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Report Number R007422
Emission Testing Report
EPA 4 – Benzene Combustor
Terminals Pty Ltd, Port Botany



Document Information

Client Name: Terminals Pty Ltd
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 Attention: Ted Wagstaff
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Report Status

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Steven Cooper
Client Manager

NATA Accredited Laboratory
No. 14601

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

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1 EXECUTIVE SUMMARY

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

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA 4 – Benzene Combustor	5 May 2019	Speciated volatile organic compounds (VOC's) Carbon dioxide, oxygen, carbon monoxide, nitrogen oxides

* Flow rate, velocity, temperature and moisture were also determined.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

2 RESULTS SUMMARY

The following licence comparison table shows that all analytes highlighted in green are below the licence limit set by the NSW EPA as per licence 1048 (last amended on 23/11/2017).

Results have also been corrected to 3% Oxygen as stipulated in Schedule 5 of the *Protection of the Environment Operations (Clean Air) Regulation, (NSW) 2010*.

EPA No.	Location Description	Parameter	Units	Licence limit	Detected values	
					5/05/2019	5/05/2019 (corrected to 3% O ₂)
4	Benzene Combustor	Nitrogen oxides (as NO ₂)	mg/m ³	350	69	130
		Volatile organic compounds (VOCs)	mg/m ³	20	<0.06	<0.1
		Benzene	mg/m ³	1	<0.07	<0.1

3 RESULTS

3.1 EPA 4 – Benzene Combustor

Date	5/05/2019	Client	Terminals Pty Ltd
Report	R007422	Stack ID	EPA 4 - Benzene Combustor Stack
Licence No.	1048	Location	Port Botany
Ektimo Staff	Steven Cooper	State	NSW
Process Conditions	Ship loaded is the Golden Leader		

Sampling Plane Details	
Sampling plane dimensions	1010 mm
Sampling plane area	0.801 m ²
Sampling port size, number	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
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is deemed to be non-ideal due to the following reasons: The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters			
Moisture content, %v/v	7.4		
Gas molecular weight, g/g mole	28.4 (wet)		29.2 (dry)
Gas density at STP, kg/m ³	1.27 (wet)		1.30 (dry)
% Oxygen correction & Factor	3 %		1.94
Gas Flow Parameters			
Flow measurement time(s) (hhmm)	2302 & 0018		
Temperature, °C	780		
Temperature, K	1053		
Velocity at sampling plane, m/s	7.1		
Volumetric flow rate, actual, m ³ /s	5.7		
Volumetric flow rate (wet STP), m ³ /s	1.5		
Volumetric flow rate (dry STP), m ³ /s	1.4		
Mass flow rate (wet basis), kg/hour	6700		
Velocity difference, %	-10		

Gas Analyser Results	Sampling time	Average			Minimum			Maximum		
		2313 - 0013			2313 - 0013			2313 - 0013		
		Corrected to 3%			Corrected to 3%			Corrected to 3%		
		Concentration	O2	Mass Rate	Concentration	O2	Mass Rate	Concentration	O2	Mass Rate
		mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min	mg/m ³	mg/m ³	g/min
Combustion Gases										
Nitrogen oxides (as NO ₂)		69	130	5.7	66	130	5.4	73	140	6
Carbon monoxide		2.7	5.2	0.22	<2	<5	<0.2	7.5	15	0.62
		Concentration			Concentration			Concentration		
		%			%			%		
Carbon dioxide		3.7			3.5			4		
Oxygen		11.7			11			12		

Total VOCs (as n-Propane)		Results		
Lower Bound	Sampling time	2310-0010		
		Corrected to 3%		
		Concentration	O2	Mass Rate
		mg/m ³	mg/m ³	g/min
Total		<0.06	<0.1	<0.005

VOC (speciated)		Results		
	Sampling time	2310-0010		
		Corrected to 3%		
		Concentration	O2	Mass Rate
		mg/m ³	mg/m ³	g/min
Detection limit ⁽¹⁾		<0.07	<0.1	<0.005
Benzene		<0.07	<0.1	<0.005

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

Ethanol, Isopropanol, 1,1-Dichloroethene, Dichloromethane, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Benzene, Carbon tetrachloride, Butanol, 1-Methoxy-2-propanol, Trichloroethylene, Toluene, 1,1,2-Trichloroethane, Tetrachloroethene, Chlorobenzene, Ethylbenzene, m + p-Xylene, Styrene, o-Xylene, 2-Butoxyethanol, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, 1,2,4-Trimethylbenzene, tert-Butylbenzene, 1,2,3-Trimethylbenzene, Acetone, Pentane, Acrylonitrile, Methyl ethyl ketone, n-Hexane, Ethyl acetate, Cyclohexane, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Heptane, Ethyl acrylate, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 2-Hexanone, Octane, Butyl acetate, 1-Methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cellosolve acetate, α-Pinene, β-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

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. All testing was conducted with the *Golden Leader* was being loaded.

5 TEST METHODS

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

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Flow rate, temperature and velocity	NSW TM-2	NA	8%, 2%, 7%	✓	NA
Moisture content	NSW TM-22	NSW TM-22	19%	✓	✓
Carbon dioxide	NSW TM-24	NSW TM-24	13%	✓	✓
Carbon monoxide	NSW TM-32	NSW TM-32	12%	✓	✓
Nitrogen oxides (NO _x)	NSW TM-11	NSW TM-11	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo 344	19%	✓	✓ [†]

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

[†] Analysis performed by Ektimo, NATA accreditation number 14601. Laboratory analytical results were reported on 23 May 2019 in report number R007422_SVOCs.

6 QUALITY ASSURANCE/QUALITY CONTROL INFORMATION

Ektimo is 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 is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing 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 Quality Director.

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 worldwide.

7 DEFINITIONS

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

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
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.
DECC	Department of Environment & Climate Change (NSW)
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.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
Lower Bound	Defines values reported below detection as equal to zero.
Medium Bound	Defines values reported below detection are equal to half the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
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 ₁₀	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
PM _{2.5}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis
RATA	Relative Accuracy Test Audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration will be determined by matching the integrated area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
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.
TM	Test Method
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Vic EPA	Victorian Environment Protection Authority
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.
XRD	X-ray Diffractometry
Upper Bound	Defines values reported below detection are equal to the detection limit.