
| Static Pressure (U-tube, if required) : | -14.4 mm |
| Absolute pressure in stack (hPa) : | 1013.59 hPa |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

| | |
|---|---|
| Date: | 17-Jun-15 |
| Client: | Weston Aluminium |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 5 |

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | ($\mu g/m^3$) | ($mg/m^3$) | (µg/s) | (mg/s) |
| Naphthalene | <470 | <0.47 | <0.00047 | 0.11 | <0.00011 | <2.8 | <0.0028 |
| 2 - Methylnapthalene | 610 | 0.61 | 0.00061 | 0.15 | 0.00015 | 3.6 | 0.0036 |
| Acenaphthylene | 970 | 0.97 | 0.00097 | 0.23 | 0.00023 | 5.7 | 0.0057 |
| Acenaphthene | 440 | 0.44 | 0.00044 | 0.11 | 0.00011 | 2.6 | 0.0026 |
| Fluorene | 1100 | 1.1 | 0.0011 | 0.27 | 0.00027 | 6.5 | 0.0065 |
| Phenanthrene | 2600 | 2.6 | 0.0026 | 0.63 | 0.00063 | 15 | 0.015 |
| Anthracene | 84 | 0.084 | 0.000084 | 0.02 | 0.00002 | 0.49 | 0.00049 |
| Fluoranthene | 620 | 0.62 | 0.00062 | 0.15 | 0.00015 | 3.6 | 0.0036 |
| Pyrene | 290 | 0.29 | 0.00029 | 0.07 | 0.00007 | 1.7 | 0.0017 |
| Benz(a)anthracene | 40 | 0.04 | 0.00004 | 0.0097 | 0.0000097 | 0.23 | 0.00023 |
| Chrysene | 110 | 0.11 | 0.00011 | 0.027 | 0.000027 | 0.65 | 0.00065 |
| Benzo(b)fluoranthene | 120 | 0.12 | 0.00012 | 0.029 | 0.000029 | 0.7 | 0.0007 |
| Benzo(k)fluoranthene | 66 | 0.066 | 0.000066 | 0.016 | 0.000016 | 0.39 | 0.00039 |
| Benzo(e)pyrene | 53 | 0.053 | 0.000053 | 0.013 | 0.000013 | 0.31 | 0.00031 |
| Benzo(a)pyrene | 110 | 0.11 | 0.00011 | 0.027 | 0.000027 | 0.65 | 0.00065 |
| Perylene | <20 | <0.02 | <0.00002 | 0.0048 | <0.0000048 | <0.12 | <0.00012 |
| Indeno(123:cd)pyrene | 37 | 0.037 | 0.000037 | 0.009 | 0.000009 | 0.22 | 0.00022 |
| Dibenzo(ah)anthracene | <20 | <0.02 | <0.00002 | 0.0048 | <0.0000048 | <0.12 | <0.00012 |
| Benzo(ghi)perylene | 41 | 0.041 | 0.000041 | 0.0099 | 0.0000099 | 0.24 | 0.00024 |
| Sum of reported PAH's | 7300 | 7.3 | 0.0073 | 1.9 | 0.0018 | 43 | 0.043 |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## 60341673 Weston Aluminium Stack 5 Speciated Dioxins and Furans Results

| Analyte | Mass ng | Toxic Equivalency Factor (1 - TEFs) | Total Toxic Equivalence (1 - TEQs) ng | Concentration ng/m$^3$ | Total Toxic Equivalence (1-TEQs) ng/m$^3$ |
|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 0.015 | 0.1 | 0.0015 | 0.0036 | 0.00036 |
| Total TCDF isomers | 0.26 | | | | |
| 2,3,7,8-TCDD | <0.005 | 1 | 0.0025 | <0.0012 | 0.0006 |
| Total TCDD isomers | 0.042 | | | | |
| | | | | | |
| 1,2,3,7,8-PeCDF | 0.017 | 0.05 | 0.00085 | 0.0041 | 0.00021 |
| 2,3,4,7,8-PeCDF | 0.019 | 0.5 | 0.0095 | 0.0046 | 0.0023 |
| Total PeCDF isomers | 0.2 | | | | |
| 1,2,3,7,8-PeCDD | 0.0044 | 0.5 | 0.0022 | 0.0011 | 0.00053 |
| Total PeCDD isomers | 0.086 | | | | |
| | | | | | |
| 1,2,3,4,7,8-HxCDF | 0.02 | 0.1 | 0.002 | 0.0048 | 0.00048 |
| 1,2,3,6,7,8-HxCDF | 0.02 | 0.1 | 0.002 | 0.0048 | 0.00048 |
| 2,3,4,6,7,8-HxCDF | 0.022 | 0.1 | 0.0022 | 0.0053 | 0.00053 |
| 1,2,3,7,8,9-HxCDF | <0.004 | 0.1 | 0.0002 | <0.00097 | 0.000048 |
| Total HxCDF isomers | 0.17 | | | | |
| 1,2,3,4,7,8-HxCDD | 0.0085 | 0.1 | 0.00085 | 0.0021 | 0.00021 |
| 1,2,3,6,7,8-HxCDD | 0.014 | 0.1 | 0.0014 | 0.0034 | 0.00034 |
| 1,2,3,7,8,9-HxCDD | 0.016 | 0.1 | 0.0016 | 0.0039 | 0.00039 |
| Total HxCDD isomers | 0.19 | | | | |
| | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 0.058 | 0.01 | 0.00058 | 0.014 | 0.00014 |
| 1,2,3,4,7,8,9-Hp CDF | 0.0054 | 0.01 | 0.000054 | 0.0013 | 0.000013 |
| Total HpCDF isomers | 0.084 | | | | |
| 1,2,3,4,6,7,8-HpCDD | 0.082 | 0.01 | 0.00082 | 0.02 | 0.0002 |
| Total HpCDD isomers | 0.16 | | | | |
| | | | | | |
| OCDF | 0.0099 | 0.001 | 0.0000099 | 0.0024 | 0.0000024 |
| OCDD | 0.59 | 0.001 | 0.00059 | 0.14 | 0.00014 |

**I-TEQ$_{DF}$**

| | |
|---|---|
| Lower Bound (excluding LOD Values) | 0.026 ng |
| Middle Bound (including half LOD Values) | 0.029 ng |
| **Date Tested** | **17-Jun-15** |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Dioxins and Furans Lower Bound**

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

Date: 17-Jun-15 Client: Weston Aluminium

AECOM's Project No: 60341673 Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 4.5704 $m^3$

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

300.0 K

Average barometric pressure ($P_{BARO}$) 1006 hPa

Average pressure at meter ($P_{M,2}$) 1006.00 hPa

Sample gas volume ($MV_4$); ($0^oC$, dry gas, 1 atm pressure): 4.1323 $m^3$

(B) Lower Bound concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: DAU150615A

Blank weight: µg

Lower Bound Weight 2.60E-05 µg

Final Lower Bound Weight (Mp1): 0.00003 µg

Lower Bound Concentration (C1): $=M_{p1}/MV_4=$ 6.3E-06 µg/$m^3$ ($0^oC$, dry gas, 1atm pressure)

;and $C_2$ = 0.0063 ng/$m^3$ ($0^oC$, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0000063 µg/$m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.0063 ng/$m^3$ ($0^oC$, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00016 µg/$m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 0.16 ng/$m^3$ ($0^oC$, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: FA8

$V_v$ = 28.1 g (from laboratory report)

$V_w$ = 13 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0375

Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 1.31 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Dioxins and Furans Lower Bound**

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

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

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

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

= 1.078 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 17.03 m/s

(ii) Average of post-sampling velocities: 16.45 m/s

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

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

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

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

Qstack = Vs x A = 29.19 $m^3$/s (stack conditions)

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

Qstd = 24.3 $m^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.00015 | µg/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 0.15 | ng/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.00015 | µg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 0.15 | ng/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.0039 | µg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 3.9 | ng/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Dioxins and Furans Middle Bound**

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 4.5704 $m^3$
Average gas meter temp. ($T_{M,2}$): 26.8 °C
300.0 K
Average barometric pressure ($P_{BARO}$) 1006 hPa
Average pressure at meter ($P_{M,2}$) 1006.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 4.1323 $m^3$

(B) Middle Bound concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: DAU150615A
Blank weight: µg
Middle Bound Weight 2.90E-05 µg
Final Middle Bound Weight (Mp1): 0.00003 µg
Middle Bound Concentration (C1): $=M_{p1}/MV_4=$ 0.000007 µg/$m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.007 ng/$m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.000007 µg/$m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.007 ng/$m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.00018 µg/$m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 0.18 ng/$m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: FA8
$V_v$ = 28.1 g (from laboratory report)
$V_w$ = 13 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0173
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0375
Therefore, $B_{ws}$ =

$$\frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$$

$B_{ws}$ = 1.31 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Dioxins and Furans Middle Bound**

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

| | |
|---|---|
| (i) Initial gas density for sampling: | 1.28 kg/m$^3$ (from Laboratory Form 107) |
| (ii) Re-calculated gas density based on moisture content in (c): | 1.28 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)<br>1.29 kg/m$^3$ (0$^o$C, dry, 1 atm pressure) |

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

= 1.078 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

| | |
|---|---|
| (i) Average of pre-sampling velocities: | 17.03 m/s |
| (ii) Average of post-sampling velocities: | 16.45 m/s |
| (iii) Average of while-sampling velocities: | N/A m/s |
| (iv) Overall average of pre-sampling and post-sampling velocities (Vs):<br>(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.) | 16.74 m/s (stack conditions, wet)<br>N/A m/s (stack conditions, wet) |

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

Qstack = Vs x A = 29.19 m$^3$/s (stack conditions)

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

Qstd = 24.3 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.00017 | µg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 0.17 | ng/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.00017 | µg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 0.17 | ng/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.0043 | µg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 4.3 | ng/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Polycyclic Aromatic Hydrocarbons**

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

Date: 17-Jun-15
Client: Weston Aluminium
AECOM's Project No: 60341673
Stack/Duct Description: Stack 5

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 4.5704 $m^3$
Average gas meter temp. ($T_{M,2}$): 26.8 °C
300.0 K
Average barometric pressure ($P_{BARO}$) 1006 hPa
Average pressure at meter ($P_{M,2}$) 1006.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 4.1323 $m^3$

(B) PAH concentration at standard conditions
Blank thimble No.: NA
Blank weight: g
Thimble No. used: DAU150615A
PAH Weight 0.0000073 g
Final PAH Weight (Mp1): 0.00001 g
PAH Concentration (C1): $=M_{p1}/MV_4=$ 0.0000018 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 0.0018 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0000018 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ 0.0018 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.5 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000046 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ 0.046 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: FA8
$V_v =$ 28.1 g (from laboratory report)
$V_w =$ 13 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0173
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0375

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

$B_{ws} =$ 1.31 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Polycyclic Aromatic Hydrocarbons**

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

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

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

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

= 1.078 $kg/m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 17.03 m/s

(ii) Average of post-sampling velocities: 16.45 m/s

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

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

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

Qstack = Vs x A = 29.19 $m^3/s$ (stack conditions)

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

Qstd = 24.3 $m^3/s$ ($0^oC$, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a} \times Qstd$ = | 0.000044 | g/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | = | 0.044 | mg/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | $C_{1a} \times Qstd$ = | 0.000044 | g/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 0.044 | mg/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a} \times Qstd$ = | 0.0011 | g/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 1.1 | mg/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## EMISSION MONITORING RESULTS, STACK 5
## WESTON ALUMINIUM
17-Jun-15
DIOXINS AND FURANS

POLYCYCLIC AROMATIC HYDROCARBONS

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1490 mm | | |
| Stack gas temperature (average) | 51.4 °C | | 324.6 K |
| Stack pressure (average) | 1014 hPa | | |
| Stack gas velocity (average, stack conditions) | 17 m/s | | |
| Stack gas flowrate (stack conditions) | 29 $m^3/s$ | | |
| Stack gas flowrate ($0^0$C, dry gas, 1 atm pressure) | 24 $m^3/s$ | | |
| **Dioxins and Furans Lower Bound Testing** | | | |
| Test Period | 9:23 | - | 15:23 |
| Dioxins and Furans Lower Bound Mass | 0.026 ng | | |
| Gas Volume Sampled | 4.13 $m^3$ | | |
| Dioxins and Furans Lower Bound Emission*1 | 0.0063 $ng/m^3$ | | |
| Dioxins and Furans Lower Bound Mass Emission Rate*2 | 0.15 ng/s | | |
| Regulatory Limit | 0.1 $ng/m^3$ | | |
| **Dioxins and Furans Middle Bound Testing** | | | |
| Test Period | 9:23 | - | 15:23 |
| Dioxins and Furans Middle Bound Mass | 0.029 ng | | |
| Gas Volume Sampled | 4.13 $m^3$ | | |
| Dioxins and Furans Middle Bound Emission*1 | 0.007 $ng/m^3$ | | |
| Dioxins and Furans Middle Bound Mass Emission Rate*2 | 0.17 ng/s | | |
| Regulatory Limit | 0.1 $ng/m^3$ | | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | | |
| Test Period | 9:23 | - | 15:23 |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0073 mg | | |
| Gas Volume Sampled | 4.13 $m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0018 $mg/m^3$ | | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.044 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 1.3 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

**Weston**

AECOM's Project Number: 60341673

Emission Source: Stack 6

Date Sampled: 26-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Total Particulate | NSW EPA TM - 15 |
| Total Fluoride | NSW EPA TM - 9 |
| Sulfuric Acid Mist | NSW EPA TM - 3 |
| Sulfur Dioxide | NSW EPA TM - 4 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Total Particulate
Test 2: Total Fluoride
Test 3: Sulfuric Acid Mist (H2SO4 as SO3)
Test 4: Sulfur Dioxide (SO2 as SO3)

Measurement/Observations

Stack Internal Dimensions:

Diameter 580 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.26 $m^2$

Minimum No. of sampling points= 8

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5
No. Diameters = 8.6
Type of Upstream Disturbance: Bend
Downstream (m) = 3
No. Diameters = 5.2
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 8
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 4
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 | 39 | 9 | | |
| 2 | 145 | 115 | | |
| 3 | 435 | 405 | | |
| 4 | 541 | 511 | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Total Particulate
Test 2: Total Fluoride
Test 3: Sulfuric Acid Mist (H2SO4 as SO3)
Test 4: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 12:20
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm), (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 12:20 | 0 | 12.9 | 4.5 |
| 2 | 12:21 | 0 | 12.9 | 4.5 |
| 3 | 12:22 | 0 | 12.9 | 4.5 |
| 4 | 12:23 | 0 | 12.9 | 4.5 |
| 5 | 12:24 | 0 | 12.9 | 4.5 |
| 6 | 12:25 | 0 | 12.9 | 4.5 |
| 7 | 12:26 | 0 | 12.9 | 4.5 |
| 8 | 12:27 | 0 | 12.9 | 4.5 |
| | Averages: | 0.0 ppm | 12.9 % | 4.5 % |

Moisture content (M3): 0.96
Moisture percentage (M2): 3.80 %

Measurements

CO: 0.0000 %,(dry)
$CO_2$: 4.5 %,(dry)
$N_2$: 82.6 %,(dry)
$O_2$: 12.9 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0000 %,(wet)
$N_2$: 79.5 %,(wet)
$CO_2$: 4.3 %,(wet)
$O_2$: 12.4 %,(wet)
$H_2O$: 3.80 %(=M2)

Therefore, stack gas density (GD) = 1.29 kg/$m^3$ ($0^oC$, wet, 1 atm pressure)
Therefore, stack gas density (GD) = 1.31 kg/$m^3$ ($0^oC$, dry, 1 atm pressure)

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Total Particulate
Test 2: Total Fluoride
Test 3: Sulfuric Acid Mist (H2SO4 as SO3)
Test 4: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 13:40

Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 13:40 | 0 | 13.0 | 4.5 |
| 2 | 13:41 | 0 | 13.0 | 4.5 |
| 3 | 13:42 | 0 | 13.0 | 4.5 |
| 4 | 13:43 | 0 | 13.0 | 4.5 |
| 5 | 13:44 | 0 | 13.0 | 4.5 |
| 6 | 13:45 | 0 | 13.0 | 4.5 |
| 7 | 13:46 | 0 | 13.0 | 4.5 |
| 8 | 13:47 | 0 | 13.0 | 4.5 |
|  | Averages: | 0.0 ppm | 13.0 % | 4.5 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 2.18 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0000 %,(dry) | $N_2$: | 82.5 %,(dry) |
| $CO_2$: | 4.5 %,(dry) | $O_2$: | 13.0 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0000 %,(wet) | $N_2$: | 80.7 %,(wet) |
| $CO_2$: | 4.4 %,(wet) | $O_2$: | 12.7 %,(wet) |
| $H_2O$: | 2.18 %(=M2) | | |

| | | |
|---|---|---|
| Therefore, stack gas density (GD) = | 1.29 $kg/m^3$ | ($0^oC$, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = | 1.31 $kg/m^3$ | ($0^oC$, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1:Total Particulate
Test 2:Total Fluoride
Test 3:Sulfuric Acid Mist (H2SO4 as SO3)
Test 4:Sulfur Dioxide (SO2 as SO3)

| | | | | |
|---|---|---|---|---|
| Time : | 12:02 | Barometric Pressure : | 1026 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.29 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 9 | 0.079 | 204.0 | 477.2 | 12.3 |
| 1/2 | 115 | 0.078 | 204.0 | 477.2 | 12.2 |
| 1/3 | 405 | 0.068 | 204.0 | 477.2 | 11.3 |
| 1/4 | 511 | 0.066 | 204.0 | 477.2 | 11.1 |
| | | | | | |
| 2/1 | 9 | 0.080 | 204.0 | 477.2 | 12.3 |
| 2/2 | 115 | 0.089 | 204.0 | 477.2 | 13.0 |
| 2/3 | 405 | 0.089 | 204.0 | 477.2 | 13.0 |
| 2/4 | 511 | 0.097 | 204.0 | 477.2 | 13.6 |
| Average | | | 204.0 | 477.2 | 12.4 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 5 mm
Absolute pressure in stack (hPa) : 1026.49 hPa

AECOM

**STACK ANALYSIS**
**SAMPLING OF TOTAL FLUORIDE**

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 6
Sample Nozzle No.: s10
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 2.89 x $10^{-5}m^2$
Thimble No: NA
Blank thimble No: NA

**Leak Check (Pre-Sampling)**
Meter start: 507.1385 Meter finish: 507.1385
Time start: 12:13 Time finish: 12:14

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 508.1077 Meter finish: 508.1077
Time start: 14:00 Time finish: 14:01

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1026 hPa (start); 1026 hPa (finish)
Meter start: 507.1395 Time start: 12:28
Meter correction factor (GMf) : 1.0101

| 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 | 0:10:00 | 39 | 13.1 | 24.0 | 23.0 | | Yes |
| 1/2 | 0:20:00 | 145 | 13.0 | 24.0 | 23.0 | | Yes |
| 1/3 | 0:30:00 | 435 | 12.0 | 24.0 | 24.0 | | Yes |
| 1/4 | 0:40:00 | 541 | 11.8 | 24.0 | 24.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:50:00 | 39 | 13.1 | 26.0 | 25.0 | | Yes |
| 2/2 | 1:00:00 | 145 | 13.8 | 26.0 | 25.0 | | Yes |
| 2/3 | 1:10:00 | 435 | 13.8 | 26.0 | 25.0 | | Yes |
| 2/4 | 1:20:00 | 541 | 14.4 | 24.0 | 25.0 | | Yes |
| Averages | | | | 24.8 | 24.3 | no result | |

Meter Finish: 508.1065
Time Finish: 1:48
Total Condensate collected: 11 ml
Silica gel No(s) used: Z11

# ı Measurement Calculations Spreadsheet

## ιLYSIS - FINAL CALCULATIONS CONTINUED

(SO2 as SO3)

ɔosition and Density (Re-calculation)

ensity for sampling: 1.29 kg/m$^3$ (from Laboratory Form 107)

ted gas density based on moisture

1.28 kg/m$^3$ (0°C, wet, 1 atm pressure)
1.31 kg/m$^3$ (0°C, dry, 1 atm pressure)

ty at stack conditions = $(ii) \times \frac{(273.2)}{(273.2+Ts)} \times \frac{(Ps)}{(1013.25)}$

= 0.794 kg/m$^3$ (stack conditions, wet)

:ities

pre-sampling velocities: 12.35 m/s

f post-sampling velocities: 9.46 m/s

ıf while-sampling velocities: N/A m/s

ʼerage of pre-sampling and post-
ıcities (Vs):
from all individual data, **not** from (i)
)

10.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)

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

Vs x A = 2.88 m$^3$/s (stack conditions)

$\text{ɔstack} \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$

1.7 m$^3$/s (0°C, dry gas, 1 atm pressure)

ission Rate

$_{1a}$ x Qstd = <0.017 g/s (0°C, dry gas, 1 atm pressure )
= <17 mg/s (0°C, dry gas, 1 atm pressure )

$_{1a}$ x Qstd = <0.046 g/s (0°C, dry gas, 1 atm pressure 12% $CO_2$)
= <46 mg/s (0°C, dry gas, 1 atm pressure 12% $CO_2$)

$_{1a}$ x Qstd = <0.03 g/s (0°C, dry gas, 1 atm pressure 7% $O_2$)
= <30 mg/s (0°C, dry gas, 1 atm pressure 7% $O_2$)

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - FINAL CALCULATIONS

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

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

Date: 26-Jun-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Stack 6

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 1.0380 $m^3$

Average gas meter temp. ($T_{M,2}$): 25.7 °C

298.9 K

Average barometric pressure ($P_{BARO}$) 1026 hPa

Average pressure at meter ($P_{M,2}$) 1026.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.9607 $m^3$

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

H2SO4 as SO3 Weight <0.005 g

Final H2SO4 as SO3 Weight (Mp1): <0.005 g

H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0052 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ <5.2 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 4.5 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.014 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ <14 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 13.0 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.009 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ <9 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z6

$V_v =$ 8.9 g (from laboratory report)

$V_w =$ 10 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0133

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0119

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

$B_{ws} =$ 2.56 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

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

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

(i) Initial gas density for sampling: 1.29 kg/m$^3$ (from Laboratory Form 107)

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

(iii) Gas density at stack conditions =

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

= 0.794 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.35 m/s

(ii) Average of post-sampling velocities: 9.46 m/s

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

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

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

Qstack = Vs x A = 2.88 m$^3$/s (stack conditions)

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

Qstd = 1.7 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = $C_{1a}$ x Qstd = <0.0091 g/s (0°C, dry gas, 1 atm pressure )
= <9.1 mg/s (0°C, dry gas, 1 atm pressure )

$C_{1a}$ x Qstd = <0.024 g/s (0°C, dry gas, 1 atm pressure 12% $CO_2$ )
= <24 mg/s (0°C, dry gas, 1 atm pressure 12% $CO_2$ )

$C_{1a}$ x Qstd = <0.016 g/s (0°C, dry gas, 1 atm pressure 7% $O_2$ )
= <16 mg/s (0°C, dry gas, 1 atm pressure 7% $O_2$ )

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 26-Jun-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Stack 6

(A) Sample gas volume at standard conditions

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| Metered volume ($MV_3$): | 0.9768 | $m^3$ | Average barometric pressure ($P_{BARO}$) | 1026 | hPa |
| Average gas meter temp. ($T_{M,2}$): | 24.5 | °C |  |  |  |
|  | 297.7 | K | Average pressure at meter ($P_{M,2}$) | 1026.00 | hPa |
| Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): | 0.9077 | $m^3$ |  |  |  |

(B) Total Fluoride concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

Total Fluoride Weight 0.00463 g

Final Total Fluoride Weight (Mp1): 0.00463 g

Total Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.0051 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2 =$ 5.1 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 4.5 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.014 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1} =$ 14 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %

Average $O_2$%: 13.0 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0089 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1} =$ 8.9 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z11

$V_v =$ 5 g (from laboratory report)

$V_w =$ 11 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0147

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0067

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

$B_{ws}$ = 2.30 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

(i) Initial gas density for sampling: 1.29 kg/m$^3$ (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.27 kg/m$^3$ (0°C, wet, 1 atm pressure)
1.31 kg/m$^3$ (0°C, dry, 1 atm pressure)

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

= 0.787 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.35 m/s

(ii) Average of post-sampling velocities: 9.46 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 10.91 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

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

Qstack = Vs x A = 2.88 m$^3$/s (stack conditions)

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

Qstd = 1.7 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0089 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 8.9 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.024 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 24 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.015 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 15 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Particulate**

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 1.9561 $m^3$
Average gas meter temp. ($T_{M,2}$): 29.6 $^oC$
302.8 K
Average barometric pressure ($P_{BARO}$) 1026 hPa
Average pressure at meter ($P_{M,2}$) 1026.00 hPa

Sample gas volume ($MV_4$); (0$^o$C, dry gas, 1 atm pressure): 1.7871 $m^3$

(B) Total Particulate concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: S47
Blank weight: g
Total Particulate Weight 0.0077 g
Final Total Particulate Weight (Mp1): 0.00770 g
Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0043 $g/m^3$ (0$^o$C, dry gas, 1atm pressure)

;and $C_2$ = 4.3 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 4.5 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.011 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 11 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 3 %
Average $O_2$%: 13.0 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0096 $g/m^3$ (0$^o$C, dry gas, 1atm pressure, 3% $O_2$)

;and $C_{b1}$ = 9.6 $mg/m^3$ (0$^o$C, dry gas, 1atm pressure, 3% $O_2$)

(C) Moisture content
Silica Gel Number: F25
$V_v$ = 5 g (from laboratory report)
$V_w$ = 18 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0240
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0067

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

$B_{ws}$ = 1.69 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

(i) Initial gas density for sampling: 1.29 kg/m$^3$ (from Laboratory Form 107)

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

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

= 0.787 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.35 m/s

(ii) Average of post-sampling velocities: 9.46 m/s

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

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

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

Qstack = Vs x A = 2.88 m$^3$/s (stack conditions)

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

Qstd = 1.8 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0076 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 7.6 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.02 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 20 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.017 | g/s (0°C, dry gas, 1 atm pressure | 3% | $O_2$ ) |
| | = | 17 | mg/s (0°C, dry gas, 1 atm pressure | 3% | $O_2$ ) |

## EMISSION MONITORING RESULTS, STACK 6
## WESTON

26-Jun-15
TOTAL PARTICULATE
TOTAL FLUORIDE
SULFURIC ACID MIST (H2SO4 AS SO3)
SULFUR DIOXIDE (SO2 AS SO3)

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 580 mm | | |
| Stack gas temperature (average) | 173.0 °C | | 446.2 K |
| Stack pressure (average) | 1026 hPa | | |
| Stack gas velocity (average, stack conditions) | 11 m/s | | |
| Stack gas flowrate (stack conditions) | 2.9 $m^3/s$ | | |
| Stack gas flowrate ($0^0$C, dry gas, 1 atm pressure) | 1.7 $m^3/s$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 12:28 | - | 1:48 |
| Total Particulate Mass | 7.7 mg | | |
| Gas Volume Sampled | 1.79 $m^3$ | | |
| Total Particulate Emission*1 at 3% O2 | 9.6 $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 at 3% O2 | 17 mg/s | | |
| Regulatory Limit at 3% O2 | 10 $mg/m^3$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 12:28 | - | 1:48 |
| Total Fluoride Mass | 4.63 mg | | |
| Gas Volume Sampled | 0.908 $m^3$ | | |
| Total Fluoride Emission*1 | 5.1 $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 8.9 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | | |
| Test Period | 12:28 | - | 1:48 |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <5 mg | | |
| Gas Volume Sampled | 0.961 $m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <5.2 $mg/m^3$ | | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <9.1 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | | |
| Test Period | 12:28 | - | 1:48 |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 mg | | |
| Gas Volume Sampled | 0.961 $m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <10 $mg/m^3$ | | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <17 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 2.2 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.31 $kg/m^3$ | | |
| **Dry Molecular Weight** | 29.2 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

AECOM

**Weston**

AECOM's Project Number: 60341673

Emission Source: Stack 6

Date Sampled: 26-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Polycyclic Aromatic Hydrocarbons | NSW EPA OM - 6 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Polycyclic Aromatic Hydrocarbons

Measurement/Observations

Stack Internal Dimensions:

Diameter 580 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.26 $m^2$

Minimum No. of sampling points= 8

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5
No. Diameters = 8.6
Type of Upstream Disturbance: Bend
Downstream (m) = 3
No. Diameters = 5.2
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 8
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 4
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 | 39 | 9 | | |
| 2 | 145 | 115 | | |
| 3 | 435 | 405 | | |
| 4 | 541 | 511 | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
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| 16 | | | | |
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| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ................................

