



Address (Head Office)
427 Canterbury Road,
SURREY HILLS VIC 3127

Postal Address
Unit 3, 4 Monash Gate,
JANDAKOT WA 6164

Office Locations
VIC NSW WA QLD

Freecall: 1300 364 005
Int'l Call: +61 3 9813 7200
www.ektimo.com.au
ABN: 86 600 381 413

Report Number R001400

Emission Testing Report
EPA 4 - Benzene Combustor
Terminals Pty Ltd, Port Botany



This document is confidential and is prepared for the exclusive use of Terminals Pty Ltd and those granted permission by Terminals Pty Ltd.

Document Information

Client Name: Terminals Pty Ltd
 Report Number: R001400
 Date of Issue: 29 July 2015
 Attention: Michael Selleck
 Address: Gate 38B, 45 Friendship Rd
 PORT BOTANY NSW 2036
 Testing Laboratory: Ektimo (ETC) ABN 74 474 273 172

Report Status

| Format | Document Number | Report Date | Prepared By | Reviewed By (1) | Reviewed By (2) |
|--------------------|-----------------|--------------|-------------|-----------------|-----------------|
| Preliminary Report | - | - | - | - | - |
| Draft Report | - | - | - | - | - |
| Final Report | R001400 | 29 July 2015 | JK | AD | SC |
| Amend Report | - | - | - | - | - |

Template Version: 150615

Amendment Record

| Document Number | Initiator | Report Date | Section | Reason |
|-----------------|-----------|-------------|---------|--------|
| Nil | - | - | - | - |

Report Authorisation



Steven Cooper
Client Manager

NATA Accredited Laboratory
No. 14601

Aaron Davis
Operations Manager

Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports

Table of Contents

| | | |
|-----|--|---|
| 1 | Licence Comparison | 4 |
| 2 | Executive Summary | 4 |
| 3 | Results | 5 |
| 3.1 | EPA 4 – Benzene Combustor | 5 |
| 4 | Plant Operating Conditions | 7 |
| 5 | Test Methods..... | 7 |
| 6 | Quality Assurance/ Quality Control Information | 7 |
| 7 | Definitions | 8 |

1 LICENCE COMPARISON

| EPA | Location Description | Parameter | Units | Licence limit | Detected values | |
|-----|----------------------|---------------------------------------|-------------------|---------------|-----------------|-----------------------------------|
| | | | | | 21/07/2015 | (corrected to 3% O ₂) |
| 4 | Benzene Combustor | Solid Particles | mg/m ³ | 50 | < 0.94 | < 1.5 |
| | | Nitrogen oxides (as NO ₂) | mg/m ³ | 350 | 84 | 140 |
| | | Volatile organic compounds (VOCs) | mg/m ³ | 20 | <0.073 | <0.12 |
| | | Hydrogen Sulfide (H ₂ S) | mg/m ³ | 5 | 0.0035 | 0.0056 |

Note: All analytes highlighted in green are below the Licence Limit set by the NSW EPA as per licence 1048 (last amended on 30/07/2014).

2 EXECUTIVE SUMMARY

Ektimo was engaged by Terminals Pty Ltd to perform emission monitoring as required by their NSW EPA Environment Protection Licence (number 1048).

Monitoring was performed as follows;

| Location | Test Date | Test Parameters* |
|---------------------------|--------------|---|
| EPA 4 – Benzene Combustor | 21 July 2015 | Solid particles, carbon dioxide, oxygen, carbon monoxide, nitrogen oxides, sulfur dioxide, hydrogen sulfide, speciated volatile organic compounds |

* Flow rate, velocity, temperature and moisture were determined unless otherwise stated

Testing commenced approximately half way through the benzene ship loading period after notification from Terminals Pty Ltd personnel.

It is noted that during sampling (between 1453 and 1508) a hexane truck was connected to the Combustor Inlet.

The methodologies chosen by Ektimo are those recommended by the NSW Office of Environment and Heritage (as specified in the Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January 2007).

Plant operating conditions have been noted in the report.