Checked: ................................

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Polycyclic Aromatic Hydrocarbons

| Sampling time start: | 12:20 | Sampling port No.: | 1 | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 12:20 | 0 | 12.9 | 4.5 |
| 2 | 12:21 | 0 | 12.9 | 4.5 |
| 3 | 12:22 | 0 | 12.9 | 4.5 |
| 4 | 12:23 | 0 | 12.9 | 4.5 |
| 5 | 12:24 | 0 | 12.9 | 4.5 |
| 6 | 12:25 | 0 | 12.9 | 4.5 |
| 7 | 12:26 | 0 | 12.9 | 4.5 |
| 8 | 12:27 | 0 | 12.9 | 4.5 |
| | Averages: | 0.0 ppm | 12.9 % | 4.5 % |

Moisture content (M3): 0.96
Moisture percentage (M2): 3.80 %

Measurements

| | |
|---|---|
| CO: 0.0000 %,(dry) | $N_2$: 82.6 %,(dry) |
| $CO_2$: 4.5 %,(dry) | $O_2$: 12.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0000 %,(wet) | $N_2$: 79.5 %,(wet) |
| $CO_2$: 4.3 %,(wet) | $O_2$: 12.4 %,(wet) |
| $H_2O$: 3.80 %(=M2) | |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0$^o$C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.31 kg/m$^3$ | (0$^o$C, dry, 1 atm pressure) |

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# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1: Polycyclic Aromatic Hydrocarbons

Sampling time start: 13:40
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 13:40 | 0 | 13.0 | 4.5 |
| 2 | 13:41 | 0 | 13.0 | 4.5 |
| 3 | 13:42 | 0 | 13.0 | 4.5 |
| 4 | 13:43 | 0 | 13.0 | 4.5 |
| 5 | 13:44 | 0 | 13.0 | 4.5 |
| 6 | 13:45 | 0 | 13.0 | 4.5 |
| 7 | 13:46 | 0 | 13.0 | 4.5 |
| 8 | 13:47 | 0 | 13.0 | 4.5 |
|  | Averages: | 0.0 ppm | 13.0 % | 4.5 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 1.85 %

Measurements

|  |  |  |  |
|---|---|---|---|
| CO: | 0.0000 %,(dry) | $N_2$: | 82.5 %,(dry) |
| $CO_2$: | 4.5 %,(dry) | $O_2$: | 13.0 %,(dry) |
| Gas Compositions converted to wet basis: |  |  |  |
| CO: | 0.0000 %,(wet) | $N_2$: | 81.0 %,(wet) |
| $CO_2$: | 4.4 %,(wet) | $O_2$: | 12.8 %,(wet) |
| $H_2O$: | 1.85 %(=M2) |  |  |

Therefore, stack gas density (GD) = 1.30 kg/m$^3$ (0$^o$C, wet, 1 atm pressure)
Therefore, stack gas density (GD) = 1.31 kg/m$^3$ (0$^o$C, dry, 1 atm pressure)

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1:Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Time : | 11:00 | Barometric Pressure : | 1026 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.29 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 9 | 0.079 | 204.0 | 477.2 | 12.3 |
| 1/2 | 115 | 0.078 | 204.0 | 477.2 | 12.2 |
| 1/3 | 405 | 0.068 | 204.0 | 477.2 | 11.3 |
| 1/4 | 511 | 0.066 | 204.0 | 477.2 | 11.1 |
| | | | | | |
| 2/1 | 9 | 0.080 | 204.0 | 477.2 | 12.3 |
| 2/2 | 115 | 0.089 | 204.0 | 477.2 | 13.0 |
| 2/3 | 405 | 0.089 | 204.0 | 477.2 | 13.0 |
| 2/4 | 511 | 0.097 | 204.0 | 477.2 | 13.6 |
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| | | | | | |
| | | | | | |
| Average | | | 204.0 | 477.2 | 12.4 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 5 mm
Absolute pressure in stack (hPa) : 1026.49 hPa

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**STACK ANALYSIS**

**SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS**

Date: 26-Jun-15

Client: Weston

AECOM's Project No: 60341673

Stack Description No.: Stack 6

| | | | | |
|---|---|---|---|---|
| Sample Nozzle No.: | G61 | Sample Nozzle Area (An): | 2.69 | x $10^{-5}m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | DAU150615B | |
| Page No: | 1 of 1 | Blank thimble No: | NA | |

**Leak Check (Pre-Sampling)**

Meter start: 315.9408 Meter finish: 315.9408

Time start: 12:25 Time finish: 12:26

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Leak Check (Post Sampling)**

Meter start: 316.9560 Meter finish: 316.9560

Time start: 1:50 Time finish: 1:51

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Sampling Record Table**

Barometric Pressure: 1026 hPa (start); 1026 hPa (finish)

Meter start: 315.9418 Time start: 12:28

Meter correction factor (GMf) : 1.0060

| 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 | 0:10:00 | 39 | 12.1 | 25.0 | 24.0 | | Yes |
| 1/2 | 0:20:00 | 145 | 12.0 | 25.0 | 25.0 | | Yes |
| 1/3 | 0:30:00 | 435 | 11.1 | 26.0 | 25.0 | | Yes |
| 1/4 | 0:40:00 | 541 | 10.9 | 26.0 | 25.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:50:00 | 39 | 12.1 | 28.0 | 27.0 | | Yes |
| 2/2 | 1:00:00 | 145 | 12.8 | 28.0 | 27.0 | | Yes |
| 2/3 | 1:10:00 | 435 | 12.8 | 28.0 | 27.0 | | Yes |
| 2/4 | 1:20:00 | 541 | 13.4 | 26.0 | 26.0 | | Yes |
| Averages | | | | 26.5 | 25.8 | no result | |

Meter Finish: 316.9550 Time Finish: 1:48

Total Condensate collected: 4 ml Silica gel No(s) used: Z13

# Emission Measurement Calculations Spreadsheet

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

AECOM

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6
Test 1:Polycyclic Aromatic Hydrocarbons

| | | | | |
|---|---|---|---|---|
| Time : | 1:55 | Barometric Pressure : | 1026 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.30 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 $^{o}$C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. $^{o}$C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 9 | 0.081 | 204.0 | 477.2 | 12.4 |
| 1/2 | 115 | 0.077 | 204.0 | 477.2 | 12.1 |
| 1/3 | 405 | 0.069 | 204.0 | 477.2 | 11.4 |
| 1/4 | 511 | 0.065 | 204.0 | 477.2 | 11.0 |
| | | | | | |
| 2/1 | 9 | 0.079 | 204.0 | 477.2 | 12.2 |
| 2/2 | 115 | 0.088 | 204.0 | 477.2 | 12.9 |
| 2/3 | 405 | 0.090 | 204.0 | 477.2 | 13.0 |
| 2/4 | 511 | 0.096 | 204.0 | 477.2 | 13.4 |
| Average | | | 204.0 | 477.2 | 12.3 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 0 mm
Absolute pressure in stack (hPa) : 1026.00 hPa

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

| | |
|---|---|
| Date: | 26-Jun-15 |
| Client: | Weston |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 6 |

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | 4700 | 4.7 | 0.0047 | 5 | 0.005 | 9.2 | 0.0092 |
| 2 - Methylnapthalene | 890 | 0.89 | 0.00089 | 0.94 | 0.00094 | 1.8 | 0.0018 |
| Acenaphthylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Acenaphthene | 180 | 0.18 | 0.00018 | 0.19 | 0.00019 | 0.35 | 0.00035 |
| Fluorene | 74 | 0.074 | 0.000074 | 0.079 | 0.000079 | 0.15 | 0.00015 |
| Phenanthrene | 420 | 0.42 | 0.00042 | 0.45 | 0.00045 | 0.83 | 0.00083 |
| Anthracene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Fluoranthene | 270 | 0.27 | 0.00027 | 0.29 | 0.00029 | 0.53 | 0.00053 |
| Pyrene | 140 | 0.14 | 0.00014 | 0.15 | 0.00015 | 0.28 | 0.00028 |
| Benz(a)anthracene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Chrysene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(b)fluoranthene | 25 | 0.025 | 0.000025 | 0.027 | 0.000027 | 0.049 | 0.000049 |
| Benzo(k)fluoranthene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(e)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Benzo(a)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Perylene | 42 | 0.042 | 0.000042 | 0.045 | 0.000045 | 0.083 | 0.000083 |
| Indeno(123:cd)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.039 | <0.000039 |
| Dibenzo(ah)anthracene | 39 | 0.039 | 0.000039 | 0.041 | 0.000041 | 0.077 | 0.000077 |
| Benzo(ghi)perylene | <29 | <0.029 | <0.000029 | 0.031 | <0.000031 | <0.057 | <0.000057 |
| Sum of reported PAH's | 6800 | 6.8 | 0.0068 | 7.4 | 0.0072 | 13 | 0.013 |

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## STACK ANALYSIS - FINAL CALCULATIONS

**Polycyclic Aromatic Hydrocarbons**

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

Date: 26-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 6

(A) Sample gas volume at standard conditions

| | | | |
|---|---|---|---|
| Metered volume ($MV_3$): | 1.0193 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1026 hPa |
| Average gas meter temp. ($T_{M,2}$): | 26.1 °C | | |
| | 299.3 K | Average pressure at meter ($P_{M,2}$) | 1026.00 hPa |

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.9421 $m^3$

(B) PAH concentration at standard conditions

Blank thimble No.: NA
Blank weight: g
Thimble No. used: DAU150615B
PAH Weight 0.0000068 g
Final PAH Weight (Mp1): 0.00001 g
PAH Concentration (C1): $=M_{p1}/MV_4=$ 7.2E-06 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.0072 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 4.5 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.000019 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.019 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 13.0 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.000013 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 0.013 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z13
$V_v$ = 9.3 g (from laboratory report)
$V_w$ = 4 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0053
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0124

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

$B_{ws}$ = 1.85 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Polycyclic Aromatic Hydrocarbons**

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

(i) Initial gas density for sampling: 1.29 kg/m$^3$ (from Laboratory Form 107)

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

(iii) Gas density at stack conditions =

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

= 0.736 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 12.35 m/s

(ii) Average of post-sampling velocities: 12.30 m/s

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

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

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

Qstack = Vs x A = 3.26 m$^3$/s (stack conditions)

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

Qstd = 1.9 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.000013 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 0.013 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.000036 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 0.036 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.000023 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 0.023 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

**EMISSION MONITORING RESULTS, STACK 6**
**WESTON**
26-Jun-15
POLYCYCLIC AROMATIC HYDROCARBONS

| | | |
|---|---|---|
| **Sampling Conditions:** | | |
| Stack internal diameter at test location | 580 mm | |
| Stack gas temperature (average) | 204.0 °C | 477.2 K |
| Stack pressure (average) | 1026 hPa | |
| Stack gas velocity (average, stack conditions) | 12 m/s | |
| Stack gas flowrate (stack conditions) | 3.3 $m^3/s$ | |
| Stack gas flowrate ($0^oC$, dry gas, 1 atm pressure) | 1.9 $m^3/s$ | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | |
| Test Period | 12:28 - | 1:48 |
| Polycyclic Aromatic Hydrocarbons Mass | 0.0068 mg | |
| Gas Volume Sampled | 0.942 $m^3$ | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.0072 $mg/m^3$ | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.013 mg/s | |
| Regulatory Limit | NA $mg/m^3$ | |
| **Moisture Content (%)** | 1.8 | |
| **Gas Density (dry at 1 atmosphere)** | 1.31 $kg/m^3$ | |
| **Dry Molecular Weight** | 29.2 g/g-mole | |

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

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

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

**Weston**

AECOM's Project Number: 60341673

Emission Source: Stack 7

Date Sampled: 2-Jun-15

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

Observations made during testing period:

Sampling Performed By:

James Lang

Vilai Kelemete-Manua

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

AECOM

## STACK ANALYSIS - PRE-SAMPLING

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

Measurement/Observations

Stack Internal Dimensions:

Diameter 1500 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.77 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Fan
Downstream (m) = 3.1
No. Diameters = 2.1
Type of Down Stream Disturbance: Stack Exit

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

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 | 66 | 36 | 66 | 36 |
| 2 | 219 | 189 | 219 | 189 |
| 3 | 444 | 414 | 444 | 414 |
| 4 | 1056 | 1026 | 1056 | 1026 |
| 5 | 1281 | 1251 | 1281 | 1251 |
| 6 | 1434 | 1404 | 1434 | 1404 |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
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| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

# Emission Measurement Calculations Spreadsheet

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 10:15 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 10:15 | 54 | 20.9 | 0.0 |
| 2 | 10:16 | 54 | 20.9 | 0.0 |
| 3 | 10:17 | 54 | 20.9 | 0.0 |
| 4 | 10:18 | 54 | 20.9 | 0.0 |
| 5 | 10:19 | 54 | 20.9 | 0.0 |
| 6 | 10:20 | 54 | 20.9 | 0.0 |
| 7 | 10:21 | 54 | 20.9 | 0.0 |
| 8 | 10:22 | 54 | 20.9 | 0.0 |
| | Averages: | 54.0 ppm | 20.9 % | 0.0 % |

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

Measurements

| | |
|---|---|
| CO: 0.0054 %,(dry) | $N_2$: 79.1 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.9 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0053 %,(wet) | $N_2$: 78.1 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 20.6 %,(wet) |
| $H_2O$: 1.30 %(=M2) | |
| Therefore, stack gas density (GD) = 1.28 kg/m$^3$ | (0°C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0°C, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Total Fluoride

| | | | | |
|---|---|---|---|---|
| Sampling time start: | 12:25 | Sampling port No.: 1 | | |
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 12:25 | 16 | 20.7 | 0.0 |
| 2 | 12:26 | 16 | 20.7 | 0.0 |
| 3 | 12:27 | 16 | 20.7 | 0.0 |
| 4 | 12:28 | 16 | 20.7 | 0.0 |
| 5 | 12:29 | 16 | 20.7 | 0.0 |
| 6 | 12:30 | 16 | 20.7 | 0.0 |
| 7 | 12:31 | 16 | 20.7 | 0.0 |
| 8 | 12:32 | 16 | 20.7 | 0.0 |
| | Averages: | 16.0 ppm | 20.7 % | 0.0 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 1.91 %

Measurements

| | |
|---|---|
| CO: 0.0016 %,(dry) | $N_2$: 79.3 %,(dry) |
| $CO_2$: 0.0 %,(dry) | $O_2$: 20.7 %,(dry) |
| Gas Compositions converted to wet basis: | |
| CO: 0.0016 %,(wet) | $N_2$: 77.8 %,(wet) |
| $CO_2$: 0.0 %,(wet) | $O_2$: 20.3 %,(wet) |
| $H_2O$: 1.91 %(=M2) | |
| Therefore, stack gas density (GD) = 1.28 kg/m$^3$ | (0$^o$C, wet, 1 atm pressure) |
| Therefore, stack gas density (GD) = 1.29 kg/m$^3$ | (0$^o$C, dry, 1 atm pressure) |

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 10:15 | Barometric Pressure : | 1021 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.225 | 29.0 | 302.2 | 16.5 |
| 1/2 | 189 | 0.235 | 29.0 | 302.2 | 16.9 |
| 1/3 | 414 | 0.238 | 29.0 | 302.2 | 17.0 |
| 1/4 | 1026 | 0.232 | 30.0 | 303.2 | 16.8 |
| 1/5 | 1251 | 0.231 | 30.0 | 303.2 | 16.7 |
| 1/6 | 1404 | 0.219 | 31.0 | 304.2 | 16.3 |
| | | | | | |
| 2/1 | 36 | 0.228 | 33.0 | 306.2 | 16.7 |
| 2/2 | 189 | 0.239 | 33.0 | 306.2 | 17.1 |
| 2/3 | 414 | 0.250 | 33.0 | 306.2 | 17.5 |
| 2/4 | 1026 | 0.253 | 33.0 | 306.2 | 17.6 |
| 2/5 | 1251 | 0.220 | 34.0 | 307.2 | 16.4 |
| 2/6 | 1404 | 0.226 | 34.0 | 307.2 | 16.6 |
| Average | | | 31.5 | 304.7 | 16.8 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 14.7 mm
Absolute pressure in stack (hPa) : 1022.44 hPa

**STACK ANALYSIS**
**SAMPLING OF FINE PARTICULATE (PM10)**

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 7
Sample Nozzle No.: Fine4
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.58 x $10^{-5}m^2$
Thimble No: T300
Blank thimble No: 0

**Leak Check (Pre-Sampling)**
Meter start: 173.5130 Meter finish: 173.5130
Time start: 10:58 Time finish: 10:59

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 174.3252 Meter finish: 174.3252
Time start: 12:27 Time finish: 12:28

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1021 hPa (start); 1021 hPa (finish)
Meter start: 173.5148
Time start: 11:19
Meter correction factor (GMf) : 1.0033

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 13.5 | 27.0 | 16.0 | | Yes |
| 1/2 | 0:05:00 | 219 | 13.5 | 26.0 | 16.0 | | Yes |
| 1/3 | 0:05:00 | 444 | 13.5 | 25.0 | 15.0 | | Yes |
| 1/4 | 0:05:00 | 1056 | 13.5 | 25.0 | 15.0 | | Yes |
| 1/5 | 0:05:00 | 1281 | 13.5 | 24.0 | 14.0 | | Yes |
| 1/6 | 0:04:45 | 1434 | 13.5 | 23.0 | 14.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:05:00 | 66 | 13.5 | 24.0 | 13.0 | | Yes |
| 2/2 | 0:05:00 | 219 | 13.5 | 23.0 | 13.0 | | Yes |
| 2/3 | 0:05:15 | 444 | 13.5 | 22.0 | 12.0 | | Yes |
| 2/4 | 0:05:15 | 1056 | 13.5 | 20.0 | 12.0 | | Yes |
| 2/5 | 0:04:45 | 1281 | 13.5 | 19.0 | 12.0 | | Yes |
| 2/6 | 0:05:00 | 1434 | 13.5 | 16.0 | 11.0 | | Yes |
| Averages | | | | 22.8 | 13.6 | no result | |

Meter Finish: 174.3220
Time Finish: 12:24
Total Condensate collected: 1 ml
Silica gel No(s) used: Z9

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**STACK ANALYSIS**
**SAMPLING OF TOTAL PARTICULATE**

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 7
Sample Nozzle No.: s16
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.35 $\times 10^{-5} m^2$
Thimble No: T305
Blank thimble No:

**Leak Check (Pre-Sampling)**
Meter start: 487.6376 Meter finish: 487.6376
Time start: 11:03 Time finish: 11:04

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**
Meter start: 488.4354 Meter finish: 488.4356
Time start: 12:29 Time finish: 12:30

Therefore, leakage rate = 0.2 L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1021 hPa (start); 1021 hPa (finish)
Meter start: 487.6401 Time start: 11:19
Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 13.3 | 20.0 | 16.0 | | Yes |
| 1/2 | 0:10:00 | 219 | 13.6 | 19.0 | 15.0 | | Yes |
| 1/3 | 0:15:00 | 444 | 13.7 | 17.0 | 14.0 | | Yes |
| 1/4 | 0:20:00 | 1056 | 13.5 | 16.0 | 13.0 | | Yes |
| 1/5 | 0:25:00 | 1281 | 13.4 | 15.0 | 13.0 | | Yes |
| 1/6 | 0:30:00 | 1434 | 13.0 | 15.0 | 13.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 66 | 13.3 | 15.0 | 13.0 | | Yes |
| 2/2 | 0:40:00 | 219 | 13.6 | 14.0 | 12.0 | | Yes |
| 2/3 | 0:45:00 | 444 | 13.9 | 14.0 | 12.0 | | Yes |
| 2/4 | 0:50:00 | 1056 | 14.0 | 13.0 | 12.0 | | Yes |
| 2/5 | 0:55:00 | 1281 | 13.0 | 13.0 | 12.0 | | Yes |
| 2/6 | 1:00:00 | 1434 | 13.1 | 12.0 | 12.0 | | Yes |
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| | | | | | | | |
| Averages | | | | 15.3 | 13.1 | no result | |

Meter Finish: 488.4341
Total Condensate collected: 1 ml
Time Finish: 12:24
Silica gel No(s) used: 134

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## STACK ANALYSIS
## SAMPLING OF TOTAL FLUORIDE

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 7

| | | | | |
|---|---|---|---|---|
| Sample Nozzle No.: | s2 | Sample Nozzle Area (An): | 1.16 | x $10^{-5}$m$^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | 0 | |
| Page No: | 1 of 1 | Blank thimble No: | | |

| **Leak Check (Pre-Sampling)** | | | | **Leak Check (Post Sampling)** | | | |
|---|---|---|---|---|---|---|---|
| Meter start: | 299.9205 | Meter finish: | 299.9205 | Meter start: | 300.6264 | Meter finish: | 300.6266 |
| Time start: | 11:07 | Time finish: | 11:08 | Time start: | 12:32 | Time finish: | 12:33 |

Therefore, leakage rate = no leak L/min — Therefore, leakage rate = 0.2 L/min

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

Repeat: — Repeat:
Comments: — Comments:

**Sampling Record Table**

Barometric Pressure: 1021 hPa (start); 1021 hPa (finish)
Meter start: 299.9240 Time start: 11:19
Meter correction factor (GMf) : 1.0063

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:00 | 66 | 11.4 | 12.0 | 11.0 | | Yes |
| 1/2 | 0:10:00 | 219 | 11.6 | 13.0 | 12.0 | | Yes |
| 1/3 | 0:15:00 | 444 | 11.7 | 14.0 | 12.0 | | Yes |
| 1/4 | 0:20:00 | 1056 | 11.5 | 15.0 | 12.0 | | Yes |
| 1/5 | 0:25:00 | 1281 | 11.5 | 15.0 | 12.0 | | Yes |
| 1/6 | 0:30:00 | 1434 | 11.2 | 16.0 | 13.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:35:00 | 66 | 11.4 | 16.0 | 14.0 | | Yes |
| 2/2 | 0:40:00 | 219 | 11.6 | 18.0 | 14.0 | | Yes |
| 2/3 | 0:45:00 | 444 | 11.9 | 19.0 | 15.0 | | Yes |
| 2/4 | 0:50:00 | 1056 | 12.0 | 21.0 | 16.0 | | Yes |
| 2/5 | 0:55:00 | 1281 | 11.1 | 22.0 | 18.0 | | Yes |
| 2/6 | 1:00:00 | 1434 | 11.2 | 23.0 | 19.0 | | Yes |
| Averages | | | | 17.0 | 14.0 | no result | |

Meter Finish: 300.6246 Time Finish: 12:24
Total Condensate collected: 1 ml Silica gel No(s) used: F25

# Emission Measurement Calculations Spreadsheet

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

AECOM

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Total Fluoride

| | | | | |
|---|---|---|---|---|
| Time : | 12:35 | Barometric Pressure : | 1021 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.199 | 31.0 | 304.2 | 15.6 |
| 1/2 | 189 | 0.287 | 31.0 | 304.2 | 18.7 |
| 1/3 | 414 | 0.263 | 31.0 | 304.2 | 17.9 |
| 1/4 | 1026 | 0.264 | 30.0 | 303.2 | 17.9 |
| 1/5 | 1251 | 0.279 | 30.0 | 303.2 | 18.4 |
| 1/6 | 1404 | 0.268 | 30.0 | 303.2 | 18.0 |
| | | | | | |
| 2/1 | 36 | 0.241 | 32.0 | 305.2 | 17.2 |
| 2/2 | 189 | 0.253 | 32.0 | 305.2 | 17.6 |
| 2/3 | 414 | 0.246 | 33.0 | 306.2 | 17.4 |
| 2/4 | 1026 | 0.244 | 33.0 | 306.2 | 17.3 |
| 2/5 | 1251 | 0.232 | 32.0 | 305.2 | 16.8 |
| 2/6 | 1404 | 0.221 | 31.0 | 304.2 | 16.4 |
| Average | | | 31.3 | 304.5 | 17.4 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 15.2 mm
Absolute pressure in stack (hPa) : 1022.49 hPa

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## STACK ANALYSIS - PM10 CALCULATIONS

| | | | |
|---|---|---|---|
| Date: | 2-Jun-15 | Client: | Weston |
| AECOM's Project No: | 60341673 | Stack/Duct Description: | Stack 7 |

### 1. Gas Analysis

| | | | |
|---|---|---|---|
| | % | | |
| %$CO_2$ | 0.0 | | |
| %$O_2$ | 20.7 | | |
| %$N_2$+%CO | 79.1 | | |
| Fraction Moisture Content, Bws | 0.01 | $M_3$= | 0.99 |

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

| | |
|---|---|
| Mol. Wt. of Stack Gas (dry) | 28.84 |
| Mol. Wt. of Stack Gas (wet) | 28.70 |

### 3. Absolute Stack Pressure

| | | |
|---|---|---|
| | Pascals | in. Hg |
| Barometric Pressure (Pbar) | 102100 | 30.14 |
| Stack Static Pressure (Pg) | 102249 | 30.19 |
| Absolute Stack Pressure | | 30.19 |

### 4. Viscosity of Stack Gas

| | | |
|---|---|---|
| | °C | °F |
| Average Stack Temp. | 31.3 | 88.4 |
| Average Meter Temperature: | 18.2 | |
| Stack Gas Viscosity | | 185.5 |

### 5. Cyclone Flow Rate

| | | | | |
|---|---|---|---|---|
| | $ft^3$/min | $m^3$/min | L/min | L/s |
| Cyclone Flow Rate | 0.46 | 0.0162 | 16.24 | 0.27 |

### 6. Nozzle Velocity, Rmin and Rmax

| Nozzle Number | Nozzle Diameter | Nozzle Velocity | | Rmin | Rmax | Vmin | Vmin | Vmax | Vmax |
|---|---|---|---|---|---|---|---|---|---|
| | (inches) | ft/sec | m/s | [-] | [-] | ft/sec | m/s | ft/sec | m/s |
| 0 | 0.125 | 90.23 | 29.70 | 0.764 | 1.225 | 68.97 | 22.63 | 110.52 | 36.26 |
| 1 | 0.133 | 78.90 | 25.97 | 0.756 | 1.230 | 59.65 | 19.57 | 97.07 | 31.85 |
| 2 | 0.147 | 65.17 | 21.45 | 0.741 | 1.240 | 48.27 | 15.84 | 80.82 | 26.52 |
| 3 | 0.163 | 52.65 | 17.33 | 0.716 | 1.255 | 37.71 | 12.37 | 66.06 | 21.67 |
| 4 | 0.176 | 45.18 | 14.87 | 0.692 | 1.268 | 31.27 | 10.26 | 57.30 | 18.80 |
| 5 | 0.194 | 37.15 | 12.23 | 0.649 | 1.290 | 24.11 | 7.91 | 47.94 | 15.73 |
| 6 | 0.214 | 30.75 | 10.12 | 0.585 | 1.318 | 17.99 | 5.90 | 40.53 | 13.30 |
| 7 | 0.229 | 26.86 | 8.84 | 0.514 | 1.342 | 13.81 | 4.53 | 36.06 | 11.83 |
| 8 | 0.260 | 20.75 | 6.83 | #NUM! | 1.402 | 10.38 | 3.40 | 29.10 | 9.55 |
| 9 | 0.294 | 16.21 | 5.33 | #NUM! | 1.481 | 8.10 | 2.66 | 23.99 | 7.87 |
| 10 | 0.339 | 12.26 | 4.04 | #NUM! | 1.600 | 6.13 | 2.01 | 18.39 | 6.03 |
| 11 | 0.390 | 9.25 | 3.05 | #NUM! | 1.762 | 4.63 | 1.52 | 13.88 | 4.55 |
| | Nozzle Diameter | Nozzle Diameter | Nozzle Area | Sample Rate | | | | | |
| Selected Nozzle | (inches) | (m) | ($m^2$) | (L/min) | | | | | |
| 4 | 0.176 | 0.004 | 0.000016 | 13.3 | | | | | |