3 RESULTS

3.1 EPA 4 – Benzene Combustor

| | | | | | |
|---------------------|--|----------|---------------------------|-------|-----|
| Date | 21/07/2015 | Client | Terminals Pty Ltd | | |
| Report | R001400 | Stack ID | EPA 4 - Benzene Combustor | | |
| Licence No. | 1048 | Location | Port Botany | State | NSW |
| Ektimo Staff | Sco/Swo | | | | |
| Process Conditions | Please refer to client records. | | | | |
| Reason for testing: | Client requested testing to determine emissions to air | | | | |

| Sampling Plane Details | |
|------------------------------------|-------------------------|
| Sampling plane dimensions | 1010 mm |
| Sampling plane area | 0.801 m ² |
| Sampling port size, number & depth | 4" Flange (x2) |
| Access & height of ports | Fixed ladder 9 m |
| Duct orientation & shape | Vertical Circular |
| Downstream disturbance | Exit 3 D |
| Upstream disturbance | Change in diameter 2 D |
| No. traverses & points sampled | 2 16 |
| Compliance to AS4323.1 | Compliant but non-ideal |

| Comments |
|--|
| The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D |
| Unless otherwise indicated, the methods cited in this report have been performed without deviation |
| All results reported on a dry basis at STP |

| Stack Parameters | | | |
|--|------------|------------|--|
| Moisture content, %v/v | 8.2 | | |
| Gas molecular weight, g/g mole | 28.4 (wet) | 29.3 (dry) | |
| Gas density at STP, kg/m ³ | 1.27 (wet) | 1.31 (dry) | |
| % Oxygen correction & Factor | 3 % | 1.61 | |
| Gas Flow Parameters | | | |
| Temperature, °C | 940 | | |
| Velocity at sampling plane, m/s | 7.9 | | |
| Volumetric flow rate, discharge, m ³ /s | 6.3 | | |
| Volumetric flow rate (wet STP), m ³ /s | 1.4 | | |
| Volumetric flow rate (dry STP), m ³ /s | 1.3 | | |
| Mass flow rate (wet basis), kg/hour | 6500 | | |
| Sampling time, min | 80 | | |
| Isokinetic rate, % | 107 | | |
| Velocity difference, % | -10 | | |

| Isokinetic | Sampling time | Results | | |
|-----------------|---------------|------------------------------------|---|--------------------|
| | | 1435-1555 | | |
| | | Concentration mg/m ³ | Corrected to 3% O ₂ mg/m ³ | Mass Rate g/min |
| Solid particles | | <0.94 | <1.5 | <0.074 |

| Non-isokinetics | Sampling time | Results | | |
|------------------|---------------|------------------------------------|---|--------------------|
| | | 1435-1535 | | |
| | | Concentration mg/m ³ | Corrected to 3% O ₂ mg/m ³ | Mass Rate g/min |
| Hydrogen sulfide | | 0.0035 | 0.0056 | 0.00027 |

| Gases | Sampling time | Average | | | Minimum | | | Maximum | | |
|---------------------------------------|---------------|------------------------------------|-------------------------------------|--------------------|------------------------------------|---|--------------------|------------------------------------|-------------------------------------|--------------------|
| | | 1436-1535 | | | 1436-1535 | | | 1436-1535 | | |
| | | Corrected to 3% O ₂ | | | Corrected to 3% O ₂ | | | Corrected to 3% O ₂ | | |
| | | Concentration mg/m ³ | O ₂ mg/m ³ | Mass Rate g/min | Concentration mg/m ³ | Corrected to 3% O ₂ mg/m ³ | Mass Rate g/min | Concentration mg/m ³ | O ₂ mg/m ³ | Mass Rate g/min |
| Nitrogen oxides (as NO ₂) | | 84 | 140 | 6.6 | 51 | 83 | 4 | 180 | 300 | 14 |
| Sulfur dioxide | | 98 | 160 | 7.7 | 74 | 120 | 5.8 | 130 | 210 | 10 |
| Carbon monoxide | | 18 | 29 | 1.4 | <2.5 | <4 | <0.19 | 32 | 52 | 2.5 |
| | | Concentration % | | | Concentration % | | | Concentration % | | |
| Carbon dioxide | | 4.9 | | | 3.4 | | | 5.8 | | |
| Oxygen | | 9.8 | | | 5.4 | | | 13.3 | | |

| | | | | | |
|---------------------|--|----------|---------------------------|-------|-----|
| Date | 21/07/2015 | Client | Terminals Pty Ltd | | |
| Report | R001400 | Stack ID | EPA 4 - Benzene Combustor | | |
| Licence No. | 1048 | Location | Port Botany | State | NSW |
| Ektimo Staff | Sco/Swo | | | | |
| Process Conditions | Please refer to client records. | | | | |
| Reason for testing: | Client requested testing to determine emissions to air | | | | |

| Total VOC's (as n-Propane) Sampling time | Results | | |
|---|------------------------------------|--|--------------------|
| | 1435-1535 | | |
| | Concentration mg/m ³ | Corrected to 3%O ₂ mg/m ³ | Mass Rate g/min |
| Total | <0.073 | <0.12 | <0.0057 |

| VOC's (speciated) Sampling time | Results | | |
|------------------------------------|------------------------------------|--|--------------------|
| | 1435-1535 | | |
| | Concentration mg/m ³ | Corrected to 3%O ₂ mg/m ³ | Mass Rate g/min |
| Detection limit ⁽¹⁾ | <0.076 | <0.12 | <0.0059 |