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**STACK ANALYSIS - PM10 CALCULATIONS CONTINUED**

Date: 2-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Stack 7

**7.Sampling Time** Total Run Time 60 Number of points 12

| Velocity Head ( pitot) Pa | Vel Head in H20 | Sqr Root | Dwell time mins |
|---|---|---|---|
| 199.14 | 0.80 | 0.89 | 4.5 |
| 287.43 | 1.15 | 1.07 | 5.4 |
| 262.91 | 1.06 | 1.03 | 5.1 |
| 263.89 | 1.06 | 1.03 | 5.1 |
| 278.60 | 1.12 | 1.06 | 5.3 |
| 267.81 | 1.07 | 1.04 | 5.2 |
| | | | |
| 241.33 | 0.97 | 0.98 | 4.9 |
| 253.10 | 1.02 | 1.01 | 5.0 |
| 246.23 | 0.99 | 0.99 | 5.0 |
| 244.27 | 0.98 | 0.99 | 5.0 |
| 231.52 | 0.93 | 0.96 | 4.8 |
| 220.73 | 0.89 | 0.94 | 4.7 |
| | Average | 1.00 | 60.00 |
| | Square | 1.00 | |

| Total time min | Full hours | Full minutes | Seconds |
|---|---|---|---|
| 5.0 | 0 | 5 | 0 |
| 10.0 | 0 | 10 | 0 |
| 15.0 | 0 | 15 | 0 |
| 20.0 | 0 | 20 | 0 |
| 25.0 | 0 | 25 | 0 |
| 29.8 | 0 | 29 | 45 |
| | | | |
| 34.8 | 0 | 34 | 45 |
| 39.8 | 0 | 39 | 45 |
| 45.0 | 0 | 45 | 0 |
| 50.3 | 0 | 50 | 15 |
| 55.0 | 0 | 55 | 0 |
| 60.0 | 1 | 0 | 0 |

**Aerodynamic Cut Size ($u_{cyc}$)**
185.9

**$PM_{10}$ Flow rate at actual cyclone conditions ($Q_s$)**
0.0133

**Actual $D_{50}$**
9.9

## STACK ANALYSIS - FINAL CALCULATIONS

**Fine Particulate (PM10)**

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

Date: 2-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

| | | | |
|---|---|---|---|
| Metered volume ($MV_3$): | 0.8099 $m^3$ | Average barometric pressure ($P_{BARO}$) | 1021 hPa |
| Average gas meter temp. ($T_{M,2}$): | 18.2 °C | | |
| | 291.4 K | Average pressure at meter ($P_{M,2}$) | 1021.00 hPa |
| Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): | 0.7651 $m^3$ | | |

(B) PM10 concentration at standard conditions

| | | | |
|---|---|---|---|
| Blank thimble No.: | 0 | Blank weight: | g |
| Thimble No. used: | T300 | PM10 Weight | 0.0004 g |
| Final PM10 Weight (Mp1): | 0.00040 g | | |

PM10 Concentration (C1): $=M_{p1}/MV_4=$ 0.00052 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.52 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00052 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.52 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.036 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 36 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: Z9

$V_v$ = 4.8 g (from laboratory report) $V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0013
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0064

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

$B_{ws}$ = 1.00 %

# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Fine Particulate (PM10)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.158 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.84 m/s

(ii) Average of post-sampling velocities: 17.43 m/s

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

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

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

Qstack = Vs x A = 30.29 m$^3$/s (stack conditions)

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

Qstd = 27.1 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.014 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 14 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.014 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 14 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.99 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 990 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

AECOM

## STACK ANALYSIS - FINAL CALCULATIONS

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.8020 $m^3$
Average gas meter temp. ($T_{M,2}$): 14.2 °C
287.4 K
Average barometric pressure ($P_{BARO}$) 1021 hPa
Average pressure at meter ($P_{M,2}$) 1021.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.7682 $m^3$

(B) Total Particulate concentration at standard conditions
Blank thimble No.:
Blank weight: g
Thimble No. used: T305
Total Particulate Weight 0.001 g
Final Total Particulate Weight (Mp1): 0.00100 g
Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0013 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 1.3 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.0013 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 1.3 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.091 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 91 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: 134
$V_v$ = 21.2 g (from laboratory report)
$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0013
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0283

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

$B_{ws}$ = 3.71 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Particulate**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.177 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.84 m/s

(ii) Average of post-sampling velocities: 17.43 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
17.14 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 = 30.29 $m^3$/s (stack conditions)

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

Qstd = 26.4 $m^3$/s ($0^oC$, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.034 | g/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | = | 34 | mg/s ($0^oC$, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.034 | g/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 34 | mg/s ($0^oC$, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 2.4 | g/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 2400 | mg/s ($0^oC$, dry gas, 1 atm pressure | 7% | $O_2$ ) |

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS

**Total Fluoride**

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.7050 $m^3$
Average gas meter temp. ($T_{M,2}$): 15.5 °C
288.7 K
Average barometric pressure ($P_{BARO}$) 1021 hPa
Average pressure at meter ($P_{M,2}$) 1021.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.6723 $m^3$

(B) Total Fluoride concentration at standard conditions
Blank thimble No.:
Thimble No. used: 0
Blank weight: g
Total Fluoride Weight 0.00018 g
Final Total Fluoride Weight (Mp1): 0.00018 g
Total Fluoride Concentration (C1): $=M_{p1}/MV_4=$ 0.00027 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.27 $mg/m^3$ (0°C, dry gas. 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.00027 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.27 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.019 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 19 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: F25
$V_v$ = 4.2 g (from laboratory report)
$V_w$ = 1 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0013
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0056

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

$B_{ws}$ = 1.02 %

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Total Fluoride**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.158 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.84 m/s

(ii) Average of post-sampling velocities: 17.43 m/s

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

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

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

Qstack = Vs x A = 30.29 m$^3$/s (stack conditions)

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

Qstd = 27.1 m$^3$/s (0$^o$C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0073 | g/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | = | 7.3 | mg/s (0$^o$C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0073 | g/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 7.3 | mg/s (0$^o$C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.51 | g/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 510 | mg/s (0$^o$C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 7**
**WESTON**
2-Jun-15
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
TOTAL FLUORIDE

| | | | |
|---|---|---|---|
| **Sampling Conditions:** | | | |
| Stack internal diameter at test location | 1500 mm | | |
| Stack gas temperature (average) | 31.4 °C | | 304.6 K |
| Stack pressure (average) | 1022 hPa | | |
| Stack gas velocity (average, stack conditions) | 17 m/s | | |
| Stack gas flowrate (stack conditions) | 30 $m^3/s$ | | |
| Stack gas flowrate ($0^0C$, dry gas, 1 atm pressure) | 27 $m^3/s$ | | |
| **Fine Particulate (PM10) Testing** | | | |
| Test Period | 11:19 | - | 12:24 |
| Fine Particulate (PM10) Mass | 0.4 mg | | |
| Gas Volume Sampled | 0.765 $m^3$ | | |
| Fine Particulate (PM10) Emission*1 | 0.52 $mg/m^3$ | | |
| Fine Particulate (PM10) Mass Emission Rate*2 | 14 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Total Particulate Testing** | | | |
| Test Period | 11:19 | - | 12:24 |
| Total Particulate Mass | 1 mg | | |
| Gas Volume Sampled | 0.768 $m^3$ | | |
| Total Particulate Emission*1 | 1.3 $mg/m^3$ | | |
| Total Particulate Mass Emission Rate*2 | 34 mg/s | | |
| Regulatory Limit | 15 $mg/m^3$ | | |
| **Total Fluoride Testing** | | | |
| Test Period | 11:19 | - | 12:24 |
| Total Fluoride Mass | 0.18 mg | | |
| Gas Volume Sampled | 0.672 $m^3$ | | |
| Total Fluoride Emission*1 | 0.27 $mg/m^3$ | | |
| Total Fluoride Mass Emission Rate*2 | 7.3 mg/s | | |
| Regulatory Limit | NA $mg/m^3$ | | |
| **Moisture Content (%)** | 2.4 | | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | | |
| **Dry Molecular Weight** | 28.8 g/g-mole | | |

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

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

# Emission Measurement Calculations Spreadsheet

AECOM

**Weston**

AECOM's Project Number: 60341673

Emission Source: Stack 7

Date Sampled: 2-Jun-15

| **ANALYTE(S)** | **METHOD** |
|---|---|
| Polycyclic Aromatic Hydrocarbons | NSW EPA OM - 6 |
| Sulfuric Acid Mist | NSW EPA TM - 3 |
| Sulfur Dioxide | NSW EPA TM - 4 |

Observations made during testing period:

Sampling Performed By:

Vilai Kelemete-Manua

Dylan Turnbull

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - PRE-SAMPLING

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1: Polycyclic Aromatic Hydrocarbons
Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
Test 3: Sulfur Dioxide (SO2 as SO3)

Measurement/Observations

Stack Internal Dimensions:

Diameter 1500 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 1.77 $m^2$

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 10
No. Diameters = 6.7
Type of Upstream Disturbance: Fan
Downstream (m) = 3.1
No. Diameters = 2.1
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 12
PM2.5/10= NA
No. of sampling traverses/ports sampled = 2
PM2.5/10= NA
No. of sampling points on each traverse/port = 6
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 | 66 | 36 | | |
| 2 | 219 | 189 | | |
| 3 | 444 | 414 | | |
| 4 | 1056 | 1026 | | |
| 5 | 1281 | 1251 | | |
| 6 | 1434 | 1404 | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

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

General Comments:

Signed: ..............................

Checked: ..............................

**ANZ**

# Emission Measurement Calculations Spreadsheet

**Q4AN(EV)-332-FM31**

AECOM

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

| | |
|---|---|
| Date: | 2-Jun-15 |
| Client: | Weston |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 7 |
| Test 1: | Polycyclic Aromatic Hydrocarbons |
| Test 2: | Sulfuric Acid Mist (H2SO4 as SO3) |
| Test 3: | Sulfur Dioxide (SO2 as SO3) |

| Sampling time start: | 9:55 | Sampling port No.: 1 | | |
|---|---|---|---|---|
| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
| 1 | 9:55 | 16 | 20.7 | 0.0 |
| 2 | 9:56 | 16 | 20.7 | 0.0 |
| 3 | 9:57 | 16 | 20.7 | 0.0 |
| 4 | 9:58 | 16 | 20.7 | 0.0 |
| 5 | 9:59 | 16 | 20.7 | 0.0 |
| 6 | 10:00 | 16 | 20.7 | 0.0 |
| 7 | 10:01 | 16 | 20.7 | 0.0 |
| 8 | 10:02 | 16 | 20.7 | 0.0 |
| | Averages: | 16.0 ppm | 20.7 % | 0.0 % |

Moisture content (M3): 0.99

Moisture percentage (M2): 1.30 %

Measurements

| | | | |
|---|---|---|---|
| CO: | 0.0016 %,(dry) | $N_2$: | 79.3 %,(dry) |
| $CO_2$: | 0.0 %,(dry) | $O_2$: | 20.7 %,(dry) |
| Gas Compositions converted to wet basis: | | | |
| CO: | 0.0016 %,(wet) | $N_2$: | 78.3 %,(wet) |
| $CO_2$: | 0.0 %,(wet) | $O_2$: | 20.4 %,(wet) |
| $H_2O$: | 1.30 %(=M2) | | |

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

# Emission Measurement Calculations Spreadsheet

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1: Polycyclic Aromatic Hydrocarbons
Test 2: Sulfuric Acid Mist (H2SO4 as SO3)
Test 3: Sulfur Dioxide (SO2 as SO3)

Sampling time start: 11:30
Sampling port No.: 1

| Measurement No. | Time sampled | CO (ppm). (dry) | $O_2$ (%), (dry) | $CO_2$ (%), (dry) |
|---|---|---|---|---|
| 1 | 11:30 | 2 | 20.9 | 0.0 |
| 2 | 11:31 | 2 | 20.9 | 0.0 |
| 3 | 11:32 | 2 | 20.9 | 0.0 |
| 4 | 11:33 | 2 | 20.9 | 0.0 |
| 5 | 11:34 | 2 | 20.9 | 0.0 |
| 6 | 11:35 | 2 | 20.9 | 0.0 |
| 7 | 11:36 | 2 | 20.9 | 0.0 |
| 8 | 11:37 | 2 | 20.9 | 0.0 |
| | Averages: | 2.0 ppm | 20.9 % | 0.0 % |

Moisture content (M3): 0.98
Moisture percentage (M2): 1.53 %

Measurements

CO: 0.0002 %,(dry)
$CO_2$: 0.0 %,(dry)
$N_2$: 79.1 %,(dry)
$O_2$: 20.9 %,(dry)

Gas Compositions converted to wet basis:

CO: 0.0002 %,(wet)
$CO_2$: 0.0 %,(wet)
$H_2O$: 1.53 %(=M2)
$N_2$: 77.9 %,(wet)
$O_2$: 20.6 %,(wet)

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

# Emission Measurement Calculations Spreadsheet

AECOM

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1:Polycyclic Aromatic Hydrocarbons
Test 2:Sulfuric Acid Mist (H2SO4 as SO3)
Test 3:Sulfur Dioxide (SO2 as SO3)

| | | | | |
|---|---|---|---|---|
| Time : | 9:55 | Barometric Pressure : | 1021 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 $^o$C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. $^o$C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.253 | 22.0 | 295.2 | 17.3 |
| 1/2 | 189 | 0.252 | 22.0 | 295.2 | 17.2 |
| 1/3 | 414 | 0.227 | 22.0 | 295.2 | 16.4 |
| 1/4 | 1026 | 0.200 | 22.0 | 295.2 | 15.4 |
| 1/5 | 1251 | 0.222 | 22.0 | 295.2 | 16.2 |
| 1/6 | 1404 | 0.181 | 22.0 | 295.2 | 14.6 |
| | | | | | |
| 2/1 | 36 | 0.228 | 22.0 | 295.2 | 16.4 |
| 2/2 | 189 | 0.239 | 22.0 | 295.2 | 16.8 |
| 2/3 | 414 | 0.250 | 22.0 | 295.2 | 17.2 |
| 2/4 | 1026 | 0.253 | 22.0 | 295.2 | 17.3 |
| 2/5 | 1251 | 0.220 | 22.0 | 295.2 | 16.1 |
| 2/6 | 1404 | 0.226 | 22.0 | 295.2 | 16.3 |
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| | | | | | |
| Average | | | 22.0 | 295.2 | 16.4 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : 12 mm
Absolute pressure in stack (hPa) : 1022.18 hPa

ANZ

# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS
## SAMPLING OF POLYCYCLIC AROMATIC HYDROCARBONS

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack Description No.: Stack 7
Sample Nozzle No.: G08
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 1.59 x $10^{-5}m^2$
Thimble No: DAU210415C
Blank thimble No: NA

**Leak Check (Pre-Sampling)**

Meter start: 303.0543 Meter finish: 303.0543
Time start: 9:58 Time finish: 9:59

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Leak Check (Post Sampling)**

Meter start: 304.0499 Meter finish: 304.0499
Time start: 11:12 Time finish: 11:13

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

**Sampling Record Table**

Barometric Pressure: 1016 hPa (start); 1016 hPa (finish)
Meter start: 303.0600 Time start: 10:02
Meter correction factor (GMf) : 1.0033

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:30 | 66 | 16.7 | 12.0 | 11.0 | | Yes |
| 1/2 | 0:11:00 | 219 | 16.6 | 13.0 | 11.0 | | Yes |
| 1/3 | 0:16:30 | 444 | 15.8 | 13.0 | 11.0 | | Yes |
| 1/4 | 0:22:00 | 1056 | 14.8 | 13.0 | 11.0 | | Yes |
| 1/5 | 0:27:30 | 1281 | 15.6 | 13.0 | 11.0 | | Yes |
| 1/6 | 0:33:00 | 1434 | 14.1 | 14.0 | 12.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:38:30 | 66 | 15.8 | 14.0 | 12.0 | | Yes |
| 2/2 | 0:44:00 | 219 | 16.2 | 14.0 | 12.0 | | Yes |
| 2/3 | 0:49:30 | 444 | 16.6 | 15.0 | 13.0 | | Yes |
| 2/4 | 0:55:00 | 1056 | 16.7 | 15.0 | 13.0 | | Yes |
| 2/5 | 1:00:30 | 1281 | 15.5 | 15.0 | 13.0 | | Yes |
| 2/6 | 1:06:00 | 1434 | 15.7 | 15.0 | 13.0 | | Yes |
| Averages | | | | 13.8 | 11.9 | no result | |

Meter Finish: 304.0490 Time Finish: 11:08
Total Condensate collected: 0 ml Silica gel No(s) used: GO46

AECOM

**STACK ANALYSIS**

**SAMPLING OF SULFURIC ACID MIST (H2SO4 AS SO3)**

Date: 2-Jun-15

Client: Weston

AECOM's Project No: 60341673

Stack Description No.: Stack 7

| | | | |
|---|---|---|---|
| Sample Nozzle No.: | S9 | Sample Nozzle Area (An): | 1.35 x $10^{-5}$ $m^2$ |
| Sampling Port No.: | 1 to 2 | Thimble No: | NA |
| Page No: | 1 of 1 | Blank thimble No: | NA |

**Leak Check (Pre-Sampling)**

Meter start: 83.2779 Meter finish: 83.2779

Time start: 10:00 Time finish: 10:01

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Leak Check (Post Sampling)**

Meter start: 84.2114 Meter finish: 84.2114

Time start: 11:15 Time finish: 11:16

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:

Comments:

**Sampling Record Table**

Barometric Pressure: 1016 hPa (start); 1016 hPa (finish)

Meter start: 83.2820 Time start: 10:02

Meter correction factor (GMf) : 1.0101

| Sampling Position No. | Stopwatch Time at Sampling Position | Distance from far wall (mm) | Isokinetic Flowrate (L/min) | Meter Inlet Temp. (°C) | Meter Outlet Temp. (°C) | Impinger Train Outlet Temp (°C) | Flowrate Attained (Y/N) |
|---|---|---|---|---|---|---|---|
| 1/1 | 0:05:30 | 66 | 14.2 | 12.0 | 11.0 | | Yes |
| 1/2 | 0:11:00 | 219 | 14.2 | 13.0 | 11.0 | | Yes |
| 1/3 | 0:16:30 | 444 | 13.5 | 13.0 | 11.0 | | Yes |
| 1/4 | 0:22:00 | 1056 | 12.7 | 14.0 | 11.0 | | Yes |
| 1/5 | 0:27:30 | 1281 | 13.3 | 14.0 | 12.0 | | Yes |
| 1/6 | 0:33:00 | 1434 | 12.0 | 15.0 | 12.0 | | Yes |
| | | | | | | | |
| 2/1 | 0:38:30 | 66 | 13.5 | 16.0 | 12.0 | | Yes |
| 2/2 | 0:44:00 | 219 | 13.8 | 17.0 | 13.0 | | Yes |
| 2/3 | 0:49:30 | 444 | 14.2 | 17.0 | 13.0 | | Yes |
| 2/4 | 0:55:00 | 1056 | 14.2 | 17.0 | 14.0 | | Yes |
| 2/5 | 1:00:30 | 1281 | 13.3 | 17.0 | 14.0 | | Yes |
| 2/6 | 1:06:00 | 1434 | 13.4 | 17.0 | 14.0 | | Yes |
| Averages | | | | 15.2 | 12.3 | no result | |

Meter Finish: 84.2100 Time Finish: 11:08

Total Condensate collected: 0 ml Silica gel No(s) used: Z12

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# Emission Measurement Calculations Spreadsheet

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

AECOM

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7
Test 1:Polycyclic Aromatic Hydrocarbons
Test 2:Sulfuric Acid Mist ($H_2SO_4$ as $SO_3$)
Test 3:Sulfur Dioxide ($SO_2$ as $SO_3$)

| | | | | |
|---|---|---|---|---|
| Time : | 11:15 | Barometric Pressure : | 1021 | hPa |
| Page No. : | 1 of 1 | Pitot Correction Factor : | 0.84 | |
| Sampling Port No: | 1 to 2 | Stack Gas Density: | 1.28 | kg/m$^3$ |
| Pitot Tube Type : | S | | | (0 °C, Wet, 1 Atm) |

| Sampling Position No. | Distance from far wall (mm) | Max. Differential Pressure ΔP, kilo Pascals | Max Temp. °C | Max Temp. (Ts) K | Corrected Velocity (Vs) m/s |
|---|---|---|---|---|---|
| 1/1 | 36 | 0.225 | 23.0 | 296.2 | 16.3 |
| 1/2 | 189 | 0.234 | 23.0 | 296.2 | 16.7 |
| 1/3 | 414 | 0.214 | 23.0 | 296.2 | 15.9 |
| 1/4 | 1026 | 0.235 | 23.0 | 296.2 | 16.7 |
| 1/5 | 1251 | 0.244 | 23.0 | 296.2 | 17.0 |
| 1/6 | 1404 | 0.168 | 24.0 | 297.2 | 14.1 |
| | | | | | |
| 2/1 | 36 | 0.213 | 23.0 | 296.2 | 15.9 |
| 2/2 | 189 | 0.245 | 23.0 | 296.2 | 17.1 |
| 2/3 | 414 | 0.237 | 24.0 | 297.2 | 16.8 |
| 2/4 | 1026 | 0.233 | 24.0 | 297.2 | 16.7 |
| 2/5 | 1251 | 0.211 | 24.0 | 297.2 | 15.9 |
| 2/6 | 1404 | 0.196 | 24.0 | 297.2 | 15.3 |
| Average | | | 23.4 | 296.6 | 16.2 |

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -12.6 mm
Absolute pressure in stack (hPa) : 1019.76 hPa

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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

| | |
|---|---|
| Date: | 2-Jun-15 |
| Client: | Weston |
| AECOM's Project No: | 60341673 |
| Stack/Duct Description: | Stack 7 |

| | Sample Result | | | Emission | | Mass Emission Rate | |
|---|---|---|---|---|---|---|---|
| | (ng) | (µg) | (mg) | (µg/m$^3$) | (mg/m$^3$) | (µg/s) | (mg/s) |
| Naphthalene | 6400 | 6.4 | 0.0064 | 6.7 | 0.0067 | 180 | 0.18 |
| 2 - Methylnapthalene | 9600 | 9.6 | 0.0096 | 10 | 0.01 | 270 | 0.27 |
| Acenaphthylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Acenaphthene | 78 | 0.078 | 0.000078 | 0.082 | 0.000082 | 2.2 | 0.0022 |
| Fluorene | 140 | 0.14 | 0.00014 | 0.15 | 0.00015 | 3.9 | 0.0039 |
| Phenanthrene | 550 | 0.55 | 0.00055 | 0.58 | 0.00058 | 15 | 0.015 |
| Anthracene | 21 | 0.021 | 0.000021 | 0.022 | 0.000022 | 0.58 | 0.00058 |
| Fluoranthene | 380 | 0.38 | 0.00038 | 0.4 | 0.0004 | 11 | 0.011 |
| Pyrene | 170 | 0.17 | 0.00017 | 0.18 | 0.00018 | 4.7 | 0.0047 |
| Benz(a)anthracene | 26 | 0.026 | 0.000026 | 0.027 | 0.000027 | 0.72 | 0.00072 |
| Chrysene | 65 | 0.065 | 0.000065 | 0.068 | 0.000068 | 1.8 | 0.0018 |
| Benzo(b)fluoranthene | 46 | 0.046 | 0.000046 | 0.048 | 0.000048 | 1.3 | 0.0013 |
| Benzo(k)fluoranthene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Benzo(e)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Benzo(a)pyrene | 44 | 0.044 | 0.000044 | 0.046 | 0.000046 | 1.2 | 0.0012 |
| Perylene | 33 | 0.033 | 0.000033 | 0.035 | 0.000035 | 0.92 | 0.00092 |
| Indeno(123:cd)pyrene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Dibenzo(ah)anthracene | <26 | <0.026 | <0.000026 | 0.027 | <0.000027 | <0.72 | <0.00072 |
| Benzo(ghi)perylene | <20 | <0.02 | <0.00002 | 0.021 | <0.000021 | <0.56 | <0.00056 |
| Sum of reported PAH's | 18000 | 18 | 0.018 | 18 | 0.018 | 490 | 0.49 |

## STACK ANALYSIS - FINAL CALCULATIONS

**Polycyclic Aromatic Hydrocarbons**

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

Date: 2-Jun-15 Client: Weston
AECOM's Project No: 60341673 Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.9923 $m^3$
Average gas meter temp. ($T_{M,2}$): 12.9 °C
286.1 K
Average barometric pressure ($P_{BARO}$) 1016 hPa
Average pressure at meter ($P_{M,2}$) 1016.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.9501 $m^3$

(B) PAH concentration at standard conditions
Blank thimble No.: NA
Thimble No. used: DAU210415C
Blank weight: g
PAH Weight 0.000018 g
Final PAH Weight (Mp1): 0.00002 g
PAH Concentration (C1): $=M_{p1}/MV_4=$ 0.000019 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = 0.019 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ 0.000019 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

;and $C_{c1}$ = 0.019 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0013 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = 1.3 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content
Silica Gel Number: GO46
$V_v$ = 11.8 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0158

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

$B_{ws}$ = 1.63 %

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Polycyclic Aromatic Hydrocarbons**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.191 $kg/m^3$ (stack conditions, wet)

### (E) Gas Velocities

(i) Average of pre-sampling velocities: 16.43 m/s

(ii) Average of post-sampling velocities: 16.20 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
16.32 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 = 28.84 $m^3/s$ (stack conditions)

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

Qstd = 26.4 $m^3/s$ (0°C, dry gas, 1 atm pressure)

### (G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | 0.0005 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | 0.5 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | 0.0005 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | 0.5 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | 0.035 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | 35 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

AECOM

## STACK ANALYSIS - FINAL CALCULATIONS

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

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

Date: 2-Jun-15 Client: Weston

AECOM's Project No: 60341673 Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.9374 $m^3$

Average gas meter temp. ($T_{M,2}$): 13.8 °C

287.0 K

Average barometric pressure ($P_{BARO}$) 1016 hPa

Average pressure at meter ($P_{M,2}$) 1016.00 hPa

Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.8947 $m^3$

(B) H2SO4 as SO3 concentration at standard conditions

Blank thimble No.: NA

Thimble No. used: NA

Blank weight: g

H2SO4 as SO3 Weight <0.002 g

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

H2SO4 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.0022 $g/m^3$ (0°C, dry gas, 1atm pressure)

;and $C_2$ = <2.2 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %

Average $CO_2$%: 0.0 %

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

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

$O_2$ Basis 7 %

Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.15 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

;and $C_{b1}$ = <150 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z12

$V_v$ = 10.1 g (from laboratory report)

$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)

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

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0135

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

$B_{ws}$ = 1.48 %

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# Emission Measurement Calculations Spreadsheet

## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

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

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

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

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

(iii) Gas density at stack conditions =

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

= 1.191 kg/m$^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.43 m/s

(ii) Average of post-sampling velocities: 16.20 m/s

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

(iv) Overall average of pre-sampling and post-sampling velocities (Vs):
16.32 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 = 28.84 m$^3$/s (stack conditions)

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

Qstd = 26.4 m$^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.058 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | <58 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.058 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <58 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <4.1 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <4100 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

## STACK ANALYSIS - FINAL CALCULATIONS

**Sulfur Dioxide (SO2 as SO3)**

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

Date: 2-Jun-15
Client: Weston
AECOM's Project No: 60341673
Stack/Duct Description: Stack 7

(A) Sample gas volume at standard conditions

Metered volume ($MV_3$): 0.9374 $m^3$
Average gas meter temp. ($T_{M,2}$): 13.8 °C
287.0 K
Average barometric pressure ($P_{BARO}$) 1016 hPa
Average pressure at meter ($P_{M,2}$) 1016.00 hPa
Sample gas volume ($MV_4$); (0°C, dry gas, 1 atm pressure): 0.8947 $m^3$

(B) SO2 as SO3 concentration at standard conditions

Blank thimble No.: NA
Thimble No. used: NA
Blank weight: g
SO2 as SO3 Weight <0.01 g
Final SO2 as SO3 Weight (Mp1): <0.01 g
SO2 as SO3 Concentration (C1): $=M_{p1}/MV_4=$ <0.011 $g/m^3$ (0°C, dry gas, 1atm pressure)
;and $C_2$ = <11 $mg/m^3$ (0°C, dry gas, 1atm pressure)

$CO_2$ Basis 12 %
Average $CO_2$%: 0.0 %

Therefore, $C_c$: $= C_a \times 12/CO_2\% =$ <0.011 $g/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)
;and $C_{c1}$ = <11 $mg/m^3$ (0°C, dry gas, 1atm pressure, 12% $CO_2$)

$O_2$ Basis 7 %
Average $O_2$%: 20.8 %

Therefore, $C_b$: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ <0.77 $g/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)
;and $C_{b1}$ = <770 $mg/m^3$ (0°C, dry gas, 1atm pressure, 7% $O_2$)

(C) Moisture content

Silica Gel Number: Z12
$V_v$ = 10.1 g (from laboratory report)
$V_w$ = 0 mL (=grams) (recorded on Laboratory Form 108)
Volume of Water Vapour Condensed ($V_{wc(std)}$) = 0.0000
Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0135

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

$B_{ws}$ = 1.48 %

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# Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

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## STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

**Sulfur Dioxide ($SO_2$ as $SO_3$)**

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

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

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

(iii) Gas density at stack conditions =

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

= 1.191 kg/$m^3$ (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 16.43 m/s

(ii) Average of post-sampling velocities: 16.20 m/s

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

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

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

Qstack = Vs x A = 28.84 $m^3$/s (stack conditions)

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

Qstd = 26.4 $m^3$/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

| | | | | | |
|---|---|---|---|---|---|
| Rm = | $C_{1a}$ x Qstd = | <0.29 | g/s (0°C, dry gas, 1 atm pressure | | ) |
| | = | <290 | mg/s (0°C, dry gas, 1 atm pressure | | ) |
| | $C_{1a}$ x Qstd = | <0.29 | g/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | = | <290 | mg/s (0°C, dry gas, 1 atm pressure | 12% | $CO_2$ ) |
| | $C_{1a}$ x Qstd = | <20 | g/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |
| | = | <20000 | mg/s (0°C, dry gas, 1 atm pressure | 7% | $O_2$ ) |

# Emission Measurement Calculations Spreadsheet

**EMISSION MONITORING RESULTS, STACK 7**
**WESTON**
2-Jun-15
POLYCYCLIC AROMATIC HYDROCARBONS
SULFURIC ACID MIST (H2SO4 AS SO3)
SULFUR DIOXIDE (SO2 AS SO3)

| | | |
|---|---|---|
| **Sampling Conditions:** | | |
| Stack internal diameter at test location | 1500 mm | |
| Stack gas temperature (average) | 22.7 $^{o}$C | 295.9 K |
| Stack pressure (average) | 1021 hPa | |
| Stack gas velocity (average, stack conditions) | 16 m/s | |
| Stack gas flowrate (stack conditions) | 29 $m^3/s$ | |
| Stack gas flowrate ($0^0$C, dry gas, 1 atm pressure) | 26 $m^3/s$ | |
| **Polycyclic Aromatic Hydrocarbons Testing** | | |
| Test Period | 10:02 - | 11:08 |
| Polycyclic Aromatic Hydrocarbons Mass | 0.018 mg | |
| Gas Volume Sampled | 0.95 $m^3$ | |
| Polycyclic Aromatic Hydrocarbons Emission*1 | 0.019 $mg/m^3$ | |
| Polycyclic Aromatic Hydrocarbons Mass Emission Rate*2 | 0.5 mg/s | |
| Regulatory Limit | NA $mg/m^3$ | |
| **Sulfuric Acid Mist (H2SO4 as SO3) Testing** | | |
| Test Period | 10:02 - | 11:08 |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass | <2 mg | |
| Gas Volume Sampled | 0.895 $m^3$ | |
| Sulfuric Acid Mist (H2SO4 as SO3) Emission*1 | <2.2 $mg/m^3$ | |
| Sulfuric Acid Mist (H2SO4 as SO3) Mass Emission Rate*2 | <58 mg/s | |
| Regulatory Limit | NA $mg/m^3$ | |
| **Sulfur Dioxide (SO2 as SO3) Testing** | | |
| Test Period | 10:02 - | 11:08 |
| Sulfur Dioxide (SO2 as SO3) Mass | <10 mg | |
| Gas Volume Sampled | 0.895 $m^3$ | |
| Sulfur Dioxide (SO2 as SO3) Emission*1 | <11 $mg/m^3$ | |
| Sulfur Dioxide (SO2 as SO3) Mass Emission Rate*2 | <290 mg/s | |
| Regulatory Limit | NA $mg/m^3$ | |
| **Moisture Content (%)** | 1.6 | |
| **Gas Density (dry at 1 atmosphere)** | 1.29 $kg/m^3$ | |
| **Dry Molecular Weight** | 28.8 g/g-mole | |

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

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

## STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

Client: Weston
Project Number: 60341673
Stack Description: Stack 1
Date: 11-Jun-15
Rotameter Correction Factor: 1.01
Time Start: 10:30
Time Finish: 11:00
Sample Flow Rate: 0.2 L/min
Sample Time: 30 min
Sampled Volume: 6.06 litres
0.00606 m$^3$

Ambient Temperature: 19 °C
Barometric Pressure: 1011 hPa
Stack Gas Moisture: 1.6 %

Corrected Volume: 0.00556 m$^3$ (0°C, dry gas, 1 atmosphere pressure)
Stack Flow Rate 23 m$^3$/s (0°C, dry gas, 1 atmosphere pressure)

### VOC AIR EMISSION TEST RESULTS

| Analyte | Sample µg | Blank µg | Sample Blank Corrected µg | (mg/m$^3$) | mg/s |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,1-dichloroethane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 2-Butanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Chloroform | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1-heptene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-heptane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Trichloroethene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| MIBK | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Toluene | 1.0 | <1.0 | 0.5 | 0.09 | 2.1 |
| 2-hexanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Chlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Ethyl Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| m- & p-xylene | <2.0 | <0.2 | <2.0 | <0.36 | <8.3 |
| o-xylene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Styrene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Cyclohexanone | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Isopropylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 2-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 4-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,3,5-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-decane | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,2,4-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,3-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,4-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| 1,2-dichlorobenzne | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| n-butylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Hexachlorobutadiene | <1.0 | <1.0 | <1.0 | <0.18 | <4.1 |
| Total | 1.0 |  | 0.5 | 0.09 | 2.1 |

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

# STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

AECOM

| | | |
|---|---|---|
| Client: | Weston | |
| Project Number: | 60341673 | |
| Stack Description: | Stack 5 | |
| Date: | 17-Jun-15 | |
| Rotameter Correction Factor: | 1.01 | |
| Time Start: | 14:28 | |
| Time Finish: | 14:58 | |
| Sample Flow Rate: | 0.2 | L/min |
| Sample Time: | 30 | min |
| Sampled Volume: | 6.06 | litres |
| | 0.00606 | $m^3$ |
| Ambient Temperature: | 16 | $^{o}C$ |
| Barometric Pressure: | 1006 | hPa |
| Stack Gas Moisture: | 1.3 | % |
| Corrected Volume: | 0.00561 | $m^3$ ($0^{o}C$, dry gas, 1 atmosphere pressure) |
| Stack Flow Rate | 24 | $m^3/s$ ($0^{o}C$, dry gas, 1 atmosphere pressure) |

**VOC AIR EMISSION TEST RESULTS**

| Analyte | Sample μg | Blank μg | Sample Blank Corrected μg | ($mg/m^3$) | mg/s |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <4.3 |
| 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 | <1.0 | <1.0 | <1.0 | <0.18 | <4.3 |
| 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-dichlorobenzne | <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 | <0.36 | <8.6 |

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.

## STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

AECOM

| | |
|---|---|
| Client: | Weston |
| Project Number: | 60341673 |
| Stack Description: | Stack 6 |
| Date: | 26-Jun-15 |
| Rotameter Correction Factor: | 1.01 |
| Time Start: | 12:35 |
| Time Finish: | 13:05 |
| Sample Flow Rate: | 0.2 L/min |
| Sample Time: | 30 min |
| Sampled Volume: | 6.06 litres |
| | 0.00606 $m^3$ |
| Ambient Temperature: | 22 °C |
| Barometric Pressure: | 1026 hPa |
| Stack Gas Moisture: | 1.8 % |
| Corrected Volume: | 0.00558 $m^3$ (0°C, dry gas, 1 atmosphere pressure) |
| Stack Flow Rate | 1.9 $m^3$/s (0°C, dry gas, 1 atmosphere pressure) |

### VOC AIR EMISSION TEST RESULTS

| Analyte | Sample µg | Blank µg | Sample Blank Corrected µg | (mg/$m^3$) | mg/s |
|---|---|---|---|---|---|
| Acetone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,1-dichloroethane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 2-Butanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Chloroform | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1-heptene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-heptane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Trichloroethene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| MIBK | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Toluene | 1.1 | <1.0 | 0.6 | 0.11 | 0.21 |
| 2-hexanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Chlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Ethyl Benzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| m- & p-xylene | <2.0 | <0.2 | <2.0 | <0.36 | <0.68 |
| o-xylene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Styrene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Cyclohexanone | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Isopropylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 2-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 4-chlorotoluene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,3,5-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-decane | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,2,4-trimethylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,3-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,4-dichlorobenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| 1,2-dichlorobenzne | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| n-butylbenzene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Hexachlorobutadiene | <1.0 | <1.0 | <1.0 | <0.18 | <0.34 |
| Total | 1.1 | | 0.6 | 0.11 | 0.21 |

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.

## STACK ANALYSIS - SAMPLING OF VOLATILE ORGANIC COMPOUNDS

| | |
|---|---|
| Client: | Weston |
| Project Number: | 60341673 |
| Stack Description: | Stack 7 |
| Date: | 25-Jun-15 |
| Rotameter Correction Factor: | 1.01 |
| Time Start: | 10:03 |
| Time Finish: | 10:33 |
| Sample Flow Rate: | 0.2 L/min |
| Sample Time: | 30 min |
| Sampled Volume: | 6.06 litres |
| | 0.00606 $m^3$ |
| Ambient Temperature: | 22 $^oC$ |
| Barometric Pressure: | 1016 hPa |
| Stack Gas Moisture: | 1.6 % |
| Corrected Volume: | 0.00553 $m^3$ ($0^oC$, dry gas, 1 atmosphere pressure) |
| Stack Flow Rate | 26 $m^3/s$ ($0^oC$, dry gas, 1 atmosphere pressure) |

**VOC AIR EMISSION TEST RESULTS**

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

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

## Appendix B

# Laboratory Analytical Reports (74 pages)

# Appendix B Laboratory Analytical Reports (74 pages)

**Steel River Testing**

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

## STACK EMISSION - MOISTURE REPORT

**Origin:** AECOM - Newcastle
**Project:** **60341673**

**Report :** 9080-0-M
Page 1 of 2

**Description :** Stack Emission Samples
Received: 12-Jun-15

**Date :** 18-Jun-15

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

**Copy to:** FILE

---

| Jar ID | Moisture (g) |
|---|---|
| B66 | 6.1 |
| F21 | 11.2 |
| F24 | 4.3 |
| F25 | 4.2 |
| F26 | 6.2 |
| G013 | 6.0 |
| G046 | 11.8 |
| G57 | 5.1 |
| I01 | 28.9 |
| I34 | 21.2 |
| M23 | 9.4 |
| M99 | 10.2 |
| P26 | 7.9 |
| P3 | 5.8 |
| P31 | 4.5 |
| P33 | 2.9 |

---

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Accredited for compliance with
ISO/IEC 17025

NATA
ACCREDITED FOR
TECHNICAL
COMPETENCE

**Reported By:** M. Campbell

Michael Campbell

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

Steel River Testing

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

# STACK EMISSION - MOISTURE REPORT

**Origin:** AECOM - Newcastle
**Project:** **60341673**

**Report :** 9080-0-M

Page 2 of 2

**Description :** Stack Emission Samples
Received: 12-Jun-15

**Date :** 18-Jun-15

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

**Copy to:** FILE

| Jar ID | Moisture (g) |
|---|---|
| Z12 | 10.1 |
| Z13 | 4.1 |
| Z14 | 7.4 |
| Z6 | 6.1 |
| Z8 | 5.8 |
| Z9 | 4.8 |

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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 :** 9080-0-P
Page 1 of 1

**Description :** Stack Emission Samples
Received: 12-Jun-15
**Date :** 18-Jun-15

**Report To :** James Lang
17 Warabrook Blvd, Warabrook NSW 2304
**Copy to:** FILE

| Thimble ID | | Volume (mL) | Total Particulate Matter (g) |
|---|---|---|---|
| T299 | Filter | - | 0.0002 |
| T300 | Filter | - | 0.0004 |
| T302 | Filter | - | 0.0002 |
| T305 | Filter | - | 0.0010 |
| T306 | Filter | - | 0.0003 |
| T309 | Filter | - | <0.0002 |
| T318 | Filter | - | 0.0095 |
| T321 | Filter | - | 0.0016 |
| T323 | Filter | - | 0.0005 |
| T324 | Filter | - | 0.0014 |

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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

**MALVERN** Instruments SB.0D 0:05 am

STEEL RIVER TESTING THIMBLE NO : S 47
DATE:7/7/2015.

000006113

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7160 stnd 11w652s

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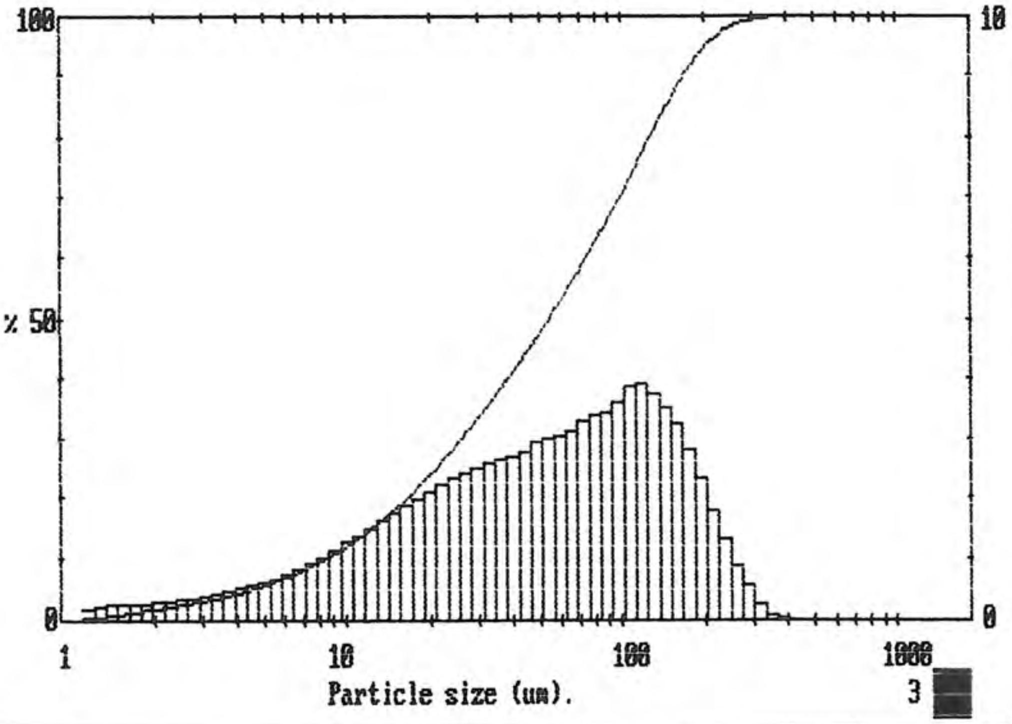


| Upper | in | Lower | Under | Upper | in | Lower | Under | Upper | in | Lower | Under |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 124 | 7.8 | 101 | 71.3 | 11.6 | 2.6 | 9.48 | 11.4 |
| | | | | 101 | 7.1 | 83.3 | 64.2 | 9.48 | 2.2 | 7.78 | 9.2 |
| | | | | 83.3 | 6.7 | 68.3 | 57.5 | 7.78 | 1.8 | 6.39 | 7.4 |
| | | | | 68.3 | 6.2 | 56.1 | 51.3 | 6.39 | 1.5 | 5.24 | 6.0 |
| 600 | 0.0 | 492 | 100 | 56.1 | 6.0 | 46.0 | 45.3 | 5.24 | 1.2 | 4.30 | 4.8 |
| 492 | 0.0 | 404 | 100 | 46.0 | 5.5 | 37.8 | 39.8 | 4.30 | 1.0 | 3.53 | 3.8 |
| 404 | 0.2 | 332 | 99.8 | 37.8 | 5.3 | 31.0 | 34.5 | 3.53 | 0.8 | 2.90 | 3.0 |
| 332 | 0.8 | 272 | 99.0 | 31.0 | 5.0 | 25.5 | 29.6 | 2.90 | 0.7 | 2.38 | 2.3 |
| 272 | 2.2 | 224 | 96.8 | 25.5 | 4.6 | 20.9 | 25.0 | 2.38 | 0.6 | 1.95 | 1.7 |
| 224 | 4.1 | 183 | 92.6 | 20.9 | 4.1 | 17.1 | 20.8 | 1.95 | 0.5 | 1.60 | 1.2 |
| 183 | 6.1 | 151 | 86.5 | 17.1 | 3.6 | 14.1 | 17.2 | 1.60 | 0.5 | 1.32 | 0.6 |
| 151 | 7.3 | 124 | 79.1 | 14.1 | 3.2 | 11.6 | 14.0 | 1.32 | 0.6 | 0.50 | 0.0 |

Span 2.96
D[4,3] 73.66µm
D[3,2] 17.52µm
D[v,0.9] 167.60µm
D[v,0.1] 8.38µm
D[v,0.5] 53.77µm

Source = :Sample
Focal length = 300 mm
Presentation = stnd

Beam length = 2.4 mm
Residual = 2.368 %
Obscuration = 0.0000
Volume distribution

Model indp
Volume Conc. = 0.0000%
Sp.S.A 0.3425 m²/cc.

Shape OFF

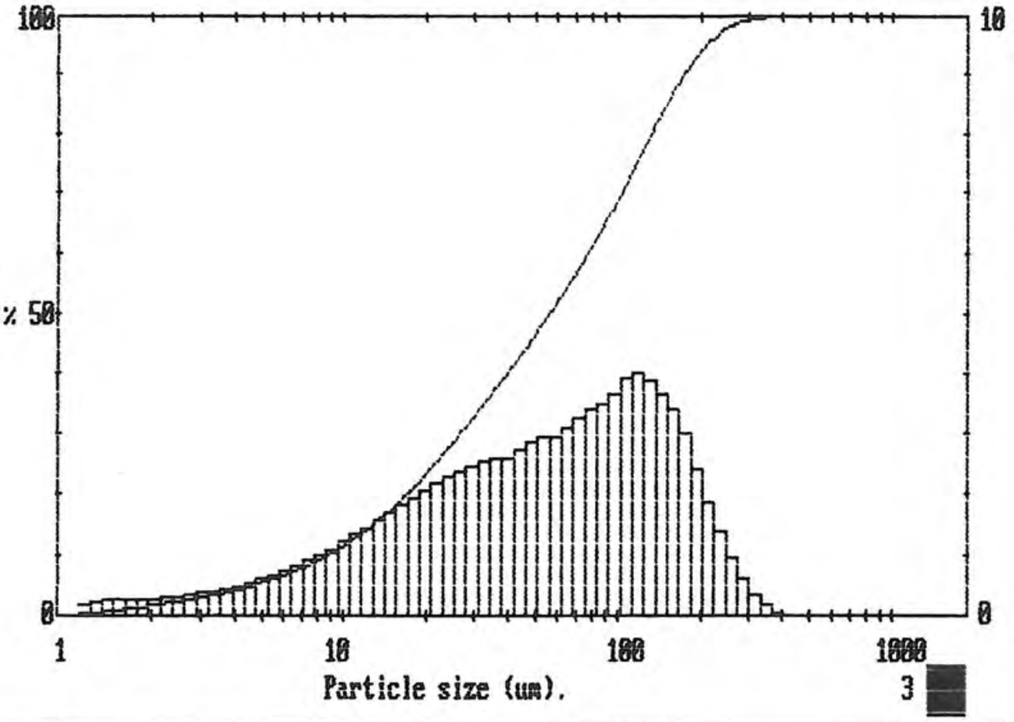
**Malvern Instruments**

MALVERN Instruments SB.0D 0:05 am

STEEL RIVER TESTING THIMBLE NO : S 47
repeat
DATE:7/7/2015.

000006112

7160 stnd 11w652s



| Upper | in | Lower | Under | Upper | in | Lower | Under | Upper | in | Lower | Under |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 124 | 8.0 | 101 | 70.0 | 11.6 | 2.6 | 9.48 | 11.0 |
| | | | | 101 | 7.2 | 83.3 | 62.8 | 9.48 | 2.1 | 7.78 | 8.9 |
| | | | | 83.3 | 6.7 | 68.3 | 56.1 | 7.78 | 1.7 | 6.39 | 7.1 |
| | | | | 68.3 | 6.1 | 56.1 | 50.0 | 6.39 | 1.4 | 5.24 | 5.7 |
| 600 | 0.0 | 492 | 100 | 56.1 | 5.9 | 46.0 | 44.2 | 5.24 | 1.1 | 4.30 | 4.6 |
| 492 | 0.0 | 404 | 100 | 46.0 | 5.3 | 37.8 | 38.8 | 4.30 | 0.9 | 3.53 | 3.7 |
| 404 | 0.2 | 332 | 99.8 | 37.8 | 5.2 | 31.0 | 33.7 | 3.53 | 0.8 | 2.90 | 2.9 |
| 332 | 1.0 | 272 | 98.8 | 31.0 | 4.8 | 25.5 | 28.8 | 2.90 | 0.7 | 2.38 | 2.2 |
| 272 | 2.4 | 224 | 96.4 | 25.5 | 4.5 | 20.9 | 24.3 | 2.38 | 0.6 | 1.95 | 1.6 |
| 224 | 4.4 | 183 | 92.0 | 20.9 | 4.0 | 17.1 | 20.3 | 1.95 | 0.5 | 1.60 | 1.1 |
| 183 | 6.4 | 151 | 85.6 | 17.1 | 3.6 | 14.1 | 16.7 | 1.60 | 0.5 | 1.32 | 0.6 |
| 151 | 7.6 | 124 | 78.0 | 14.1 | 3.1 | 11.6 | 13.6 | 1.32 | 0.6 | 0.50 | 0.0 |

Span
2.91

D[4,3]
75.93µm

D[3,2]
18.08µm

D[v,0.9]
171.51µm

D[v,0.1]
8.68µm

Source = :Sample

Focal length = 300 mm
Presentation = stnd

Beam length = 2.4 mm
Residual = 2.378 %
Obscuration = 0.0000
Volume distribution

Model indp

Volume Conc. = 0.0000%
Sp.S.A 0.3318 m²/cc.

D[v,0.5]
56.03µm

Shape OFF

Malvern Instruments

Steel River Testing

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

# STACK EMISSION - MOISTURE REPORT

| | | | | |
|---|---|---|---|---|
| **Origin:** | AECOM - Newcastle | **Report :** | 9172-0-M | Page 1 of 1 |
| **Project:** | **60341673** | | | |
| **Description :** | Stack Emission Samples<br>Received: 29-Jun-15 | **Date :** | 10-Jul-15 | |
| **Report To :** | Colin Clarke<br>17 Warabrook Blvd, Warabrook NSW 2304 | **Copy to:** | FILE | |

| Jar ID | Moisture (g) |
|---|---|
| DT351 | 7.9 |
| F99 | 22.0 |
| FA8 | 28.1 |
| G050 | 8.3 |
| I66 | 8.6 |
| P29 | 10.2 |
| P30 | 8.0 |
| Z13 | 9.3 |
| Z2 | 7.4 |
| Z6 | 8.9 |
| Z9 | 7.2 |

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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 :** 9172-0-P Page 1 of 1

**Description :** Stack Emission Samples
Received: 29-Jun-15

**Date :** 10-Jul-15

**Report To :** Colin Clarke
17 Warabrook Blvd, Warabrook NSW 2304

**Copy to:** FILE

| Thimble ID | | Volume (mL) | Total Particulate Matter (g) |
|---|---|---|---|
| N7 | Thimble | - | 0.0031 |
| S47 | Thimble | - | 0.0077 |
| T4 | Thimble | - | 0.0289 |

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*Note : Sampled by Client*

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**Reported By:** M. Campbell
Michael Campbell

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

**Steel River Testing**

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

# STACK EMISSION - MOISTURE REPORT

**Origin:** AECOM - Newcastle
**Project:** **60341673**
**Report :** 9502-0-M
Page 1 of 1

**Description :** Stack Emission Samples
Received: 19-Aug-15
**Date :** 28-Aug-15

**Report To :** James Lang
17 Warabrook Blvd, Warabrook NSW 2304
**Copy to:** FILE

| Jar ID | Moisture (g) |
|---|---|
| G012 | 5.7 |
| P29 | 6.1 |

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COMPETENCE

**Reported By:** M. Campbell

Michael Campbell

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

**Steel River Testing**

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

# STACK EMISSION - PARTICULATES REPORT

| | | | | |
|---|---|---|---|---|
| **Origin:** | AECOM - Newcastle | **Report :** | 9502-0-P | Page 1 of 1 |
| **Project:** | **60341673** | | | |
| **Description :** | Stack Emission Samples<br>Received: 19-Aug-15 | **Date :** | 28-Aug-15 | |
| **Report To :** | James Lang<br>17 Warabrook Blvd, Warabrook NSW 2304 | **Copy to:** | FILE | |

| Thimble ID | | Volume (mL) | Total Particulate Matter (g) |
|---|---|---|---|
| S03 | Thimble | - | 0.0059 |
| T13 | Thimble | - | 0.0017 |

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*Note : Sampled by Client*

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**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

Australian Government
National Measurement Institute

# CERTIFICATE OF ANALYSIS # DAU15_115

| | | | |
|---|---|---|---|
| **Client** | AECOM<br>17 Warabrook Boulevarde<br>Warabrook NSW 2304 | **Job No.** | AECO01/150619 |
| | | **Sampled by** | Client |
| | | **Date Sampled** | 17-Jun-15 |
| **Contact** | Dylan Turnbull | **Date Received** | 19-Jun-15 |

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

**Method** AUTL_02 **Date Reported** 2-Jul-15

**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<br>Senior Chemist<br>Dioxin Analysis Unit | Dr Alan Yates<br>Senior Analyst<br>Dioxin Analysis Unit |

**Accreditation**

NATA Accreditation Number : 198

Accredited for compliance with ISO/IEC 17025.

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## Sample Details : Job No. AECO01/150619

| Laboratory Reg. No. | Client Sample Ref. | Matrix | Description |
|---|---|---|---|
| N15/015071X | DAU150615A | Emission | Resin, Filter, Rinses |

## Project Details

| | |
|---|---|
| Project Name | *Stack 5* |
| Project Number | *60341673* |

## Key

**Analytes**

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

**Units & Abbreviations**

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

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

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

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

| | |
|---|---|
| Lower Bound TEQ | defines all congener values reported below the LOD as equal to zero. |
| Middle Bound TEQ | defines all congener values reported below the LOD as equal to half the LOD. |
| Upper Bound TEQ | defines all congener values reported below the LOD as equal to the LOD. |
| Surrogate Recovery | percentage recovery for $^{13}C_{12}$ labelled surrogate standard |
| ⚐ | Laboratory surrogate recovery outside normal acceptance criteria:<br>**40-130%** for Tetra/Penta/Hexa congeners - **25-130%** for Hepta/Octa congeners |
| ⚑ | Field surrogate recovery outside normal acceptance criteria (**70-130%**) |

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

USEPA US Environmental Protection Agency

# Results : Job No. AECO01/150619

| | | | |
|---|---|---|---|
| **Laboratory Reg. No.** | N15/015071X | **Date Extracted** | 24-Jun-15 |
| **Client Sample Ref.** | DAU150615A | **DB5 Analysis** | 26-Jun-15 |
| **Matrix** | Emission | **DB-Dioxin Analysis** | 29-Jun-15 |
| **Description** | Resin, Filter, Rinses | | |

| PCDD/F Congeners | Level pg | I-TEF | I-TEQ contribution | Labelled Surrogate recovery | |
|---|---|---|---|---|---|
| 2,3,7,8-TCDF | 15 | 0.1 | 1.5 | 69 | |
| 2,3,7,8-TCDD | <5 | 1 | 2.5 | 65 | |
| 1,2,3,7,8-PeCDF | 17 | 0.05 | 0.86 | 69 | |
| 2,3,4,7,8-PeCDF | 19 | 0.5 | 9.5 | **103** | |
| 1,2,3,7,8-PeCDD | 4.4 | 0.5 | 2.2 | 70 | |
| 1,2,3,4,7,8-HxCDF | 20 | 0.1 | 2.0 | **117** | |
| 1,2,3,6,7,8-HxCDF | 20 | 0.1 | 2.0 | 57 | |
| 2,3,4,6,7,8-HxCDF | 22 | 0.1 | 2.2 | | |
| 1,2,3,7,8,9-HxCDF | <4 | 0.1 | 0.2 | | |
| 1,2,3,4,7,8-HxCDD | 8.5 | 0.1 | 0.85 | **118** | |
| 1,2,3,6,7,8-HxCDD | 14 | 0.1 | 1.4 | 58 | |
| 1,2,3,7,8,9-HxCDD | 16 | 0.1 | 1.6 | | |
| 1,2,3,4,6,7,8-HpCDF | 58 | 0.01 | 0.58 | 53 | |
| 1,2,3,4,7,8,9-HpCDF | 5.4 | 0.01 | 0.054 | **95** | |
| 1,2,3,4,6,7,8-HpCDD | 82 | 0.01 | 0.82 | 56 | |
| OCDF | 9.9 | 0.001 | 0.0099 | | |
| OCDD | 590 | 0.001 | 0.59 | 51 | |

| PCDD/F Homologue Groups | Level pg |
|---|---|
| Total TCDF isomers | 260 |
| Total TCDD isomers | 42 |
| Total PeCDF isomers | 200 |
| Total PeCDD isomers | 86 |
| Total HxCDF isomers | 170 |
| Total HxCDD isomers | 190 |
| Total HpCDF isomers | 84 |
| Total HpCDD isomers | 160 |

## Summary Results

| | | |
|---|---|---|
| **Sum of PCDD and PCDF congeners** | | |
| Excluding LOD values | 1790 | pg |
| **I-TEQ** | | |
| Lower Bound [excluding LOD values] | **26** | pg |
| Middle Bound [including half LOD values] | **29** | pg |
| Upper Bound [including LOD values] | **32** | pg |

ALS Environmental

# CERTIFICATE OF ANALYSIS

**Work Order** : **EN1512010**
Client : **AECOM Australia Pty Ltd**
Contact : MR JAMES LANG
Address : 17 WARABROOK BOULEVARDE
WARABROOK NSW 2304

E-mail : james.lang@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 : ----
Site : ----

Quote number : ----

Page : 1 of 12
Laboratory : Environmental Division Newcastle
Contact : Peter Keyte
Address : 5/585 Maitland Road Mayfield West NSW Australia 2304

E-mail : peter.keyte@alsglobal.com
Telephone : +61 2 4014 2500
Facsimile : +61 2 4967 7382
QC Level : NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Date Samples Received : 15-Jun-2015 11:20
Date Analysis Commenced : 18-Jun-2015
Issue Date : 22-Jun-2015 16:58

No. of samples received : 20
No. of samples analysed : 20

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.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ankit Joshi | Inorganic Chemist | Sydney Inorganics |
| Barbara Coupland | Quality Officer | Newcastle - Inorganics |
| Daniel Junek | Senior Air Analyst | Newcastle - Organics |
| Dianne Blane | Laboratory Coordinator (2IC) | Newcastle - Inorganics |
| Justin Houghton | Senior Analyst - Organic | Newcastle - Organics |
| Merrin Avery | Supervisor - Inorganic | Newcastle - Inorganics |

## General Comments

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

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

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

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

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

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

- Filters were supplied by the client. Filter preparation may not meet ALS method requirements.
- ED009x: LOR has been raised for Chloride due to sample 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.