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, Dodecane, Tridecane, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, Cellosolve acetate, 2-Butoxyethyl acetate, Ethyldiglycol acetate, Diacetone alcohol, Isophorone, Benzene, Toluene, Ethylbenzene, m-p-Xylene, Styrene, o-Xylene, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, alpha-Methylstyrene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, m-Diethylbenzene, o-Diethylbenzene, p-Diethylbenzene, Dichloromethane, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Terminals Pty Ltd's records for complete process conditions.

5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request

| Parameter | Test Method | Method Detection Limit | Uncertainty* | NATA Accredited | |
|--------------------------------------|-------------|---------------------------|---------------|-----------------|----------|
| | | | | Sampling | Analysis |
| Sample plane criteria | NSW TM-1 | NA | - | ✓ | NA |
| Velocity | NSW TM-2 | 2ms ⁻¹ | 7% | ✓ | NA |
| Temperature | NSW TM-2 | 0°C | 2% | ✓ | NA |
| Flow rate | NSW TM-2 | Location | 8% | ✓ | NA |
| Sulfur dioxide | NSW TM-4 | 6mg/m ³ | 12% | ✓ | ✓ |
| Hydrogen sulfide | NSW TM-5 | 0.5mg/m ³ | not specified | ✓ | ✓ |
| Nitrogen oxides (NO _x) | NSW TM-11 | 4mg/m ³ | 12% | ✓ | ✓ |
| Solid particles | NSW TM-15 | 0.001g/m ³ | 5% | ✓ | ✓ |
| Moisture content | NSW TM-22 | 0.40% | 8% | ✓ | ✓ |
| Carbon dioxide | NSW TM-24 | 0.1% | 13% | ✓ | ✓ |
| Oxygen | NSW TM-25 | 0.1% | 13% | ✓ | ✓ |
| Carbon monoxide | NSW TM-32 | 0.0025g/m ³ | 12% | ✓ | ✓ |
| Speciated volatile organic compounds | NSW TM-34 | 0.3mg/m ³ | 19% | ✓ | ✓ |

* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

6 QUALITY ASSURANCE/ QUALITY CONTROL INFORMATION

Ektimo (EML), Ektimo (ETC) and Ektimo (ECS) are accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo (EML), Ektimo (ETC) and Ektimo (ECS) are accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025. – General Requirements for the Competence of Testing and Calibration Laboratories. ISO/IEC 17025 requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Compliance Manager.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised world –wide.

A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate; the sampling reproducibility, analytical method, accuracy, precision and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

7 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

| | |
|-------------------|--|
| STP | Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified. |
| Disturbance | A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter. |
| VOC | Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts. |
| TOC | The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives. |
| OU | The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response). |
| PM _{2.5} | Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm). |
| PM ₁₀ | Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm). |
| BSP | British standard pipe |
| NT | Not tested or results not required |
| NA | Not applicable |
| D ₅₀ | 'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D ₅₀ method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D ₅₀ of that cyclone and less than the D ₅₀ of the preceding cyclone. |
| D | Duct diameter or equivalent duct diameter for rectangular ducts |
| < | Less than |
| > | Greater than |
| ≥ | Greater than or equal to |
| ~ | Approximately |
| CEM | Continuous Emission Monitoring |
| CEMS | Continuous Emission Monitoring System |
| DER | WA Department of Environment & Regulation |
| DECC | Department of Environment & Climate Change (NSW) |
| EPA | Environment Protection Authority |
| FTIR | Fourier Transform Infra Red |
| NATA | National Association of Testing Authorities |
| RATA | Relative Accuracy Test Audit |
| AS | Australian Standard |
| USEPA | United States Environmental Protection Agency |
| Vic EPA | Victorian Environment Protection Authority |
| ISC | Intersociety committee, Methods of Air Sampling and Analysis |
| ISO | International Organisation for Standardisation |
| APHA | American public health association, Standard Methods for the Examination of Water and Waste Water |
| CARB | Californian Air Resources Board |
| TM | Test Method |
| OM | Other approved method |
| CTM | Conditional test method |
| VDI | Verein Deutscher Ingenieure (Association of German Engineers) |
| NIOSH | National Institute of Occupational Safety and Health |
| XRD | X-ray Diffractometry |