## Analytical Results

| Sub-Matrix: **FILTER**<br>(Matrix: **AIR**) | | | *Client sample ID* | **Stack 1_Particulate Fluoride** | **Particulate Fluoride_Blank** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [11-Jun-2015] | [11-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-004** | **EN1512010-013** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| EA144C: Gaseous and Particulate Fluorides | | | | | | | | |
| **Fluoride (Particulate) as HF** | ---- | 1 | µg/filter | **14** | <1 | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: **IMPINGER SOLUTION**<br>(Matrix: **AIR**) | | | *Client sample ID* | **Stack 4_Total Fluoride** | **Stack 7_Total Fluoride** | **Stack 1_Gaseous Fluoride** | **BH2_Total Fluoride** | **BH3_Total Fluoride** |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [12-Jun-2015] | [02-Jun-2015] | [11-Jun-2015] | [01-Jun-2015] | [01-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-001** | **EN1512010-002** | **EN1512010-003** | **EN1512010-005** | **EN1512010-006** |
| | | | | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **EA144C: Gaseous and Particulate Fluorides** | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | **0.23** | **0.18** | **0.06** | **0.06** | **0.05** |
| **Volume - Impinger** | ---- | 1 | mL | **285** | **335** | **210** | **200** | **320** |
| **EA147: Acid Gases** | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **EA147: Halogens** | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **ED009: Anions** | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | ---- | ---- | ---- | ---- | ---- |
| **Sampling Method** | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | ---- | ---- | ---- | ---- | ---- |

## Analytical Results

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

| | | | *Client sample ID* | **Stack 7_SOx_IPA** | **Stack 7_SOx_H2O2** | **Stack 7_HCl_H2SO4** | **Stack 1_Cl2_NaOH** | **Stack 1_SOx_IPA** |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [05-Jun-2015] | [05-Jun-2015] | [11-Jun-2015] | [11-Jun-2015] | [11-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-007** | **EN1512010-008** | **EN1512010-009** | **EN1512010-010** | **EN1512010-011** |
| | | | | Result | Result | Result | Result | Result |
| EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3) | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | **247** | ---- | ---- | ---- | **197** |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | <2 | ---- | ---- | ---- | <2 |
| **Volume - Impinger** | ---- | 1 | mL | ---- | **315** | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | <10 | ---- | ---- | ---- |
| EA144C: Gaseous and Particulate Fluorides | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| EA147: Acid Gases | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | <2.00 | ---- | ---- |
| EA147: Halogens | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | ---- | ---- | <2.00 | ---- |
| ED009: Anions | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | ---- | ---- | <2.00 | <2.00 | ---- |
| Sampling Method | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | ---- | ---- | **214** | **211** | ---- |

## Analytical Results

| Sub-Matrix: **IMPINGER SOLUTION**<br>(Matrix: **AIR**) | | | *Client sample ID* | **Stack 1_SOx_H2O2** | **Gaseous Fluoride_Blank** | **SOx_IPA_Blank** | **SOx_H2O2_Blank** | **HCl_H2SO4_Blank** |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [11-Jun-2015] | [11-Jun-2015] | [05-Jun-2015] | [05-Jun-2015] | [11-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-012** | **EN1512010-014** | **EN1512010-015** | **EN1512010-016** | **EN1512010-017** |
| | | | | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | **198** | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | <2 | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | **238** | ---- | ---- | **202** | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | <10 | ---- | ---- | <10 | ---- |
| **EA144C: Gaseous and Particulate Fluorides** | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | **0.38** | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | **202** | ---- | ---- | ---- |
| **EA147: Acid Gases** | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | ---- | ---- | <2.00 |
| **EA147: Halogens** | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **ED009: Anions** | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | ---- | ---- | ---- | ---- | <2.00 |
| **Sampling Method** | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | ---- | ---- | ---- | ---- | **199** |

## Analytical Results

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

| | | | *Client sample ID* | **Cl2_NaOH_Blank** | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [11-Jun-2015] | ---- | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-018** | -------- | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **EA144C: Gaseous and Particulate Fluorides** | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **EA147: Acid Gases** | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **EA147: Halogens** | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | <2.00 | ---- | ---- | ---- | ---- |
| **ED009: Anions** | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | <2.00 | ---- | ---- | ---- | ---- |
| **Sampling Method** | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | **201** | ---- | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE**<br>**(Matrix: AIR)** | | | Client sample ID | **Stack 7_VOC** | **VOC_Blank** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [05-Jun-2015] | [05-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-019** | **EN1512010-020** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091A: Aliphatic Hydrocarbons - Total** | | | | | | | | |
| ^ **1-heptene** | 592-76-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Decane** | 124-18-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Heptane** | 142-82-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons - Total** | | | | | | | | |
| ^ **Benzene** | 71-43-2 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Toluene** | 108-88-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Ethylbenzene** | 100-41-4 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg/sample | <2 | <2 | ---- | ---- | ---- |
| ^ **Styrene** | 100-42-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **ortho-Xylene** | 95-47-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **n-Butylbenzene** | 104-51-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Isopropylbenzene** | 98-82-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds - Total** | | | | | | | | |
| ^ **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds - Total** | | | | | | | | |
| ^ **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Chloroform** | 67-66-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Trichloroethene** | 79-01-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Chlorobenzene** | 108-90-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Chlorotoluene** | 95-49-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **4-Chlorotoluene** | 106-43-4 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 1)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)** | | | | | | | | |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE**<br>(Matrix: **AIR**) | | | Client sample ID | **Stack 7_VOC** | **VOC_Blank** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | [05-Jun-2015] | [05-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-019** | **EN1512010-020** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1) - Continued** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 1)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 1)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 2)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2)** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE**<br>(Matrix: **AIR**) | | | Client sample ID | **Stack 7_VOC** | **VOC_Blank** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | [05-Jun-2015] | [05-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512010-019** | **EN1512010-020** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued** | | | | | | | | |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 2)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 2)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 3)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **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 | ---- | ---- | ---- |

## Analytical Results

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

| | | | Client sample ID | Stack 7_VOC | VOC_Blank | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | [05-Jun-2015] | [05-Jun-2015] | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EN1512010-019 | EN1512010-020 | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued** | | | | | | | | |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 3)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 3)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 1)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **84.6** | **86.7** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **70.2** | **73.3** | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 2)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **83.5** | **85.5** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **73.2** | **70.4** | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 3)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **86.7** | **85.2** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **71.0** | **72.4** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 1)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **97.8** | **103** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 2)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **99.3** | **97.1** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 3)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **100** | **101** | ---- | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EN1512073** | Page | : 1 of 10 |
| Client | : **AECOM Australia Pty Ltd** | Laboratory | : Environmental Division Newcastle |
| Contact | : MR JAMES LANG | Contact | : Peter Keyte |
| Address | : 17 WARABROOK BOULEVARDE<br>WARABROOK NSW 2304 | Address | : 5/585 Maitland Road Mayfield West NSW Australia 2304 |
| E-mail | : james.lang@aecom.com | E-mail | : peter.keyte@alsglobal.com |
| Telephone | : +61 02 4911 4900 | Telephone | : +61 2 4014 2500 |
| Facsimile | : +61 02 4911 4999 | Facsimile | : +61 2 4967 7382 |
| Project | : 60341673 Task 1.2 | QC Level | : NEPM 2013 Schedule B(3) and ALS QCS3 requirement |
| Order number | : 60341673 Task 1.2 | Date Samples Received | : 19-Jun-2015 12:56 |
| C-O-C number | : ---- | Date Analysis Commenced | : 22-Jun-2015 |
| Sampler | : ---- | Issue Date | : 29-Jun-2015 12:20 |
| Site | : ---- | | |
| | | No. of samples received | : 16 |
| Quote number | : ---- | 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

WORLD RECOGNISED ACCREDITATION

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.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Alison Graham | Supervisor - Inorganic | Newcastle - Inorganics |
| Ankit Joshi | Inorganic Chemist | Sydney Inorganics |
| Daniel Junek | Senior Air Analyst | Newcastle - Organics |
| Dianne Blane | Laboratory Coordinator (2IC) | Newcastle - Inorganics |
| Justin Houghton | Senior Analyst - Organic | Newcastle - Organics |

## General Comments

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

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

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

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

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

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

- EK026SF:Poor spike recovery for (Total Cyanide analysis) due to matrix interferences(confirmed by re-analysis).
- ED009x: LOR for Chloride has been raised due to sample 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: **IMPINGER SOLUTION**<br>(Matrix: **AIR**) |  |  | *Client sample ID* | **Stack5_SOx(IPA)** | **Stack5_SOx(H2O2)** | **Stack5_Total Fluoride** | **Stack5_HCl(H2SO4)** | **Stack5_Cl2(NaOH)** |
|---|---|---|---|---|---|---|---|---|
|  |  |  | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-001** | **EN1512073-002** | **EN1512073-003** | **EN1512073-004** | **EN1512073-005** |
|  |  |  |  | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** |  |  |  |  |  |  |  |  |
| **Volume - Impinger** | ---- | 1 | mL | **208** | ---- | ---- | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | <2 | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | **244** | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | <10 | ---- | ---- | ---- |
| **EA144C: Gaseous and Particulate Fluorides** |  |  |  |  |  |  |  |  |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | **0.12** | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | **270** | ---- | ---- |
| **EA147: Acid Gases** |  |  |  |  |  |  |  |  |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | ---- | **0.899** | ---- |
| **EA147: Halogens** |  |  |  |  |  |  |  |  |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | ---- | ---- | ---- | **0.679** |
| **ED009: Anions** |  |  |  |  |  |  |  |  |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | ---- | ---- | ---- | **6.72** | **3.43** |
| **EK026-I: Cyanide in Air Impinger Solutions** |  |  |  |  |  |  |  |  |
| ø **Cyanide** | 57-12-5 | 0.01 | mg | ---- | ---- | ---- | ---- | ---- |
| ø **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sampling Method** |  |  |  |  |  |  |  |  |
| **Volume - Impinger** | ---- | 0.01 | mL | ---- | ---- | ---- | **130** | **198** |

## Analytical Results

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

| | | | *Client sample ID* | **Stack1_CyanideA** | **Stack1_CyanideB** | **SOx(IPA)_Blank** | **SOx(H2O2)_Blank** | **Total Fluoride_Blank** |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-009** | **EN1512073-010** | **EN1512073-011** | **EN1512073-012** | **EN1512073-013** |
| | | | | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | **194** | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | <2 | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | **202** | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | ---- | ---- | <10 | ---- |
| **EA144C: Gaseous and Particulate Fluorides** | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | ---- | ---- | **0.07** |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | **200** |
| **EA147: Acid Gases** | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **EA147: Halogens** | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | ---- | ---- | ---- | ---- |
| **ED009: Anions** | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | ---- | ---- | ---- | ---- | ---- |
| **EK026-I: Cyanide in Air Impinger Solutions** | | | | | | | | |
| ø **Cyanide** | 57-12-5 | 0.01 | mg | <0.01 | <0.01 | ---- | ---- | ---- |
| ø **Volume - Impinger** | ---- | 1 | mL | **249** | **107** | ---- | ---- | ---- |
| **Sampling Method** | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | ---- | ---- | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: **IMPINGER SOLUTION**<br>(Matrix: **AIR**) | | | *Client sample ID* | **HCl(H2SO4)_Blank** | **Cl2(NaOH)_Blank** | **Cyanide_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-014** | **EN1512073-015** | **EN1512073-016** | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3)** | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **EA144C: Gaseous and Particulate Fluorides** | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **EA147: Acid Gases** | | | | | | | | |
| ^ **Hydrogen Chloride** | 7647-01-0 | 0.1 | mg | <2.00 | ---- | ---- | ---- | ---- |
| **EA147: Halogens** | | | | | | | | |
| ^ **Chlorine** | 7782-50-5 | 0.1 | mg | ---- | <2.00 | ---- | ---- | ---- |
| **ED009: Anions** | | | | | | | | |
| ø **Chloride** | 16887-00-6 | 0.1 | mg/L | <2.00 | <2.00 | ---- | ---- | ---- |
| **EK026-I: Cyanide in Air Impinger Solutions** | | | | | | | | |
| ø **Cyanide** | 57-12-5 | 0.01 | mg | ---- | ---- | <0.01 | ---- | ---- |
| ø **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | **260** | ---- | ---- |
| **Sampling Method** | | | | | | | | |
| **Volume - Impinger** | ---- | 0.01 | mL | **206** | **226** | ---- | ---- | ---- |

## Analytical Results

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

| | | | *Client sample ID* | **Stack5_VOC** | **Stack1_VOC** | **VOC_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-006** | **EN1512073-007** | **EN1512073-008** | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091A: Aliphatic Hydrocarbons - Total** | | | | | | | | |
| ^ **1-heptene** | 592-76-7 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Decane** | 124-18-5 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Heptane** | 142-82-5 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons - Total** | | | | | | | | |
| ^ **Benzene** | 71-43-2 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Toluene** | 108-88-3 | 0.5 | µg/sample | <1.0 | **1.0** | <1.0 | ---- | ---- |
| ^ **Ethylbenzene** | 100-41-4 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg/sample | <2 | <2 | <2 | ---- | ---- |
| ^ **Styrene** | 100-42-5 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **ortho-Xylene** | 95-47-6 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **n-Butylbenzene** | 104-51-8 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Isopropylbenzene** | 98-82-8 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091C: Oxygenated Compounds - Total** | | | | | | | | |
| ^ **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091D: Halogenated Compounds - Total** | | | | | | | | |
| ^ **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Chloroform** | 67-66-3 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Trichloroethene** | 79-01-6 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Chlorobenzene** | 108-90-7 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **2-Chlorotoluene** | 95-49-8 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **4-Chlorotoluene** | 106-43-4 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| ^ **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg/sample | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 1)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)** | | | | | | | | |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE** (Matrix: **AIR**) | | | Client sample ID | **Stack5_VOC** | **Stack1_VOC** | **VOC_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-006** | **EN1512073-007** | **EN1512073-008** | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1) - Continued** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | **1.0** | <1.0 | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | <2 | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 1)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 1)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 2)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2)** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | <2 | ---- | ---- |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE**<br>(Matrix: **AIR**) |  |  | *Client sample ID* | **Stack5_VOC** | **Stack1_VOC** | **VOC_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
|  |  |  | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-006** | **EN1512073-007** | **EN1512073-008** | -------- | -------- |
|  |  |  |  | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued** |  |  |  |  |  |  |  |  |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 2)** |  |  |  |  |  |  |  |  |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 2)** |  |  |  |  |  |  |  |  |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 3)** |  |  |  |  |  |  |  |  |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)** |  |  |  |  |  |  |  |  |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | <2 | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |

## Analytical Results

| Sub-Matrix: **SORBENT TUBE**<br>(Matrix: **AIR**) | | | *Client sample ID* | **Stack5_VOC** | **Stack1_VOC** | **VOC_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-006** | **EN1512073-007** | **EN1512073-008** | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued** | | | | | | | | |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 3)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 3)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | <1.0 | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 1)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **91.4** | **96.6** | **96.9** | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **72.6** | **76.4** | **74.9** | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 2)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **95.8** | **90.5** | **97.6** | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **74.5** | **73.0** | **78.4** | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 3)** | | | | | | | | |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **94.6** | **90.5** | **96.9** | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **72.6** | **75.0** | **73.9** | ---- | ---- |
| **EP091: MAH Surrogates (Section 1)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **87.3** | **89.6** | **89.6** | ---- | ---- |
| **EP091: MAH Surrogates (Section 2)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **91.1** | **86.3** | **92.0** | ---- | ---- |
| **EP091: MAH Surrogates (Section 3)** | | | | | | | | |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **87.3** | **87.3** | **88.3** | ---- | ---- |

## Analytical Results

| Sub-Matrix: **WATER**<br>(Matrix: **WATER**) |  |  | Client sample ID | **Stack1_CyanideA** | **Stack1_CyanideB** | **Cyanide_Blank** | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
|  |  |  | *Client sampling date / time* | [17-Jun-2015] | [17-Jun-2015] | [17-Jun-2015] | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512073-009** | **EN1512073-010** | **EN1512073-016** | -------- | -------- |
|  |  |  |  | Result | Result | Result | Result | Result |
| **EK026SF: Total CN by Segmented Flow Analyser** |  |  |  |  |  |  |  |  |
| **Total Cyanide** | 57-12-5 | 0.004 | mg/L | <0.004 | <0.004 | <0.004 | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

**Work Order** : **EN1512153**
Client : **AECOM Australia Pty Ltd**
Contact : MR JAMES LANG
Address : 17 WARABROOK BOULEVARDE
WARABROOK NSW 2304
E-mail : james.lang@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 : ----
Site : ----

Quote number : ----

Page : 1 of 8
Laboratory : Environmental Division Newcastle
Contact : Peter Keyte
Address : 5/585 Maitland Road Mayfield West NSW Australia 2304
E-mail : peter.keyte@alsglobal.com
Telephone : +61 2 4014 2500
Facsimile : +61 2 4967 7382
QC Level : NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Date Samples Received : 29-Jun-2015 09:45
Date Analysis Commenced : 30-Jun-2015
Issue Date : 06-Jul-2015 15:51

No. of samples received : 8
No. of samples analysed : 8

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
WORLD RECOGNISED ACCREDITATION

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.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Dianne Blane | Laboratory Coordinator (2IC) | Newcastle - Inorganics |
| Justin Houghton | Senior Analyst - Organic | Newcastle - Organics |
| Merrin Avery | Supervisor - Inorganic | Newcastle - Inorganics |
| Peter Keyte | Newcastle Manager | Newcastle - Organics |

## General Comments

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

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

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

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

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

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

- Particular samples required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- 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.

## Analytical Results

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

| | | | Client sample ID | **Stack 6_SOx (IPA)** | **Stack 6_SOx (H2O2)** | **Stack 6_SOx (H2O2) Blank** | **Stack 6_SOx (IPA) Blank** | **Stack 6_Total Fluoride** |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | [26-Jun-2015] | [26-Jun-2015] | [26-Jun-2015] | [26-Jun-2015] | [26-Jun-2015] |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-001** | **EN1512153-002** | **EN1512153-003** | **EN1512153-004** | **EN1512153-005** |
| | | | | Result | Result | Result | Result | Result |
| EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3) | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | **213** | ---- | ---- | **190** | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | <5 | ---- | ---- | <5 | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | **250** | **176** | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | <10 | <10 | ---- | ---- |
| EA144C: Gaseous and Particulate Fluorides | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | ---- | ---- | ---- | ---- | **4.63** |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | **260** |

## Analytical Results

| Sub-Matrix: **IMPINGER SOLUTION**<br>(Matrix: **AIR**) | | | *Client sample ID* | **Stack 6_TF Blank** | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [26-Jun-2015] | ---- | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-006** | -------- | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| EA143C: Sulfuric Acid and Sulfur Dioxide (as SO3) | | | | | | | | |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfuric Acid as SO3** | ---- | 2 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | ---- | ---- | ---- | ---- | ---- |
| **Sulfur Dioxide as SO3** | ---- | 10 | mg/sample | ---- | ---- | ---- | ---- | ---- |
| EA144C: Gaseous and Particulate Fluorides | | | | | | | | |
| **Fluoride (as HF)** | ---- | 0.01 | mg/sample | <0.01 | ---- | ---- | ---- | ---- |
| **Volume - Impinger** | ---- | 1 | mL | **303** | ---- | ---- | ---- | ---- |

## Analytical Results

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

|  |  |  | Client sample ID | **VOC Blank** | **Stack 6_VOC** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
|  |  |  | Client sampling date / time | [26-Jun-2015] | [26-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-007** | **EN1512153-008** | -------- | -------- | -------- |
|  |  |  |  | Result | Result | Result | Result | Result |
| **EP091A: Aliphatic Hydrocarbons - Total** |  |  |  |  |  |  |  |  |
| ^ **1-heptene** | 592-76-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Decane** | 124-18-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Heptane** | 142-82-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons - Total** |  |  |  |  |  |  |  |  |
| ^ **Benzene** | 71-43-2 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Toluene** | 108-88-3 | 0.5 | µg/sample | <1.0 | **1.1** | ---- | ---- | ---- |
| ^ **Ethylbenzene** | 100-41-4 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg/sample | <2 | <2 | ---- | ---- | ---- |
| ^ **Styrene** | 100-42-5 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **ortho-Xylene** | 95-47-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **n-Butylbenzene** | 104-51-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Isopropylbenzene** | 98-82-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds - Total** |  |  |  |  |  |  |  |  |
| ^ **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds - Total** |  |  |  |  |  |  |  |  |
| ^ **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Chloroform** | 67-66-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Trichloroethene** | 79-01-6 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Chlorobenzene** | 108-90-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **2-Chlorotoluene** | 95-49-8 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **4-Chlorotoluene** | 106-43-4 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| ^ **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg/sample | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 1)** |  |  |  |  |  |  |  |  |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1)** |  |  |  |  |  |  |  |  |

## Analytical Results

| Sub-Matrix: **PASSIVE SORBENT**<br>(Matrix: **AIR**) | | | *Client sample ID* | **VOC Blank** | **Stack 6_VOC** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [26-Jun-2015] | [26-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-007** | **EN1512153-008** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 1) - Continued** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | **1.1** | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 1)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 1)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 2)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2)** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |

## Analytical Results

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

| | | | *Client sample ID* | **VOC Blank** | **Stack 6_VOC** | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | *Client sampling date / time* | [26-Jun-2015] | [26-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-007** | **EN1512153-008** | -------- | -------- | -------- |
| | | | | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 2) - Continued** | | | | | | | | |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3.5-Trimethylbenzene** | 108-67-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2.4-Trimethylbenzene** | 95-63-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 2)** | | | | | | | | |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 2)** | | | | | | | | |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091A: Aliphatic Hydrocarbons (Section 3)** | | | | | | | | |
| **1-heptene** | 592-76-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Heptane** | 142-82-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Decane** | 124-18-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3)** | | | | | | | | |
| **Benzene** | 71-43-2 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Toluene** | 108-88-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Ethylbenzene** | 100-41-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **meta- & para-Xylene** | 108-38-3 106-42-3 | 1 | µg | <2 | <2 | ---- | ---- | ---- |
| **Styrene** | 100-42-5 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **ortho-Xylene** | 95-47-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **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 | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: **PASSIVE SORBENT**<br>(Matrix: **AIR**) |  |  | *Client sample ID* | **VOC Blank** | **Stack 6_VOC** | **----** | **----** | **----** |
|---|---|---|---|---|---|---|---|---|
|  |  |  | *Client sampling date / time* | [26-Jun-2015] | [26-Jun-2015] | ---- | ---- | ---- |
| *Compound* | *CAS Number* | *LOR* | *Unit* | **EN1512153-007** | **EN1512153-008** | **--------** | **--------** | **--------** |
|  |  |  |  | Result | Result | Result | Result | Result |
| **EP091B: Monocyclic Aromatic Hydrocarbons (Section 3) - Continued** |  |  |  |  |  |  |  |  |
| **n-Butylbenzene** | 104-51-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Isopropylbenzene** | 98-82-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091C: Oxygenated Compounds (Section 3)** |  |  |  |  |  |  |  |  |
| **2-Propanone (Acetone)** | 67-64-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Butanone (MEK)** | 78-93-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Methyl-2-pentanone (MIBK)** | 108-10-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Hexanone (MBK)** | 591-78-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091D: Halogenated Compounds (Section 3)** |  |  |  |  |  |  |  |  |
| **1.1-Dichloroethane** | 75-34-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chloroform** | 67-66-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Trichloroethene** | 79-01-6 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Chlorobenzene** | 108-90-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **2-Chlorotoluene** | 95-49-8 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **4-Chlorotoluene** | 106-43-4 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.3-Dichlorobenzene** | 541-73-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.4-Dichlorobenzene** | 106-46-7 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **1.2-Dichlorobenzene** | 95-50-1 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **Hexachlorobutadiene** | 87-68-3 | 0.5 | µg | <1.0 | <1.0 | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 1)** |  |  |  |  |  |  |  |  |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **113** | **116** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **77.9** | **74.5** | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 2)** |  |  |  |  |  |  |  |  |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **107** | **116** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **79.5** | **81.8** | ---- | ---- | ---- |
| **EP091: Chlorinated Organic Surrogates (Section 3)** |  |  |  |  |  |  |  |  |
| **1.2-Dichloroethane-D4** | 17060-07-0 | 0.5 | % | **112** | **117** | ---- | ---- | ---- |
| **4-Bromofluorobenzene** | 460-00-4 | 0.5 | % | **76.0** | **82.5** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 1)** |  |  |  |  |  |  |  |  |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **85.9** | **99.2** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 2)** |  |  |  |  |  |  |  |  |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **86.3** | **90.5** | ---- | ---- | ---- |
| **EP091: MAH Surrogates (Section 3)** |  |  |  |  |  |  |  |  |
| **Toluene-D8** | 2037-26-5 | 0.5 | % | **90.0** | **92.2** | ---- | ---- | ---- |

SGS LEEDER CONSULTING

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

Chartered Chemists

**REPORT NUMBER: M151361**

Site/Client Ref: 60341673/1.1

Order No: 60341673/1.1

**24-Jun-2015**

**AECOM**

**17 Warabrook Bvde**
**Warabrook**

**NSW 2304**
**Attention: James Lang**

## CERTIFICATE OF ANALYSIS

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

**DATE RECEIVED:** **16-Jun-2015**

**DATE COMMENCED:** **16-Jun-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:**

Ming

**Ming Dai**
Senior Chemist

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number: 14429

Accredited for compliance with ISO/IEC 17025.

## (I) RESULTS

**Report N°: M151361**

**Matrix: Filter**

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

Sample units are expressed in µg total

| | **Leeder ID** | 2015014782 | 2015014783 | 2015014784 |
|---|---|---|---|---|
| | **Client ID** | Stack 1_Metals 1 | Stack 1_Metals 12 Blank | Method |
| | **Sampled Date** | 11/06/2015 | 11/06/2015 | |
| **Analyte Name** | **PQL** | | | Blank |
| Sb | 0.2 | nd | nd | nd |
| As | 0.2 | nd | 0.2 | nd |
| Be | 0.2 | nd | nd | nd |
| Cd | 0.2 | nd | nd | nd |
| Cr | 0.2 | 0.7 | 0.8 | nd |
| Co | 0.2 | nd | nd | nd |
| Cu | 0.2 | 0.3 | 0.4 | nd |
| Pb | 0.2 | 0.5 | 0.3 | nd |
| Mg | 2 | 8 | 20 | nd |
| Mn | 0.2 | 0.4 | 0.6 | nd |
| Hg | 0.2 | nd | nd | nd |
| Ni | 0.2 | nd | nd | nd |
| Se | 0.2 | nd | nd | nd |
| Tl | 0.2 | nd | nd | nd |
| Sn | 0.2 | nd | nd | nd |
| V | 0.2 | 0.8 | 0.7 | nd |
| Zn | 0.2 | 960 | 1200 | nd |

## (I) RESULTS

**Report N°: M151361**

**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

| | **Leeder ID** | 2015014785 | 2015014786 |
|---|---|---|---|
| | **Client ID** | Stack 1_Metals 3 | Stack 1_Metals 4 |
| | **Sampled Date** | 11/06/2015 | 11/06/2015 |
| **Analyte Name** | **PQL** | | |
| Sb | 0.1 | nd | nd |
| As | 0.1 | nd | nd |
| Be | 0.1 | nd | nd |
| Cd | 0.1 | 1.4 | 0.4 |
| Cr | 0.1 | 0.5 | 7.8 |
| Co | 0.1 | nd | nd |
| Cu | 0.1 | 1.9 | 2.0 |
| Pb | 0.1 | 17 | 1.3 |
| Mg | 0.1 | 8.1 | nd |
| Mn | 0.1 | 9.1 | 1.3 |
| Hg | 0.1 | nd | nd |
| Ni | 0.1 | 1.5 | 20 |
| Se | 0.1 | nd | 0.6 |
| Tl | 0.1 | nd | nd |
| Sn | 0.1 | nd | nd |
| V | 0.1 | nd | nd |
| Zn | 0.1 | 420 | 2.1 |
| Sample Volume | | 93 | 310 |

## (I) RESULTS

**Report N°: M151361**

**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

| | **Leeder ID** | 2015014787 | 2015014788 | 2015014789 | 2015014790 | 2015014791 |
|---|---|---|---|---|---|---|
| | **Client ID** | Stack 1_Metals 8A Blank | Stack 1_Metals 9 Blank | Stack 1_Metals 5A | Stack 1_Metals 5C | Stack 1_Metals 8B Blank |
| | **Sampled Date** | 11/06/2015 | 11/06/2015 | 11/06/2015 | 11/06/2015 | 11/06/2015 |
| **Analyte Name** | **PQL** | | | | | |
| Sb | 0.1 | nd | nd | | | |
| As | 0.1 | nd | nd | | | |
| Be | 0.1 | nd | nd | | | |
| Cd | 0.1 | nd | 0.1 | | | |
| Cr | 0.1 | 0.2 | 0.2 | | | |
| Co | 0.1 | nd | nd | | | |
| Cu | 0.1 | 0.1 | 0.1 | | | |
| Pb | 0.1 | nd | 0.1 | | | |
| Mg | 0.1 | nd | nd | | | |
| Mn | 0.1 | 0.4 | 0.3 | | | |
| Hg | 0.1 | nd | nd | nd | nd | nd |
| Ni | 0.1 | 4.0 | 2.7 | | | |
| Se | 0.1 | nd | nd | | | |
| Tl | 0.1 | nd | nd | | | |
| Sn | 0.1 | nd | nd | | | |
| V | 0.1 | nd | nd | | | |
| Zn | 0.1 | nd | 0.2 | | | |
| Sample Volume | | 300 | 200 | 100 | 250 | 200 |

## (I) RESULTS

**Matrix: Impinger Solution**

**Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)**

Sample units are expressed in µg total

| | **Leeder ID** | 2015014792 | 2015014793 |
|---|---|---|---|
| | **Client ID** | Stack 1_Metals 11 Blank | Method |
| | **Sampled Date** | 11/06/2015 | |
| **Analyte Name** | **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 | nd |
| Ni | 0.1 | | nd |
| Se | 0.1 | | nd |
| Tl | 0.1 | | nd |
| Sn | 0.1 | | nd |
| V | 0.1 | | nd |
| Zn | 0.1 | | nd |
| Sample Volume | | 250 | |

## (I) RESULTS

**Report N°: M151361**

**Matrix: KMnO4**

**Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.04 Mercury in Impingers (ug total)**

Sample units are expressed in µg total

| | | | | |
|---|---|---|---|---|
| | **Leeder ID** | 2015014794 | 2015014795 | 2015014796 |
| | **Client ID** | Stack 1_Metals 5B | Stack 1_Metals 10 Blank | Method |
| | **Sampled Date** | 11/06/2015 | 11/06/2015 | |
| **Analyte Name** | **PQL** | | | Blank |
| Hg | 0.5 | nd | nd | nd |
| Sample Volume | | 260 | 100 | |

## (II) QUALITY CONTROL

**Matrix: Filter**

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

Quality Control Results are expressed in Percent Recovery of expected result

| | **Leeder ID** | 2015014797 | 2015014798 |
|---|---|---|---|
| | **Client ID** | Matrix | Matrix |
| | **Sampled Date** | | |
| **Analyte Name** | **PQL** | Spike | Spike Dup |
| Sb | | 81 | 81 |
| As | | 85 | 85 |
| Be | | 79 | 73 |
| Cd | | 81 | 82 |
| Cr | | 87 | 87 |
| Co | | 83 | 84 |
| Cu | | 89 | 89 |
| Pb | | 82 | 84 |
| Mg | | 75 | 74 |
| Mn | | 86 | 86 |
| Hg | | 77 | 78 |
| Ni | | 87 | 87 |
| Se | | 91 | 83 |
| Tl | | 83 | 82 |
| Sn | | 84 | 84 |
| V | | 80 | 80 |
| Zn | | U | U |

## (II) QUALITY CONTROL

**Report N°: M151361**

**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

| | **Leeder ID** | 2015014799 | 2015014800 |
|---|---|---|---|
| | **Client ID** | Matrix | Matrix |
| | **Sampled Date** | | |
| **Analyte Name** | **PQL** | Spike | Spike Dup |
| Sb | | 81 | 79 |
| As | | 86 | 83 |
| Be | | 77 | 82 |
| Cd | | 82 | 79 |
| Cr | | 86 | 83 |
| Co | | 83 | 81 |
| Cu | | 89 | 86 |
| Pb | | 86 | 79 |
| Mg | | 74 | 73 |
| Mn | | 88 | 81 |
| Hg | | 79 | 76 |
| Ni | | 87 | 85 |
| Se | | 81 | 74 |
| Tl | | 82 | 80 |
| Sn | | 83 | 80 |
| V | | 80 | 77 |
| Zn | | U | U |

## (II) QUALITY CONTROL

**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

| | **Leeder ID** | 2015014801 |
|---|---|---|
| | **Client ID** | Matrix |
| | **Sampled Date** | |
| **Analyte Name** | **PQL** | Spike |
| Hg | | 108 |

**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

| | **Leeder ID** | 2015014802 |
|---|---|---|
| | **Client ID** | Matrix |
| | **Sampled Date** | |
| **Analyte Name** | **PQL** | Spike Dup |
| Hg | | 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 non-petroleum hydrocarbon profile |

# APPENDIX ONE.

## CHAIN OF CUSTODY DOCUMENT

# Chain of Custody Record - SGS Leeder Consulting

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

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

**Sheet** 1 **of** 1

**CLIENT NAME: AECOM**

**CLIENT ADDRESS: 17 Warabrook Blvd**

**Warabrook NSW 2304**

**CONTACT:** James Lang

**SAMPLED BY:** VK + CC

**PROJECT REF. / ORDER No:** 60341673/1.1

**CONTACT PHONE No:** 02 4911 4900

**CONTACT FAX No:** 02 4911 4999

**RESULTS REQUIRED BY:** James Lang

**EMAIL REPORT TO:** ntlair.labs@aecom.com+james.lang@aecom.com

**LAB QUOTE NUMBER:**

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

| Client Sample ID | Date Sampled | Matrix | | | Containers/Preservation (please tick) (G=glass, P=plastic) | | | | | | | | | | Analyses Required (Analyte + Method Code) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Filter | Impinger | KMnO4 | 0.1-1L Jar(G) n.a. | 0.1-1.0 litre(G) Nat. | 0.1-1.0 litre(P) Nat. | 40ml Vial(G) Nat. | 40ml Vial(G) H2SO4 | 0.1-1L (P) H2SO4 | 125mL (P) HCl acid washed | 125mL (P) Zn Ace. NaOH | 125mL (P) Filtered Yes/No HNO3 | 125mL (P) NaOH | Metals -USEPA Method 29* | Mercury | | | | | | | |
| Stack 1_Metals 1 | 11/06/15 | X | | | X | | | | | | | | | | X | | | | | | | | |
| Stack 1_Metals 3 | 11/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 1_Metals 4 | 11/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 1_Metals 5A | 11/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 5B | 11/06/15 | | | X | | X | | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 5C | 11/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 8A Blank | 11/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 1_Metals 8B Blank | 11/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 9 Blank | 11/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 1_Metals 10 Blank | 11/06/15 | | | X | | X | | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 11 Blank | 11/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 1_Metals 12 Blank | 11/06/15 | X | | | X | | | | | | | | | | X | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| ---------------- | Totals: | | | | | | | | | | | | | | | | | | | | | | |

## CHAIN OF CUSTODY RECORD

| RELEASED BY: (Name) | (Signature) | (Date / Time) | |
|---|---|---|---|
| Vilai Kelemete | VK | 11/06/15 | *Custody Seals Intact?* [✓ *Yes*] / *No* |
| **RECEIVED BY:** (Name) | (Signature) | (Date / Time) | |
| Benedict Robinson | | 16/6/15 11:00am | *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

SGS LEEDER CONSULTING

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

Chartered Chemists

**REPORT NUMBER: M151392**
Site/Client Ref: 60341673/1.1
Order No: 60341673/1.1

**26-Jun-2015**

**AECOM**

**17 Warabrook Bvde**
**Warabrook**

**NSW 2304**
**Attention: James Lang**

## CERTIFICATE OF ANALYSIS

| | |
|---|---|
| **SAMPLES:** | Twelve samples were received for analysis |
| **DATE RECEIVED:** | **19-Jun-2015** |
| **DATE COMMENCED:** | **19-Jun-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:**

Ming

**Ming Dai**
Senior Chemist

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number: 14429

Accredited for compliance with ISO/IEC 17025.

## ANALYTICAL RESULTS

**Matrix: Filter**

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

Sample units are expressed in µg total

Test Started: 24/06/2015

| **Leeder ID** | | 2015015089 | 2015015090 | 2015015091 |
|---|---|---|---|---|
| **Client ID** | | Stack 5_Metals 1 | Stack 5_Metals 12 Blank | Method |
| **Analyte Name** | **Sampled Date** | 17/06/2015 | 17/06/2015 | |
| | **PQL** | | | Blank |
| Sb | 0.2 | 25 | nd | nd |
| As | 0.2 | 19 | nd | nd |
| Be | 0.2 | 0.4 | nd | nd |
| Cd | 0.2 | 1.4 | nd | nd |
| Cr | 0.2 | 570 | 0.5 | nd |
| Co | 0.2 | 55 | nd | nd |
| Cu | 0.2 | 320 | 0.3 | nd |
| Pb | 0.2 | 89 | 0.2 | nd |
| Mg | 2 | 4900 | 33 | nd |
| Mn | 0.2 | 410 | 0.5 | nd |
| Hg | 0.2 | nd | nd | nd |
| Ni | 0.2 | 110 | nd | nd |
| Se | 0.2 | 6.8 | nd | nd |
| Tl | 0.2 | nd | nd | nd |
| Sn | 0.2 | 1100 | 3.8 | nd |
| V | 0.2 | 50 | 0.4 | nd |
| Zn | 0.2 | 17000 | 550 | nd |

# ANALYTICAL RESULTS

**Matrix: Impinger Solution**

**Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)**

Sample units are expressed in µg total

Test Started: 24/06/2015

| | **Leeder ID**<br>**Client ID** | 2015015092<br>Stack 5_Metals 3 | 2015015093<br>Stack 5_Metals 4 |
|---|---|---|---|
| **Analyte Name** | **Sampled Date**<br>**PQL** | 17/06/2015 | 17/06/2015 |
| Sb | 0.1 | nd | nd |
| As | 0.1 | nd | nd |
| Be | 0.1 | nd | nd |
| Cd | 0.1 | 0.4 | 0.4 |
| Cr | 0.1 | nd | 1.3 |
| Co | 0.1 | nd | nd |
| Cu | 0.1 | 1.1 | 0.6 |
| Pb | 0.1 | 15 | 0.5 |
| Mg | 0.1 | 1.6 | 2.7 |
| Mn | 0.1 | 0.3 | 5.3 |
| Hg | 0.1 | nd | nd |
| Ni | 0.1 | 0.3 | 10 |
| Se | 0.1 | nd | 0.6 |
| Tl | 0.1 | nd | nd |
| Sn | 0.1 | nd | 0.5 |
| V | 0.1 | nd | nd |
| Zn | 0.1 | 5.7 | 5.1 |
| Sample Volume | | 100 | 310 |

# ANALYTICAL RESULTS

**Matrix: Impinger Solution**

**Method: USEPA M29 (Analysis only) - MA-1400.IMP.M29.06 Metals in Impingers (ug total)**

Sample units are expressed in µg total

Test Started: 24/06/2015

| | **Leeder ID** | 2015015094 | 2015015095 | 2015015096 | 2015015097 | 2015015098 |
|---|---|---|---|---|---|---|
| | **Client ID** | Stack 5_Metals 8A Blank | Stack 5_Metals 9 Blank | Stack 5_Metals 5A | Stack 5_Metals 5C | Stack 5_Metals 8B Blank |
| **Analyte Name** | **Sampled Date** | 17/06/2015 | 17/06/2015 | 17/06/2015 | 17/06/2015 | 17/06/2015 |
| | **PQL** | | | | | |
| Sb | 0.1 | nd | nd | | | |
| As | 0.1 | nd | nd | | | |
| Be | 0.1 | nd | nd | | | |
| Cd | 0.1 | nd | nd | | | |
| Cr | 0.1 | nd | nd | | | |
| Co | 0.1 | nd | nd | | | |
| Cu | 0.1 | nd | 0.3 | | | |
| Pb | 0.1 | nd | nd | | | |
| Mg | 0.1 | 0.5 | 1.2 | | | |
| Mn | 0.1 | nd | nd | | | |
| Hg | 0.1 | nd | nd | nd | nd | nd |
| Ni | 0.1 | nd | nd | | | |
| Se | 0.1 | nd | nd | | | |
| Tl | 0.1 | nd | nd | | | |
| Sn | 0.1 | nd | nd | | | |
| V | 0.1 | nd | nd | | | |
| Zn | 0.1 | 1.2 | 0.7 | | | |
| Sample Volume | | 310 | 200 | 100 | 250 | 110 |

**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: 24/06/2015

| | Leeder ID | 2015015099 | 2015015100 |
|---|---|---|---|
| | Client ID | Stack 5_Metals 11 Blank | Method |
| Analyte Name | Sampled Date | 17/06/2015 | |
| | 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 | nd |
| Ni | 0.1 | | nd |
| Se | 0.1 | | nd |
| Tl | 0.1 | | nd |
| Sn | 0.1 | | nd |
| V | 0.1 | | nd |
| Zn | 0.1 | | nd |
| Sample Volume | | 250 | |

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

Test Started: 22/06/2015

| | Leeder ID | 2015015101 | 2015015102 | 2015015103 |
|---|---|---|---|---|
| | Client ID | Stack 5_Metals 5B | Stack 5_Metals 10 Blank | Method |
| Analyte Name | Sampled Date | 17/06/2015 | 17/06/2015 | |
| | PQL | | | Blank |
| Hg | 0.5 | nd | nd | nd |
| Sample Volume | | 400 | 120 | |

**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: 24/06/2015

| | **Leeder ID** | 2015015104 | 2015015105 |
|---|---|---|---|
| | **Client ID** | Matrix | Matrix |
| **Analyte Name** | **Sampled Date** | | |
| | **PQL** | Spike | Spike Dup |
| Sb | | 100 | 102 |
| As | | 97 | 99 |
| Be | | 102 | 99 |
| Cd | | 99 | 100 |
| Cr | | 104 | 104 |
| Co | | 93 | 98 |
| Cu | | 105 | 114 |
| Pb | | 96 | 105 |
| Mg | | 104 | 109 |
| Mn | | 101 | 95 |
| Hg | | 96 | 93 |
| Ni | | 101 | 112 |
| Se | | 103 | 101 |
| Tl | | 95 | 95 |
| Sn | | 89 | 89 |
| V | | 97 | 104 |
| 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: 24/06/2015

| | **Leeder ID**<br>**Client ID**<br>**Sampled Date**<br>**PQL** | 2015015106<br>Matrix<br>Spike | 2015015107<br>Matrix<br>Spike Dup |
|---|---|---|---|
| **Analyte Name** | | | |
| Sb | | 102 | 101 |
| As | | 101 | 101 |
| Be | | 100 | 107 |
| Cd | | 102 | 101 |
| Cr | | 104 | 104 |
| Co | | 96 | 95 |
| Cu | | 107 | 107 |
| Pb | | 96 | 92 |
| Mg | | 109 | 108 |
| Mn | | 105 | 104 |
| Hg | | 99 | 98 |
| Ni | | 105 | 103 |
| Se | | 106 | 107 |
| Tl | | 96 | 96 |
| Sn | | 99 | 102 |
| V | | 103 | 104 |
| Zn | | 96 | 96 |

**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: 22/06/2015

| | **Leeder ID**<br>**Client ID**<br>**Sampled Date**<br>**PQL** | 2015015108<br>Matrix<br>Spike |
|---|---|---|
| **Analyte Name** | | |
| Hg | | 107 |

**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: 22/06/2015

| | **Leeder ID**<br>**Client ID**<br>**Sampled Date**<br>**PQL** | 2015015109<br>Matrix<br>Spike Dup |
|---|---|---|
| **Analyte Name** | | |
| Hg | | 107 |

## QUALIFIERS / NOTES FOR REPORTED RESULTS

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

## APPENDIX ONE.

CHAIN OF CUSTODY DOCUMENT

# *Chain of Custody Record - SGS Leeder Consulting*

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

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

**Sheet** 1 **of** 1

**CLIENT NAME: AECOM**

**CLIENT ADDRESS: 17 Warabrook Blvd**

**Warabrook NSW 2304**

**CONTACT:** James Lang

**SAMPLED BY:** VK + DT

**PROJECT REF. / ORDER No:** 60341673/1.1

**CONTACT PHONE No:** 02 4911 4900

**CONTACT FAX No:** 02 4911 4999

**RESULTS REQUIRED BY:** James.lang@aecom.com

**EMAIL REPORT TO:** ntlair.labs@aecom.com

**LAB QUOTE NUMBER:**

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

| Client Sample ID | Date Sampled | Matrix | | | Containers/Preservation (please tick) | | | | | | | | | (G=glass, P=plastic) | Analyses Required (Analyte + Method Code) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Filter | Impinger | KMnO4 | 0.1-1L Jar(G) n.a. | 0.1-1.0 litre(G) Nat. | 0.1-1.0 litre(P) Nat. | 40ml Vial(G) Nat. | 40ml Vial(G) H2SO4 | 0.1-1L (P) H2SO4 | 125mL (P) HCl acid washed | 125mL (P) Zn Ace. NaOH | 125mL (P) Filtered Yes/No HNO3 | 125mL (P) NaOH | Metals -USEPA Method 29* | Mercury | | | | | | | |
| Stack 5_Metals 1 | 17/06/15 | X | | | X | | | | | | | | | | X | | | | | | | | |
| Stack 5_Metals 3 | 17/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 5_Metals 4 | 17/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 5_Metals 5A | 17/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 5_Metals 5B | 17/06/15 | | | X | | X | | | | | | | | | | X | | | | | | | |
| Stack 5_Metals 5C | 17/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 5_Metals 8A Blank | 17/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 5_Metals 8B Blank | 17/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 5_Metals 9 Blank | 17/06/15 | | X | | | | X | | | | | | | | X | | | | | | | | |
| Stack 5 _Metals 10 Blank | 17/06/15 | | | X | | X | | | | | | | | | | X | | | | | | | |
| Stack_Metals 11 Blank | 17/06/15 | | X | | | | X | | | | | | | | | X | | | | | | | |
| Stack 5_Metals 12 Blank | 17/06/15 | X | | | X | | | | | | | | | | X | | | | | | | | |
| | 17/06/15 | | | | | | | | | | | | | | | | | | | | | | |
| ---------------- | Totals: | | | | | | | | | | | | | | | | | | | | | | |

**CHAIN OF CUSTODY RECORD**

| RELEASED BY: (Name) | (Signature) | (Date / Time) | *Custody Seals Intact?* | *Yes / No* |
|---|---|---|---|---|
| Vilai Kelemete- Manua | VK | 18/06/15 | | |
| **RECEIVED BY:** (Name) | (Signature) | (Date / Time) | *Samples Received Chilled?* | *Yes / No* |
| Sandra Behnak | | 19/6/15 10:45am | | |

**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

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**National Measurement Institute**

# ANALYSIS REPORT # ORG15_110

**Client** AECOM AUSTRALIA
17 WARABROOK BOULEVARDE
WARABROOK NSW 2304

**Contact** Colin Clarke

**Job No.** AECO01/150616

**Sampled by** Client
**Date Sampled** 5/11-Jun-2015
**Date Received** 16-Jun-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
July 8, 2015

**Accreditation** NATA Accreditation Number : 198

Accredited for compliance with ISO/IEC 17025.

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## Sample Details : Job No. AECO01/150616

| Laboratory Reg. No. | Client Sample Ref. | Matrix | Description |
|---|---|---|---|
| N15/014599 | DAU210415C / Stack 7 | Emission | Cartridge, Filter & Rinses |
| N15/014600 | DAU030615D / Stack 1 | Emission | Cartridge, Filter & Rinses |

## Project Details

| | |
|---|---|
| Project Name | *Not specified* |
| Project Number | *60341673* |

## 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$^{\dagger}$ | Benzo(a)pyrene Potency Equivalent Factor |
| BaP-TEQ$_{PAH}$ | Benzo(a)pyrene Toxic Equivalents |

$^{\dagger}$ as defined in "Benzo(a)pyrene as a Toxic Air Contaminant", CARB/OEHHA Executive Summary, July 1994

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

$$\text{BaP}-\text{TEQ}_{\text{PAH}} = \sum_{i=1}^{n}\left[\text{PAH}_i \times \text{BaP}-\text{PEF}_i\right]$$

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

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

## Results : Job No. AECO01/150616

| | | | |
|---|---|---|---|
| **Laboratory Reg. No.** | N15/014599 | **Date Reported** | 08-Jul-2015 |
| **Client Sample Ref.** | DAU210415C / Stack 7 | **Date Extracted** | 23-Jun-2015 |
| **Matrix** | Emission | | |
| **Description** | Cartridge, Filter & Rinses | | |

| PAH | Conc. ng | Reporting Level (LOR, ng) | BaP-PEF Value | BaP-TEQ Contribution | Labelled Internal recovery (%) | Flags |
|---|---|---|---|---|---|---|
| Naphthalene | 6400 | 1400 | - | - | 49 | * |
| 2-Methylnaphthalene | 9600 | 530 | - | - | | |
| Acenaphthylene | <20 | 20 | - | - | 42 | * |
| Acenaphthene | 78 | 20 | - | - | 49 | * |
| Fluorene | 140 | 20 | - | - | 63 | |
| Phenanthrene | 550 | 32 | - | - | 90 | |
| Anthracene | 21 | 20 | - | - | | |
| Fluoranthene | 380 | 20 | - | - | 68 | |
| Pyrene | 170 | 20 | - | - | | |
| Benz(a)anthracene | 26 | 20 | 0.1 | 2.6 | 68 | |
| Chrysene | 65 | 20 | 0.01 | 0.7 | 69 | |
| Benzo(b)fluoranthene | 46 | 20 | 0.1 | 4.6 | 60 | |
| Benzo(k)fluoranthene | <20 | 20 | 0.1 | 1.0 | 59 | |
| Benzo(e)pyrene | <20 | 20 | - | - | | |
| Benzo(a)pyrene | 44 | 20 | 1.0 | 44 | 63 | |
| Perylene | 33 | 20 | - | - | | |
| Indeno(1,2,3-cd)pyrene | <20 | 20 | 0.1 | 1.0 | 55 | |
| Dibenz(ah)anthracene | <26 | 26 | 0.4 | 5.2 | 55 | |
| Benzo(ghi)perylene | <20 | 20 | - | - | 53 | |

**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 | 56 |

| Summary Results | | |
|---|---|---|
| **BaP -TEQ$_{PAH}$** | | |
| Lower Bound [excluding LOD values] | **52** | ng |
| Middle Bound [including half LOD values] | **59** | ng |
| Upper Bound [including LOD values] | **66** | ng |

## Results : Job No. AECO01/150616

| | | | |
|---|---|---|---|
| **Laboratory Reg. No.** | N15/014600 | **Date Reported** | 08-Jul-2015 |
| **Client Sample Ref.** | DAU030615D / Stack 1 | **Date Extracted** | 23-Jun-2015 |
| **Matrix** | Emission | | |
| **Description** | Cartridge, Filter & Rinses | | |

| PAH | Conc. ng | Reporting Level (LOR, ng) | BaP-PEF Value | BaP-TEQ Contribution | Labelled Internal recovery (%) | Flags |
|---|---|---|---|---|---|---|
| Naphthalene | 2100 | 1400 | - | - | 52 | |
| 2-Methylnaphthalene | 790 | 530 | - | - | | |
| Acenaphthylene | 42 | 20 | - | - | 42 | * |
| Acenaphthene | 26 | 20 | - | - | 50 | * |
| Fluorene | 52 | 20 | - | - | 67 | |
| Phenanthrene | 400 | 32 | - | - | 81 | |
| Anthracene | <20 | 20 | - | - | | |
| Fluoranthene | 280 | 20 | - | - | 59 | |
| Pyrene | 170 | 20 | - | - | | |
| Benz(a)anthracene | 120 | 20 | 0.1 | 12 | 60 | |
| Chrysene | 360 | 20 | 0.01 | 3.6 | 62 | |
| Benzo(b)fluoranthene | 350 | 20 | 0.1 | 35 | 62 | |
| Benzo(k)fluoranthene | 190 | 20 | 0.1 | 19 | 61 | |
| Benzo(e)pyrene | 150 | 20 | - | - | | |
| Benzo(a)pyrene | <20 | 20 | 1.0 | 10 | 59 | |
| Perylene | <20 | 20 | - | - | | |
| Indeno(1,2,3-cd)pyrene | 34 | 20 | 0.1 | 3.4 | 59 | |
| Dibenz(ah)anthracene | <26 | 26 | 0.4 | 5.2 | 59 | |
| Benzo(ghi)perylene | <20 | 20 | - | - | 55 | |

**Flags**

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

| Surrogate Recovery | % |
|---|---|
| d14-Terphenyl | 52 |

| Summary Results | | |
|---|---|---|
| **BaP -TEQ$_{PAH}$** | | |
| Lower Bound [excluding LOD values] | **73** | ng |
| Middle Bound [including half LOD values] | **88** | ng |
| Upper Bound [including LOD values] | **100** | ng |

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**National Measurement Institute**

# ANALYSIS REPORT # ORG15_114

|  |  |  |  |
|---|---|---|---|
| **Client** | AECOM AUSTRALIA<br>17 WARABROOK BOULEVARDE<br>WARABROOK NSW 2304 | **Job No.** | AECO01/150619 |
|  |  | **Sampled by** | Client |
|  |  | **Date Sampled** | 17-Jun-2015 |
| **Contact** | Dylan Turnbull | **Date Received** | 19-Jun-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
July 9, 2015

**Accreditation** NATA Accreditation Number : 198

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COMPETENCE

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## Sample Details : Job No. AECO01/150619

| Laboratory Reg. No. | Client Sample Ref. | Matrix | Description |
|---|---|---|---|
| N15/015071 | DAU 150615A | Emission | Resin, Filter, Rinses |

## Project Details

| | |
|---|---|
| Project Name | *Stack 5* |
| Project Number | *60341673* |

## Key

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

**Abbreviations & Definitions**

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

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

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

$$\mathrm{BaP-TEQ}_{PAH} = \sum_{i=1}^{n}\left[\mathrm{PAH}_i \times \mathrm{BaP-PEF}_i\right]$$

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

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

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## Results : Job No. AECO01/150619

**Laboratory Reg. No.** N15/015071

**Date Reported** 09-Jul-2015

**Client Sample Ref.** DAU 150615A

**Date Extracted** 24-Jun-2015

**Matrix** Emission

**Description** Resin, Filter, Rinses

| PAH | Conc. ng | Reporting Level (LOR, ng) | BaP-PEF Value | BaP-TEQ Contribution | Labelled Internal recovery (%) | Flags |
|---|---|---|---|---|---|---|
| Naphthalene | <470 | 470 | - | - | 48 | * |
| 2-Methylnaphthalene | 610 | 36 | - | - | | |
| Acenaphthylene | 970 | 20 | - | - | 33 | * |
| Acenaphthene | 440 | 20 | - | - | 43 | * |
| Fluorene | 1100 | 49 | - | - | 47 | * |
| Phenanthrene | 2600 | 20 | - | - | 69 | |
| Anthracene | 84 | 20 | - | - | | |
| Fluoranthene | 620 | 20 | - | - | 64 | |
| Pyrene | 290 | 20 | - | - | | |
| Benz(a)anthracene | 40 | 20 | 0.1 | 4.0 | 63 | |
| Chrysene | 110 | 20 | 0.01 | 1.1 | 69 | |
| Benzo(b)fluoranthene | 120 | 20 | 0.1 | 12 | 62 | |
| Benzo(k)fluoranthene | 66 | 20 | 0.1 | 6.6 | 57 | |
| Benzo(e)pyrene | 53 | 20 | - | - | | |
| Benzo(a)pyrene | 110 | 20 | 1 | 110 | 57 | |
| Perylene | <20 | 20 | - | - | | |
| Indeno(1,2,3-cd)pyrene | 37 | 20 | 0.1 | 3.7 | 59 | |
| Dibenz(ah)anthracene | <20 | 20 | 0.4 | 4.0 | 59 | |
| Benzo(ghi)perylene | 41 | 20 | - | - | 54 | |

**Flags**

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

Acceptable recovery range set at 50 to 150%.

| Surrogate Recovery | % |
|---|---|
| d14-Terphenyl | 52 |

| Summary Results | | |
|---|---|---|
| **BaP -TEQ$_{PAH}$** | | |
| Lower Bound [excluding LOD values] | **140** | ng |
| Middle Bound [including half LOD values] | **140** | ng |
| Upper Bound [including LOD values] | **150** | ng |

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# ANALYSIS REPORT # ORG15_117

**Client** AECOM AUSTRALIA
17 WARABROOK BOULEVARDE
WARABROOK NSW 2304

**Contact** Dylan Turnbull

**Job No.** AECO01/150629

**Sampled by** Client
**Date Sampled** Not specified
**Date Received** 29-Jun-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
July 22, 2015

**Accreditation** NATA Accreditation Number : 198

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## Sample Details : Job No. AECO01/150629

| Laboratory Reg. No. | Client Sample Ref. | Matrix | Description |
|---|---|---|---|
| N15/015946 | DAU150615 B | Emission | Cartridge, Filter, Solvent Rinses |

## Project Details

| | |
|---|---|
| Project Name | *Stack 6* |
| Project Number | *60341673* |

## Key

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

**Abbreviations & Definitions**

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

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

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

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

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

## Results : Job No. AECO01/150629

**Laboratory Reg. No.** N15/015946
**Date Reported** 22-Jul-2015

**Client Sample Ref.** DAU150615 B
**Date Extracted** 15-Jul-2015
**Matrix** Emission
**Description** Cartridge, Filter, Solvent Rinses

| PAH | Conc. ng | Reporting Level (LOR, ng) | BaP-PEF Value | BaP-TEQ Contribution | Labelled Internal recovery (%) | Flags |
|---|---|---|---|---|---|---|
| Naphthalene | 4700 | 544 | - | - | 47 | * |
| 2-Methylnaphthalene | 890 | 238 | - | - | | |
| Acenaphthylene | <20 | 20 | - | - | 29 | * |
| Acenaphthene | 180 | 20 | - | - | 39 | * |
| Fluorene | 74 | 20 | - | - | 43 | * |
| Phenanthrene | 420 | 20 | - | - | 52 | |
| Anthracene | <20 | 20 | - | - | | |
| Fluoranthene | 270 | 20 | - | - | 47 | * |
| Pyrene | 140 | 20 | - | - | | |
| Benz(a)anthracene | <20 | 20 | 0.1 | 1.0 | 52 | |
| Chrysene | <20 | 20 | 0.01 | 0.1 | 61 | |
| Benzo(b)fluoranthene | 25 | 20 | 0.1 | 2.5 | 45 | * |
| Benzo(k)fluoranthene | <20 | 20 | 0.1 | 1.0 | 45 | * |
| Benzo(e)pyrene | <20 | 20 | - | - | | |
| Benzo(a)pyrene | <20 | 20 | 1.0 | 10 | 44 | * |
| Perylene | 42 | 20 | - | - | | |
| Indeno(1,2,3-cd)pyrene | <20 | 20 | 0.1 | 1.0 | 48 | * |
| Dibenz(ah)anthracene | 39 | 20 | 0.4 | 16 | 47 | * |
| Benzo(ghi)perylene | <29 | 29 | - | - | 43 | * |

**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 | 56 |

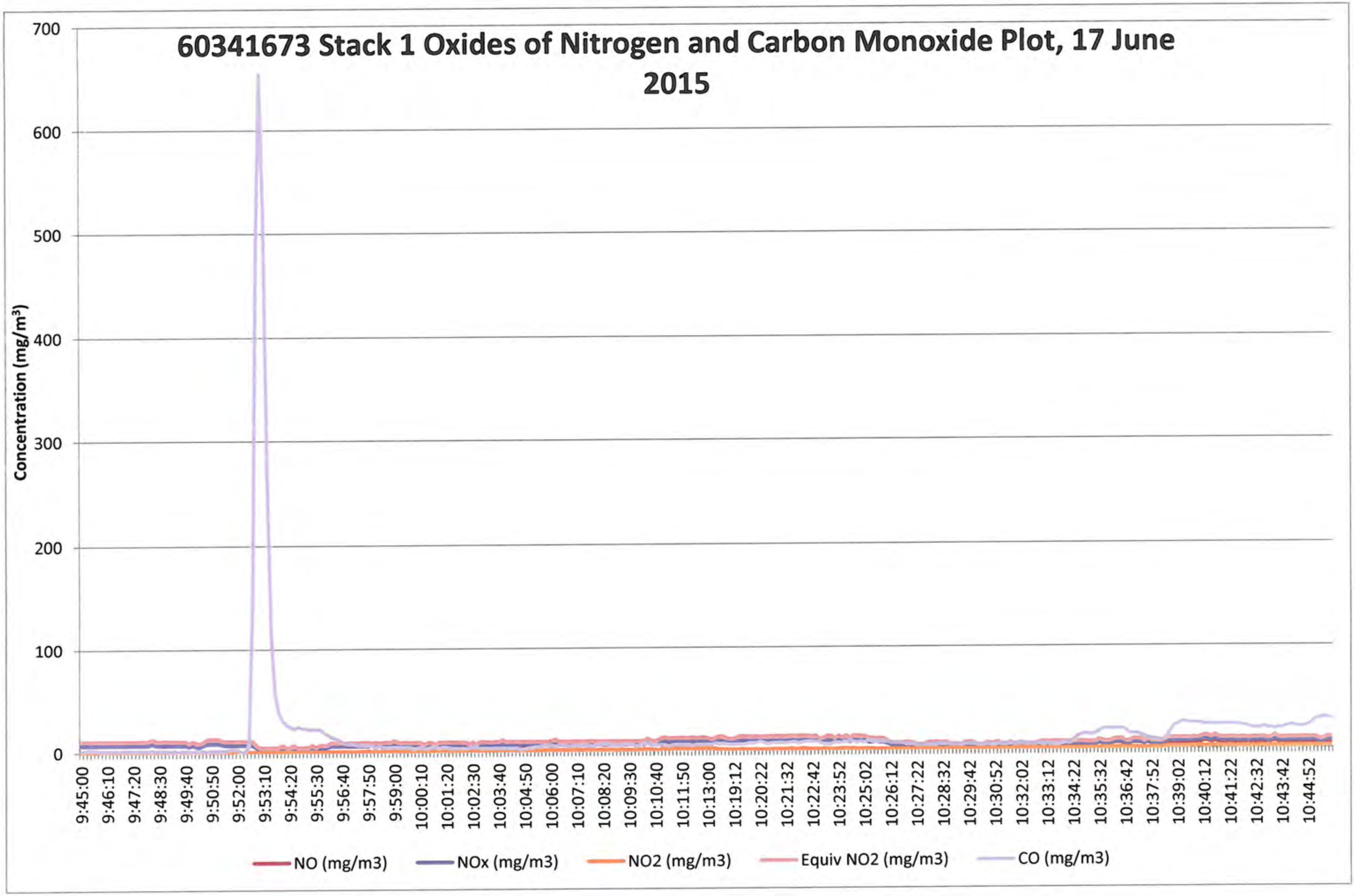
| Summary Results | | |
|---|---|---|
| **BaP -TEQ$_{PAH}$** | | |
| Lower Bound [excluding LOD values] | **19** | ng |
| Middle Bound [including half LOD values] | **32** | ng |
| Upper Bound [including LOD values] | **45** | ng |

## Appendix C

# Raw & Calculated Gas Data (21 pages)

# Appendix C Raw & Calculated Gas Data (21 pages)

## 60341673 Stack 1 Oxides of Nitrogen and Carbon Monoxide Plot, 17 June 2015



| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 9:45:00 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:45:10 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:45:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 9:45:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:45:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 9:45:50 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:00 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:10 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:46:50 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:00 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:10 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:47:50 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:48:00 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:48:10 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 1 | 1 |
| 17-Jun-15 | 9:48:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:48:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:48:40 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:48:50 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:49:00 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 |
| 17-Jun-15 | 9:49:10 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:49:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 |
| 17-Jun-15 | 9:49:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:49:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:49:50 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 1 | 1 |
| 17-Jun-15 | 9:50:00 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 |
| 17-Jun-15 | 9:50:10 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 1 | 1 |
| 17-Jun-15 | 9:50:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 1 | 1 |
| 17-Jun-15 | 9:50:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:50:40 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 |
| 17-Jun-15 | 9:50:50 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 1 | 1 |
| 17-Jun-15 | 9:51:00 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 1 | 1 |
| 17-Jun-15 | 9:51:10 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 1 | 1 |
| 17-Jun-15 | 9:51:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:51:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 1 | 1 |
| 17-Jun-15 | 9:51:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 9:51:50 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 9:52:00 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 9:52:10 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 |
| 17-Jun-15 | 9:52:20 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 |
| 17-Jun-15 | 9:52:30 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 5 | 6 |
| 17-Jun-15 | 9:52:40 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 113 | 141 |
| 17-Jun-15 | 9:52:50 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 384 | 480 |
| 17-Jun-15 | 9:53:00 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 523 | 654 |
| 17-Jun-15 | 9:53:10 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 414 | 518 |
| 17-Jun-15 | 9:53:20 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 215 | 269 |
| 17-Jun-15 | 9:53:30 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 93 | 116 |
| 17-Jun-15 | 9:53:40 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 46 | 58 |
| 17-Jun-15 | 9:53:50 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 30 | 38 |
| 17-Jun-15 | 9:54:00 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 24 | 30 |
| 17-Jun-15 | 9:54:10 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 21 | 26 |
| 17-Jun-15 | 9:54:20 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 19 | 24 |
| 17-Jun-15 | 9:54:30 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 17 | 21 |
| 17-Jun-15 | 9:54:40 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 19 | 24 |
| 17-Jun-15 | 9:54:50 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 18 | 23 |
| 17-Jun-15 | 9:55:00 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 18 | 23 |
| 17-Jun-15 | 9:55:10 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 17 | 21 |
| 17-Jun-15 | 9:55:20 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 17 | 21 |
| 17-Jun-15 | 9:55:30 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 17 | 21 |
| 17-Jun-15 | 9:55:40 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 17 | 21 |
| 17-Jun-15 | 9:55:50 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 15 | 19 |
| 17-Jun-15 | 9:56:00 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 13 | 16 |
| 17-Jun-15 | 9:56:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 11 | 14 |
| 17-Jun-15 | 9:56:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 10 | 13 |
| 17-Jun-15 | 9:56:30 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 9 | 11 |
| 17-Jun-15 | 9:56:40 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 7 | 9 |
| 17-Jun-15 | 9:56:50 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 6 | 8 |
| 17-Jun-15 | 9:57:00 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 6 | 8 |
| 17-Jun-15 | 9:57:10 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 5 | 6 |
| 17-Jun-15 | 9:57:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 5 | 6 |
| 17-Jun-15 | 9:57:30 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 5 | 6 |
| 17-Jun-15 | 9:57:40 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 5 | 6 |
| 17-Jun-15 | 9:57:50 | 4 | 5 | 5 | 6 | 0.2 | 0 | 6 | 9 | 5 | 6 |
| 17-Jun-15 | 9:58:00 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 4 | 5 |
| 17-Jun-15 | 9:58:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:58:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 4 | 5 |
| 17-Jun-15 | 9:58:30 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:58:40 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 3 | 4 |
| 17-Jun-15 | 9:58:50 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:59:00 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 3 | 4 |
| 17-Jun-15 | 9:59:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:59:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:59:30 | 4 | 5 | 5 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:59:40 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 9:59:50 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 2 | 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 10:00:00 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:00:10 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 10:00:20 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 2 | 3 |
| 17-Jun-15 | 10:00:30 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:00:40 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 10:00:50 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:01:00 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:01:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 10:01:20 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 3 | 4 |
| 17-Jun-15 | 10:01:30 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:01:40 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:01:50 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:02:00 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:02:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:02:20 | 3 | 4 | 4 | 4 | 0.1 | 0 | 5 | 6 | 2 | 3 |
| 17-Jun-15 | 10:02:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 3 | 4 |
| 17-Jun-15 | 10:02:40 | 3 | 4 | 4 | 4 | 0.1 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:02:50 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:03:00 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:03:10 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:03:20 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 2 | 3 |
| 17-Jun-15 | 10:03:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:03:40 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:03:50 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 2 | 3 |
| 17-Jun-15 | 10:04:00 | 4 | 5 | 5 | 6 | 0.3 | 1 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:04:10 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:04:20 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:04:30 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:04:40 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 1 | 1 |
| 17-Jun-15 | 10:04:50 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 1 | 1 |
| 17-Jun-15 | 10:05:00 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 2 | 3 |
| 17-Jun-15 | 10:05:10 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 2 | 3 |
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| 17-Jun-15 | 10:05:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 3 | 4 |
| 17-Jun-15 | 10:05:40 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:05:50 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:06:00 | 4 | 5 | 4 | 6 | 0.4 | 1 | 7 | 9 | 4 | 5 |
| 17-Jun-15 | 10:06:10 | 5 | 7 | 5 | 7 | 0.3 | 1 | 8 | 11 | 3 | 4 |
| 17-Jun-15 | 10:06:20 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:06:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:06:40 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:06:50 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 3 | 4 |
| 17-Jun-15 | 10:07:00 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:07:10 | 4 | 5 | 4 | 6 | 0.4 | 1 | 7 | 9 | 4 | 5 |
| 17-Jun-15 | 10:07:20 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:07:30 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:07:40 | 4 | 5 | 4 | 6 | 0.4 | 1 | 7 | 9 | 4 | 5 |
| 17-Jun-15 | 10:07:50 | 4 | 5 | 4 | 6 | 0.4 | 1 | 7 | 9 | 3 | 4 |
| 17-Jun-15 | 10:08:00 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:08:10 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:08:20 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 5 | 6 |
| 17-Jun-15 | 10:08:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 5 | 6 |
| 17-Jun-15 | 10:08:40 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:08:50 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:09:00 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:09:10 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:09:20 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 5 | 6 |
| 17-Jun-15 | 10:09:30 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:09:40 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 4 | 5 |
| 17-Jun-15 | 10:09:50 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 3 | 4 |
| 17-Jun-15 | 10:10:00 | 4 | 5 | 4 | 6 | 0.2 | 0 | 6 | 9 | 4 | 5 |
| 17-Jun-15 | 10:10:10 | 4 | 5 | 5 | 6 | 0.5 | 1 | 7 | 9 | 5 | 6 |
| 17-Jun-15 | 10:10:20 | 5 | 7 | 5 | 8 | 0.4 | 1 | 8 | 11 | 5 | 6 |
| 17-Jun-15 | 10:10:30 | 4 | 5 | 5 | 6 | 0.4 | 1 | 7 | 9 | 4 | 5 |
| 17-Jun-15 | 10:10:40 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 4 | 5 |
| 17-Jun-15 | 10:10:50 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 4 | 5 |
| 17-Jun-15 | 10:11:00 | 5 | 7 | 6 | 9 | 0.9 | 2 | 9 | 12 | 4 | 5 |
| 17-Jun-15 | 10:11:10 | 5 | 7 | 5 | 8 | 0.6 | 1 | 8 | 12 | 3 | 4 |
| 17-Jun-15 | 10:11:20 | 5 | 7 | 5 | 8 | 0.5 | 1 | 8 | 11 | 3 | 4 |
| 17-Jun-15 | 10:11:30 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:11:40 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:11:50 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:12:00 | 5 | 7 | 5 | 8 | 0.5 | 1 | 8 | 11 | 4 | 5 |
| 17-Jun-15 | 10:12:10 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:12:20 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 3 | 4 |
| 17-Jun-15 | 10:12:30 | 5 | 7 | 5 | 8 | 0.5 | 1 | 8 | 11 | 4 | 5 |
| 17-Jun-15 | 10:12:40 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:12:50 | 5 | 7 | 5 | 8 | 0.7 | 1 | 8 | 12 | 4 | 5 |
| 17-Jun-15 | 10:13:00 | 5 | 7 | 5 | 8 | 0.5 | 1 | 8 | 11 | 4 | 5 |
| 17-Jun-15 | 10:13:10 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 4 | 5 |
| 17-Jun-15 | 10:13:20 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 5 | 6 |
| 17-Jun-15 | 10:18:32 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 4 | 5 |
| 17-Jun-15 | 10:18:42 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:18:52 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 4 | 5 |
| 17-Jun-15 | 10:19:02 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 4 | 5 |
| 17-Jun-15 | 10:19:12 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 4 | 5 |
| 17-Jun-15 | 10:19:22 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 4 | 5 |
| 17-Jun-15 | 10:19:32 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 4 | 5 |
| 17-Jun-15 | 10:19:42 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 4 | 5 |
| 17-Jun-15 | 10:19:52 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 5 | 6 |
| 17-Jun-15 | 10:20:02 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 5 | 6 |
| 17-Jun-15 | 10:20:12 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 10:20:22 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 6 | 8 |
| 17-Jun-15 | 10:20:32 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 5 | 6 |
| 17-Jun-15 | 10:20:42 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 4 | 5 |
| 17-Jun-15 | 10:20:52 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:02 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:12 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:22 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:32 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:42 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 5 | 6 |
| 17-Jun-15 | 10:21:52 | 6 | 8 | 7 | 9 | 0.3 | 1 | 10 | 13 | 6 | 8 |
| 17-Jun-15 | 10:22:02 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 5 | 6 |
| 17-Jun-15 | 10:22:12 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 5 | 6 |
| 17-Jun-15 | 10:22:22 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 6 | 8 |
| 17-Jun-15 | 10:22:32 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 6 | 8 |
| 17-Jun-15 | 10:22:42 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 6 | 8 |
| 17-Jun-15 | 10:22:52 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 6 | 8 |
| 17-Jun-15 | 10:23:02 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 5 | 6 |
| 17-Jun-15 | 10:23:12 | 5 | 7 | 6 | 7 | 0.2 | 0 | 8 | 11 | 4 | 5 |
| 17-Jun-15 | 10:23:22 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 4 | 5 |
| 17-Jun-15 | 10:23:32 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 4 | 5 |
| 17-Jun-15 | 10:23:42 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 5 | 6 |
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| 17-Jun-15 | 10:24:22 | 5 | 7 | 6 | 7 | 0.2 | 0 | 8 | 11 | 6 | 8 |
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| 17-Jun-15 | 10:24:52 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 6 | 8 |
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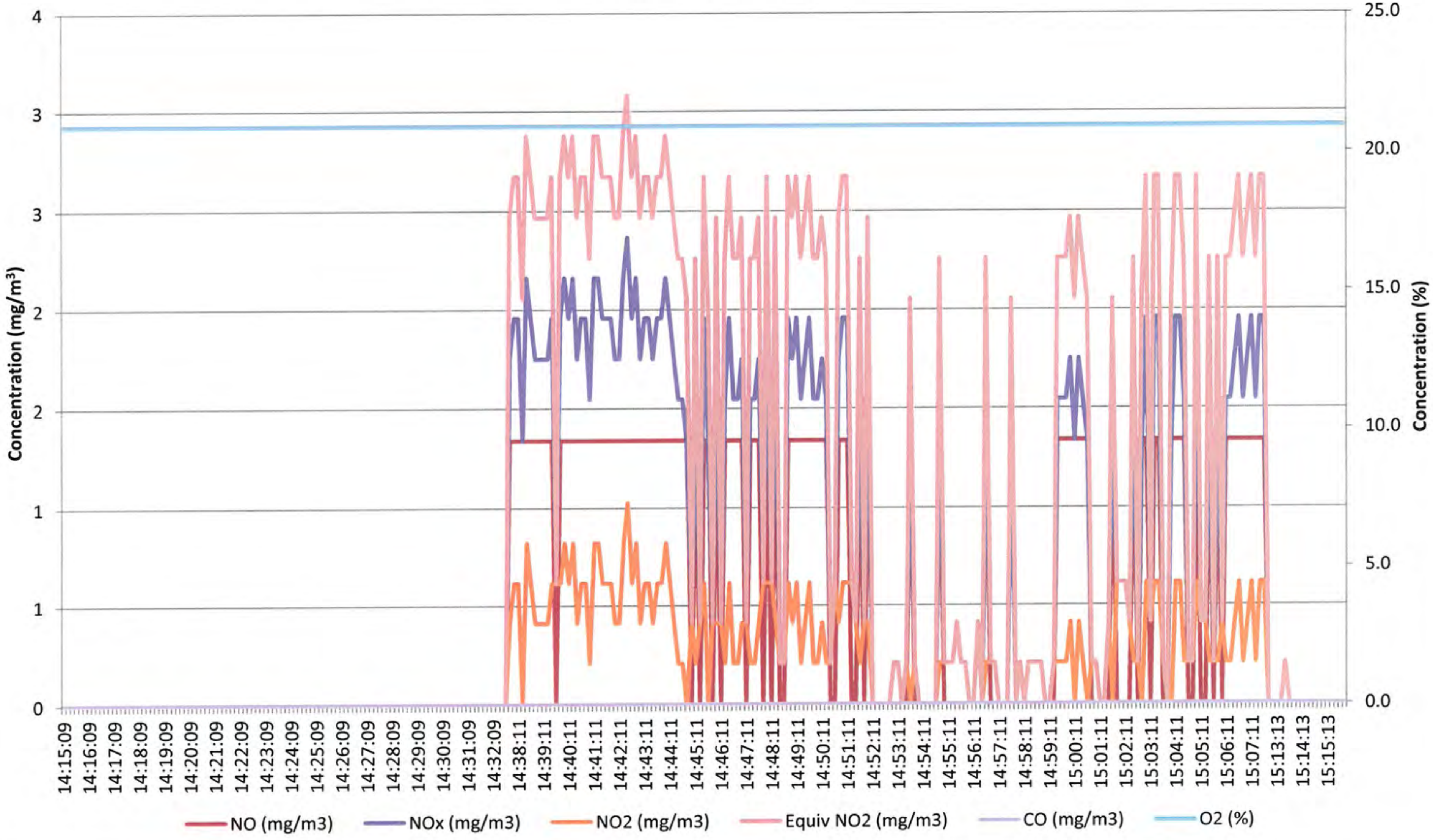
| 17-Jun-15 | 10:25:12 | 5 | 7 | 5 | 7 | 0.2 | 0 | 8 | 11 | 7 | 9 |
| 17-Jun-15 | 10:25:22 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 6 | 8 |
| 17-Jun-15 | 10:25:32 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 5 | 6 |
| 17-Jun-15 | 10:25:42 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 6 | 8 |
| 17-Jun-15 | 10:25:52 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 6 | 8 |
| 17-Jun-15 | 10:26:02 | 4 | 5 | 4 | 5 | 0.0 | 0 | 6 | 8 | 6 | 8 |
| 17-Jun-15 | 10:26:12 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 5 | 6 |
| 17-Jun-15 | 10:26:22 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 5 | 6 |
| 17-Jun-15 | 10:26:32 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 5 | 6 |
| 17-Jun-15 | 10:26:42 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 5 | 6 |
| 17-Jun-15 | 10:26:52 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:27:02 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:27:12 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:27:22 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:27:32 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:27:42 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:27:52 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:28:02 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:28:12 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:28:22 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:28:32 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:28:42 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:28:52 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:29:02 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:29:12 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:29:22 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:29:32 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:29:42 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:29:52 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:30:02 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:30:12 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:30:22 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:30:32 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:30:42 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 3 | 4 |
| 17-Jun-15 | 10:30:52 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:31:02 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:31:12 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:31:22 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:31:32 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:31:42 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:31:52 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:32:02 | 2 | 3 | 2 | 3 | 0.0 | 0 | 3 | 4 | 5 | 6 |
| 17-Jun-15 | 10:32:12 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:32:22 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:32:32 | 2 | 3 | 2 | 3 | 0.1 | 0 | 3 | 4 | 4 | 5 |
| 17-Jun-15 | 10:32:42 | 2 | 3 | 3 | 3 | 0.2 | 0 | 3 | 5 | 4 | 5 |
| 17-Jun-15 | 10:32:52 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:33:02 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:33:12 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 4 | 5 |
| 17-Jun-15 | 10:33:22 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 3 | 4 |
| 17-Jun-15 | 10:33:32 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 3 | 4 |
| 17-Jun-15 | 10:33:42 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 3 | 4 |
| 17-Jun-15 | 10:33:52 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 4 | 5 |
| 17-Jun-15 | 10:34:02 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 5 | 6 |
| 17-Jun-15 | 10:34:12 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 4 | 5 |
| 17-Jun-15 | 10:34:22 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 6 | 8 |
| 17-Jun-15 | 10:34:32 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 9 | 11 |
| 17-Jun-15 | 10:34:42 | 3 | 4 | 3 | 5 | 0.3 | 1 | 5 | 7 | 10 | 13 |
| 17-Jun-15 | 10:34:52 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 11 | 14 |
| 17-Jun-15 | 10:35:02 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 11 | 14 |
| 17-Jun-15 | 10:35:12 | 3 | 4 | 3 | 4 | 0.0 | 0 | 5 | 6 | 10 | 13 |
| 17-Jun-15 | 10:35:22 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 11 | 14 |
| 17-Jun-15 | 10:35:32 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 13 | 16 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 10:35:42 | 3 | 4 | 4 | 5 | 0.3 | 1 | 5 | 7 | 15 | 19 |
| 17-Jun-15 | 10:35:52 | 3 | 4 | 4 | 4 | 0.2 | 0 | 5 | 7 | 15 | 19 |
| 17-Jun-15 | 10:36:02 | 3 | 4 | 4 | 5 | 0.3 | 1 | 5 | 7 | 15 | 19 |
| 17-Jun-15 | 10:36:12 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 15 | 19 |
| 17-Jun-15 | 10:36:22 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 15 | 19 |
| 17-Jun-15 | 10:36:32 | 4 | 5 | 4 | 6 | 0.5 | 1 | 7 | 9 | 15 | 19 |
| 17-Jun-15 | 10:36:42 | 3 | 4 | 4 | 4 | 0.2 | 0 | 5 | 7 | 14 | 18 |
| 17-Jun-15 | 10:36:52 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 11 | 14 |
| 17-Jun-15 | 10:37:02 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 11 | 14 |
| 17-Jun-15 | 10:37:12 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 11 | 14 |
| 17-Jun-15 | 10:37:22 | 4 | 5 | 4 | 6 | 0.3 | 1 | 6 | 9 | 10 | 13 |
| 17-Jun-15 | 10:37:32 | 3 | 4 | 3 | 4 | 0.1 | 0 | 5 | 6 | 9 | 11 |
| 17-Jun-15 | 10:37:42 | 4 | 5 | 4 | 6 | 0.1 | 0 | 6 | 8 | 8 | 10 |
| 17-Jun-15 | 10:37:52 | 3 | 4 | 4 | 4 | 0.2 | 0 | 5 | 7 | 7 | 9 |
| 17-Jun-15 | 10:38:02 | 3 | 4 | 3 | 5 | 0.3 | 1 | 5 | 7 | 7 | 9 |
| 17-Jun-15 | 10:38:12 | 3 | 4 | 4 | 4 | 0.2 | 0 | 5 | 7 | 6 | 8 |
| 17-Jun-15 | 10:38:22 | 3 | 4 | 3 | 4 | 0.2 | 0 | 5 | 7 | 6 | 8 |
| 17-Jun-15 | 10:38:32 | 4 | 5 | 4 | 6 | 0.5 | 1 | 7 | 9 | 8 | 10 |
| 17-Jun-15 | 10:38:42 | 4 | 5 | 4 | 7 | 0.6 | 1 | 7 | 9 | 13 | 16 |
| 17-Jun-15 | 10:38:52 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:39:02 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:39:12 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 20 | 25 |
| 17-Jun-15 | 10:39:22 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 20 | 25 |
| 17-Jun-15 | 10:39:32 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 19 | 24 |
| 17-Jun-15 | 10:39:42 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 19 | 24 |
| 17-Jun-15 | 10:39:52 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 19 | 24 |
| 17-Jun-15 | 10:40:02 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 19 | 24 |
| 17-Jun-15 | 10:40:12 | 5 | 7 | 5 | 8 | 0.7 | 1 | 8 | 12 | 18 | 23 |
| 17-Jun-15 | 10:40:22 | 5 | 7 | 5 | 8 | 0.7 | 1 | 8 | 12 | 18 | 23 |
| 17-Jun-15 | 10:40:32 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:40:42 | 5 | 7 | 5 | 9 | 0.9 | 2 | 9 | 12 | 18 | 23 |
| 17-Jun-15 | 10:40:52 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:41:02 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:41:12 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:41:22 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:41:32 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 18 | 23 |
| 17-Jun-15 | 10:41:42 | 4 | 5 | 5 | 7 | 0.6 | 1 | 7 | 9 | 18 | 23 |
| 17-Jun-15 | 10:41:52 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:42:02 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:42:12 | 4 | 5 | 5 | 6 | 0.5 | 1 | 7 | 9 | 16 | 20 |
| 17-Jun-15 | 10:42:22 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 15 | 19 |
| 17-Jun-15 | 10:42:32 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 15 | 19 |
| 17-Jun-15 | 10:42:42 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 15 | 19 |
| 17-Jun-15 | 10:42:52 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 16 | 20 |
| 17-Jun-15 | 10:43:02 | 4 | 5 | 5 | 6 | 0.5 | 1 | 7 | 9 | 15 | 19 |
| 17-Jun-15 | 10:43:12 | 4 | 5 | 5 | 7 | 0.6 | 1 | 7 | 9 | 15 | 19 |
| 17-Jun-15 | 10:43:22 | 5 | 7 | 5 | 8 | 0.8 | 2 | 8 | 12 | 14 | 18 |
| 17-Jun-15 | 10:43:32 | 4 | 5 | 5 | 7 | 0.7 | 1 | 7 | 10 | 15 | 19 |
| 17-Jun-15 | 10:43:42 | 4 | 5 | 5 | 6 | 0.5 | 1 | 7 | 9 | 15 | 19 |
| 17-Jun-15 | 10:43:52 | 4 | 5 | 4 | 7 | 0.6 | 1 | 7 | 9 | 16 | 20 |
| 17-Jun-15 | 10:44:02 | 4 | 5 | 4 | 7 | 0.7 | 1 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:44:12 | 4 | 5 | 4 | 7 | 0.7 | 1 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:44:22 | 4 | 5 | 4 | 7 | 0.7 | 1 | 7 | 10 | 16 | 20 |
| 17-Jun-15 | 10:44:32 | 4 | 5 | 4 | 7 | 0.7 | 1 | 7 | 10 | 16 | 20 |
| 17-Jun-15 | 10:44:42 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 16 | 20 |
| 17-Jun-15 | 10:44:52 | 4 | 5 | 5 | 7 | 0.8 | 2 | 7 | 10 | 17 | 21 |
| 17-Jun-15 | 10:45:02 | 4 | 5 | 4 | 7 | 0.7 | 1 | 7 | 10 | 19 | 24 |
| 17-Jun-15 | 10:45:12 | 4 | 5 | 4 | 7 | 0.8 | 2 | 7 | 10 | 22 | 28 |
| 17-Jun-15 | 10:45:22 | 3 | 4 | 4 | 6 | 0.8 | 2 | 5 | 8 | 22 | 28 |
| 17-Jun-15 | 10:45:32 | 3 | 4 | 4 | 6 | 0.8 | 2 | 5 | 8 | 23 | 29 |
| 17-Jun-15 | 10:45:42 | 4 | 5 | 4 | 7 | 0.8 | 2 | 7 | 10 | 23 | 29 |
| 17-Jun-15 | 10:45:52 | 4 | 5 | 5 | 7 | 0.9 | 2 | 7 | 10 | 22 | 28 |
| | **Average** | **4** | **5** | **4** | **6** | **0** | **0** | **6** | **9** | **12** | **15** |
| | **Maximum** | **6** | **8** | **7** | **9** | **1** | **2** | **10** | **13** | **523** | **654** |
| | **Minimum** | **2** | **3** | **2** | **3** | **0** | **0** | **3** | **4** | **0** | **0** |

# 60431673 Stack 5 Oxides of Nitrogen, Carbon Monoxide and Oxygen Data Plot, 17 June 2015



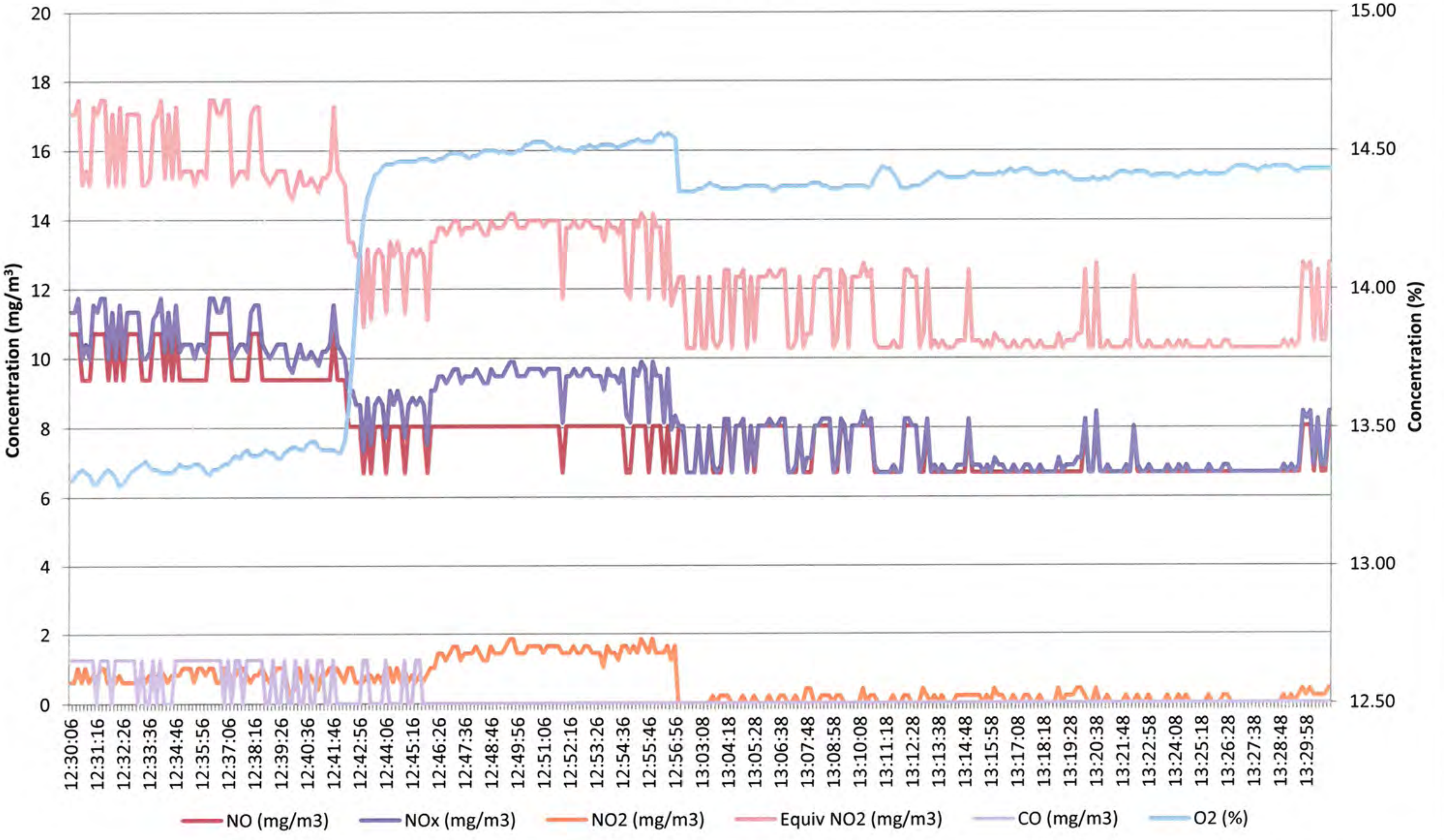
| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) | O2 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 14:15:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:15:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:15:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:15:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:15:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:15:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:16:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:17:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:18:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:19:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:20:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:21:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:22:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:23:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:24:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:25:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:26:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:27:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:28:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:29:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:30:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:30:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:30:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:30:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:30:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 14:30:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:49 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:31:59 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:32:09 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:32:19 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:32:29 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:32:39 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:37:51 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:01 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:21 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:31 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:38:51 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:11 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:21 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:31 | 1 | 1 | 2 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:41 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:39:51 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:01 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:21 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:31 | 1 | 1 | 2 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:40:51 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:01 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:11 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:21 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:31 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:41:51 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:11 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:21 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:31 | 1 | 1 | 1 | 2 | 0.5 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:42:51 | 1 | 1 | 2 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:21 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:31 | 1 | 1 | 2 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:43:51 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:01 | 1 | 1 | 1 | 2 | 0.4 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:21 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:41 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:44:51 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:01 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:11 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:21 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:31 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:41 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:45:51 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:11 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:31 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:41 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:46:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:11 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:41 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:47:51 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:01 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:11 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:21 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:31 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:41 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:48:51 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:31 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:49:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:01 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:11 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:31 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:41 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:50:51 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:01 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:21 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:31 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:41 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:51:51 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 14:52:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:52:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:52:21 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:52:31 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:52:41 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:52:51 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:01 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:11 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:21 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:31 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:41 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:53:51 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:01 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:21 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:31 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:41 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:54:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:01 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:11 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:21 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:31 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:41 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:55:51 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:01 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:21 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:31 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:41 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:56:51 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:01 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:21 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:31 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:41 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:57:51 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:01 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:21 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:31 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:41 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:58:51 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:01 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:21 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:41 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 14:59:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:11 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:21 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:41 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:00:51 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:01 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:11 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:21 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:31 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:41 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:01:51 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:01 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:11 | 0 | 0 | 1 | 1 | 0.3 | 1 | 0 | 1 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:21 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:41 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:02:51 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:01 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:11 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:21 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:31 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:41 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:03:51 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:01 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:21 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:41 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:04:51 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:01 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:11 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:21 | 0 | 0 | 1 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:31 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:41 | 0 | 0 | 1 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:05:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:01 | 0 | 0 | 0 | 0 | 0.2 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:11 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:31 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:06:51 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:07:01 | 1 | 1 | 1 | 2 | 0.2 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:07:11 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:07:21 | 1 | 1 | 1 | 2 | 0.1 | 0 | 2 | 2 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:07:31 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:07:41 | 1 | 1 | 1 | 2 | 0.3 | 1 | 2 | 3 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:12:53 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 15:13:03 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:13:13 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:13:23 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:13:33 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:13:43 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:13:53 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:03 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:13 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:23 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:33 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:43 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:14:53 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:03 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:13 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:23 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:33 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:43 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| 17-Jun-15 | 15:15:53 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 20.9 |
| | **Average** | **0** | **0** | **0** | **1** | **0.1** | **0** | **1** | **1** | **0** | **0** | **20.9** |
| | **Maximum** | **1** | **1** | **2** | **2** | **0.5** | **1** | **2** | **3** | **0** | **0** | **20.9** |
| | **Minimum** | **0** | **0** | **0** | **0** | **0.0** | **0** | **0** | **0** | **0** | **0** | **20.9** |

## 60341673 Stack 6 Oxides of Nitrogen, Carbon Monoxide and Oxygen Data Plot, 26 June 2015



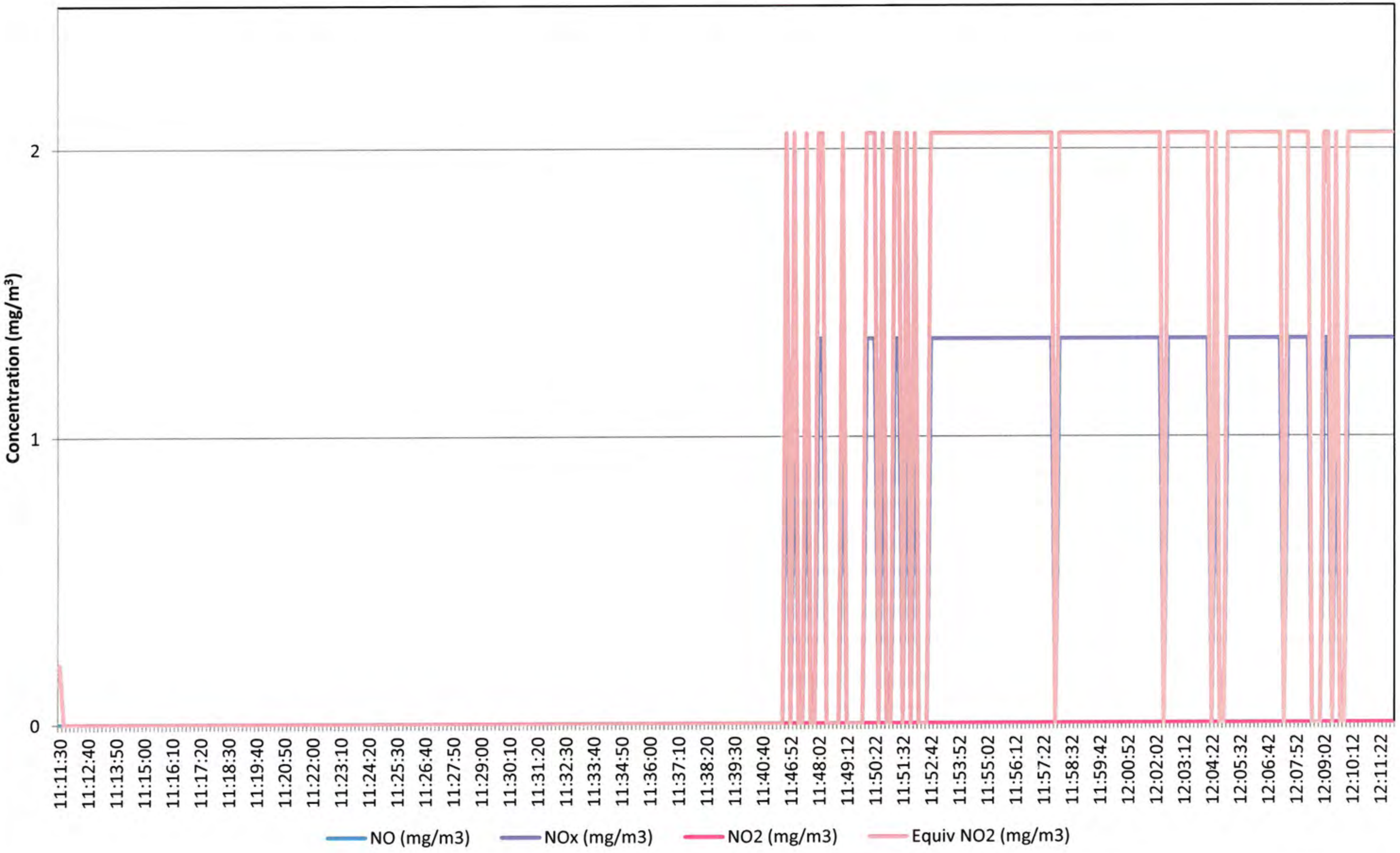
| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) | O2 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-Jun-15 | 12:30:06 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:30:16 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:30:26 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:30:36 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:30:46 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:30:56 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:31:06 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:31:16 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 0 | 0 | 13.3 |
| 26-Jun-15 | 12:31:26 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:31:36 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:31:46 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:31:56 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 0 | 0 | 13.3 |
| 26-Jun-15 | 12:32:06 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:32:16 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:32:26 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:32:36 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:32:46 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:32:56 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:33:06 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:33:16 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:33:26 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:33:36 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:33:46 | 8 | 11 | 8 | 11 | 0.2 | 0 | 12 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:33:56 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:34:06 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:34:16 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.3 |
| 26-Jun-15 | 12:34:26 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 0 | 0 | 13.3 |
| 26-Jun-15 | 12:34:36 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.3 |
| 26-Jun-15 | 12:34:46 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:34:56 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:06 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:16 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:26 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:36 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:46 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:35:56 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:36:06 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:36:16 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.3 |
| 26-Jun-15 | 12:36:26 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:36:36 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:36:46 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:36:56 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:37:06 | 8 | 11 | 8 | 12 | 0.5 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:37:16 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:37:26 | 7 | 9 | 7 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:37:36 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:37:46 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:37:56 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:38:06 | 8 | 11 | 8 | 11 | 0.3 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:38:16 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:38:26 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:38:36 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:38:46 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:38:56 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:39:06 | 7 | 9 | 7 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:39:16 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:39:26 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:39:36 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:39:46 | 7 | 9 | 7 | 10 | 0.2 | 0 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:39:56 | 7 | 9 | 7 | 10 | 0.1 | 0 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:40:06 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:40:16 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:40:26 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:40:36 | 7 | 9 | 8 | 10 | 0.3 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:40:46 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.5 |
| 26-Jun-15 | 12:40:56 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.5 |
| 26-Jun-15 | 12:41:06 | 7 | 9 | 8 | 10 | 0.2 | 0 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:41:16 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:41:26 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:41:36 | 7 | 9 | 8 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:41:46 | 8 | 11 | 8 | 12 | 0.4 | 1 | 13 | 17 | 1 | 1 | 13.4 |
| 26-Jun-15 | 12:41:56 | 7 | 9 | 7 | 10 | 0.5 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:42:06 | 7 | 9 | 8 | 10 | 0.4 | 1 | 11 | 15 | 0 | 0 | 13.4 |
| 26-Jun-15 | 12:42:16 | 7 | 9 | 7 | 10 | 0.3 | 1 | 11 | 15 | 0 | 0 | 13.5 |
| 26-Jun-15 | 12:42:26 | 6 | 8 | 7 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 13.6 |
| 26-Jun-15 | 12:42:36 | 6 | 8 | 7 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 13.8 |
| 26-Jun-15 | 12:42:46 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.0 |
| 26-Jun-15 | 12:42:56 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.1 |
| 26-Jun-15 | 12:43:06 | 5 | 7 | 6 | 7 | 0.3 | 1 | 8 | 11 | 1 | 1 | 14.3 |
| 26-Jun-15 | 12:43:16 | 6 | 8 | 6 | 9 | 0.4 | 1 | 10 | 13 | 1 | 1 | 14.3 |
| 26-Jun-15 | 12:43:26 | 5 | 7 | 6 | 8 | 0.4 | 1 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 12:43:36 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 12:43:46 | 6 | 8 | 6 | 9 | 0.4 | 1 | 10 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 12:43:56 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 12:44:06 | 5 | 7 | 6 | 8 | 0.5 | 1 | 8 | 11 | 1 | 1 | 14.5 |
| 26-Jun-15 | 12:44:16 | 6 | 8 | 6 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:44:26 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:44:36 | 6 | 8 | 6 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:44:46 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:44:56 | 5 | 7 | 6 | 8 | 0.5 | 1 | 8 | 11 | 1 | 1 | 14.5 |
| 26-Jun-15 | 12:45:06 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:45:16 | 6 | 8 | 6 | 9 | 0.4 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:45:26 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 1 | 1 | 14.5 |
| 26-Jun-15 | 12:45:36 | 6 | 8 | 6 | 9 | 0.4 | 1 | 10 | 13 | 1 | 1 | 14.5 |
| 26-Jun-15 | 12:45:46 | 6 | 8 | 6 | 9 | 0.3 | 1 | 10 | 13 | 0 | 0 | 14.5 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) | O2 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-Jun-15 | 12:45:56 | 5 | 7 | 6 | 8 | 0.4 | 1 | 8 | 11 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:06 | 6 | 8 | 6 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:16 | 6 | 8 | 7 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:26 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:36 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:46 | 6 | 8 | 7 | 9 | 0.6 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:46:56 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:06 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:16 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:26 | 6 | 8 | 6 | 9 | 0.6 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:36 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:46 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:47:56 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:06 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:16 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:26 | 6 | 8 | 6 | 9 | 0.6 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:36 | 6 | 8 | 6 | 9 | 0.6 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:46 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:48:56 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:06 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:16 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:26 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:36 | 6 | 8 | 7 | 10 | 0.9 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:46 | 6 | 8 | 7 | 10 | 0.9 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:49:56 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:06 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:16 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:26 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:36 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:46 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:50:56 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:06 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:16 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:26 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:36 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:46 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:51:56 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:06 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:16 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:26 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:36 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:46 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:52:56 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:06 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:16 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:26 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:36 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:46 | 6 | 8 | 6 | 9 | 0.5 | 1 | 10 | 13 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:53:56 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:06 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:16 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:26 | 6 | 8 | 6 | 9 | 0.6 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:36 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:46 | 5 | 7 | 6 | 8 | 0.8 | 2 | 8 | 12 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:54:56 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:06 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:16 | 6 | 8 | 6 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:26 | 6 | 8 | 7 | 10 | 0.9 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:36 | 6 | 8 | 6 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:46 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:55:56 | 6 | 8 | 7 | 10 | 0.9 | 2 | 10 | 14 | 0 | 0 | 14.5 |
| 26-Jun-15 | 12:56:06 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.6 |
| 26-Jun-15 | 12:56:16 | 6 | 8 | 7 | 9 | 0.7 | 1 | 10 | 14 | 0 | 0 | 14.6 |
| 26-Jun-15 | 12:56:26 | 5 | 7 | 6 | 8 | 0.7 | 1 | 8 | 12 | 0 | 0 | 14.6 |
| 26-Jun-15 | 12:56:36 | 6 | 8 | 7 | 10 | 0.8 | 2 | 10 | 14 | 0 | 0 | 14.6 |
| 26-Jun-15 | 12:56:46 | 5 | 7 | 6 | 8 | 0.6 | 1 | 8 | 12 | 0 | 0 | 14.6 |
| 26-Jun-15 | 12:56:56 | 5 | 7 | 6 | 8 | 0.8 | 2 | 8 | 12 | 0 | 0 | 14.5 |
| 26-Jun-15 | 13:02:08 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:02:18 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:02:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:02:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:02:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:02:58 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:38 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:03:58 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:08 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:18 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:38 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:48 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:04:58 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:18 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:38 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:48 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:05:58 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:06:08 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:06:18 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:06:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:06:38 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) | O2 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-Jun-15 | 13:06:48 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:06:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:48 | 5 | 7 | 5 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:07:58 | 5 | 7 | 5 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:08 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:18 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:28 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:38 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:48 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:08:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:08 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:18 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:48 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:09:58 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:08 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:18 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:38 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:48 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:10:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:11:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:08 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:18 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:28 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:38 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:12:58 | 5 | 7 | 6 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:08 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:48 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:13:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:48 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:14:58 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:08 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:48 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:15:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:08 | 5 | 7 | 5 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:16:58 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:17:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:08 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:18:58 | 5 | 7 | 5 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:28 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:48 | 5 | 7 | 6 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:19:58 | 5 | 7 | 6 | 7 | 0.2 | 0 | 8 | 11 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:08 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:38 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:20:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:08 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:21:58 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:22:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:22:18 | 6 | 8 | 6 | 8 | 0.0 | 0 | 9 | 12 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:22:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) | CO (ppm) | CO (mg/m$^3$) | O2 (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-Jun-15 | 13:22:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:22:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:22:58 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:48 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:23:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:24:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:25:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:28 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:26:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:27:58 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:18 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:38 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:48 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:28:58 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:08 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:18 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:28 | 5 | 7 | 5 | 7 | 0.0 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:48 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:29:58 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:08 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:18 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:28 | 6 | 8 | 6 | 8 | 0.1 | 0 | 9 | 13 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:38 | 5 | 7 | 5 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:48 | 5 | 7 | 6 | 7 | 0.1 | 0 | 8 | 10 | 0 | 0 | 14.4 |
| 26-Jun-15 | 13:30:58 | 6 | 8 | 6 | 8 | 0.2 | 0 | 9 | 13 | 0 | 0 | 14.4 |
|  | **Average** | **6** | **8** | **6** | **8** | **0.3** | **1** | **9** | **13** | **0** | **0** | **14.2** |
|  | **Maximum** | **8** | **11** | **8** | **12** | **0.9** | **2** | **13** | **17** | **1** | **1** | **14.6** |
|  | **Minimum** | **5** | **7** | **5** | **7** | **0.0** | **0** | **8** | **10** | **0** | **0** | **13.3** |

# 60341673 Stack 7 Oxides of Nitrogen Data Plot, 17 June 2015



60341673 Stack 7 Raw and Calculated Gas Data, 17 June 2015

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 11:11:30 | 0 | 0 | 0 | 0 | 0.1 | 0 | 0 | 0 |
| 17-Jun-15 | 11:11:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:11:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:12:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:13:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:14:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:15:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:16:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:17:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:18:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:19:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:20:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:21:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:22:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:23:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:24:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:24:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:24:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 11:24:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:24:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:24:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:25:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:26:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:27:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:28:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:29:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:30:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:31:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:32:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:33:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:34:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:35:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:36:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:37:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:37:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:37:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |

60341673 Stack 7 Raw and Calculated Gas Data, 17 June 2015

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 11:37:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:37:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:37:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:38:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:39:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:30 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:40 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:40:50 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:41:00 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:41:10 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:41:20 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:46:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:46:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:46:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:47:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:47:12 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:47:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:47:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:47:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:47:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:48:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:48:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:48:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:48:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:48:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:48:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:49:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:49:12 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:49:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:49:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:49:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:49:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:50:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:50:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:50:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:50:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:50:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:50:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:51:02 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:51:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:51:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:51:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:51:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:51:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:52:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:52:12 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:52:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:52:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:52:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:52:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:53:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:54:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:55:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:55:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:55:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | NO$_2$ (ppm) | NO$_2$ (mg/m$^3$) | Equiv NO$_2$ (ppm) | Equiv NO$_2$ (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 11:55:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:55:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:55:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:56:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:57:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 11:58:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:58:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:58:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:58:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:58:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:58:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 11:59:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:00:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:01:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:02:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:02:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:02:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:02:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:02:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:02:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:03:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:04:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:04:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:04:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:04:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:04:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:04:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:05:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:05:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:05:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:05:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:05:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:05:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:06:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:07:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:07:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:07:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:07:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:07:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:07:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:08:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:08:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:08:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |

| Date | Time | NO (ppm) | NO (mg/m$^3$) | NOx (ppm) | NOx (mg/m$^3$) | $NO_2$ (ppm) | $NO_2$ (mg/m$^3$) | Equiv $NO_2$ (ppm) | Equiv $NO_2$ (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 17-Jun-15 | 12:08:32 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:08:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:08:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:09:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:09:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:09:22 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:09:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:09:42 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:09:52 | 0 | 0 | 0 | 0 | 0.0 | 0 | 0 | 0 |
| 17-Jun-15 | 12:10:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:10:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:10:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:10:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:10:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:10:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:02 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:12 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:22 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:32 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:42 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
| 17-Jun-15 | 12:11:52 | 1 | 1 | 1 | 1 | 0.0 | 0 | 2 | 2 |
|  | **Average** | **0** | **0** | **0** | **0** | **0.0** | **0** | **1** | **1** |
|  | **Maximum** | **1** | **1** | **1** | **1** | **0.1** | **0** | **2** | **2** |
|  | **Minimum** | **0** | **0** | **0** | **0** | **0.0** | **0** | **0** | **0** |

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