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Report No: R000020a

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Terminals Pty Ltd
Gate 38B,45 Friendship Rd
Port Botany NSW 2036

Emission Testing – October 2014
EPA 4 – Benzene Combustor

Dear Mr Michael Selleck,

Tests were performed 27 October 2014 to determine emissions to air from the Benzene Combustor at the 45 Friendship Rd plant of Terminals Pty Ltd.

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Yours faithfully
Emission Testing Consultants



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LICENCE COMPARISON

EPA No.	Location Description	Pollutant	Unit of measure	Licence limit	Detected Values	Detected Values (corrected to 3% O ₂)
4	Benzene Combustor	Solid Particles	milligrams per cubic meter (mg/m ³)	50	<5	<8
		Nitrogen oxides (as NO ₂)	milligrams per cubic meter (mg/m ³)	350	80	120
		Volatile organic compounds (VOCs)	milligrams per cubic meter (mg/m ³)	20	<0.04	<0.07
		Hydrogen Sulphide (H ₂ S)	milligrams per cubic meter (mg/m ³)	5	0.0072	0.011

Note: All analytes highlighted in green are below the Licence Limit set by the NSW EPA as per licence 1048 (last amended on **13/09/2013**).

EXECUTIVE SUMMARY

Ektimo Pty Ltd (ETC) was engaged by Terminals Pty Ltd to perform emission monitoring as required by their NSW EPA Environment Protection Licence (number 1048). Monitoring was performed at the Benzene Combustor (Outlet), for the following parameters:

Discharge point	Selection of sampling positions	Flow rate	Velocity	Temperature	Moisture	Particulate matter	Dry gas Density	Molecular weight	Carbon dioxide (CO ₂)	Oxygen (O ₂)	Carbon monoxide (CO)	Nitrogen oxides (NO _x) as NO ₂	Sulphur dioxide (SO ₂)	Hydrogen sulphide (H ₂ S)	Volatile organic compounds (VOC)
EPA 4 - Benzene Combustor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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

The methodologies chosen by Ektimo (ETC) are those stipulated by Terminals Pty Ltd Licence (1048). There were no technical issues in terms of sampling on the days of testing. Plant operating conditions have been noted in the report.

RESULTS

EPA 4 – Benzene Combustor 27 October 2014



Flow Results		Measured MW	EPA 4 - Benzene Combustor R000020
Date and time of flow test		27/10/2014 5:09	
Date and time of flow test		27/10/2014 6:40	
Stack dimensions at sampling plane		1010	mm
Velocity at sampling plane		3.4	m/s
Average temperature		773	°C
Moisture content	Alt008	6.8	% v/v
Flow rate at discharge conditions		2.7	m ³ /sec
Flow rate at wet NTP conditions		0.70	m ³ /sec
Flow rate at dry NTP conditions		0.65	m ³ /sec

Isokinetic Sampling Results	EPA 4 - Benzene Combustor R000020 41	Sampling Times	Concentration at NTP	Concentration at 3% O ₂	Mass rate
Solid particles		0519-0619	< 5 mg/m ³	< 8 mg/m ³	< 0.2 g/min
<i>No. of sampling points</i>			12		
<i>Length of sampling, min</i>			60		
<i>Stack gas molecular weight, g/g-mole (wet)</i>			28.3		
<i>Stack gas density, at wet NTP</i>			1.26		

Continuous Analyser Results	EPA 4 - Benzene Combustor R000020 39	Sampling Times	Concentration at NTP	Concentration at 3% O ₂	Mass rate
Oxygen (dry basis)		0519-0618	9.2 % v/v	-	-
Carbon dioxide (dry basis)		0519-0618	4.1 % v/v	-	190 kg/hour
Dry gas density		0519-0618	1.3 kg/m ³	-	-
Molecular weight of stack gas, dry basis		0519-0618	29 g/g-mole	-	-
Nitrogen oxides as NO₂		0519-0618	80 mg/m ³	120 mg/m ³	3.1 g/min
Sulphur dioxide as SO₂		0519-0618	72 mg/m ³	110 mg/m ³	2.8 g/min
Carbon monoxide as CO		0519-0618	9.9 mg/m ³	15 mg/m ³	0.39 g/min

EPA 4 – Benzene Combustor

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Manual Sampling Results	EPA 4 - Benzene Combustor R000020 39	Sampling Times	Concentration at NTP	Concentration at 3% O2	Mass rate
Hydrogen sulphide		0519-0619	0.0072 mg/m3	0.011 mg/m3	0.00028 g/min

Volatile Organic Compound (VOC) Results	EPA 4 - Benzene Combustor R000020 41	Sampling Times	Concentration at NTP	Concentration at 3% O2	Mass rate
Total VOC as n-propane		0535-0635	< 0.04 mg/m3	< 0.07 mg/m3	< 0.002 g/min

Note: If not listed above, the following compounds were not detected above the analytical range of the instrument:

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, 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, μ g/tube, μ g/tube, 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, N 1581, 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, 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

Refer to “**SAMPLING PLANE OBSERVATIONS**” on page 5.

SAMPLING PLANE OBSERVATIONS

EPA 4 – Benzene Combustor (Outlet)

The sampling plane had 2 x 4 inch flange port(s). The location was determined to be “ideal” as per AS4323.1. It was more than the required 2 duct diameters upstream from the exit. It was more than the required 6 duct diameters downstream from a junction. The sampling plane passed the flow assessment (items (a) to (f) of AS4323.1) and was therefore “compliant”.

PLANT OPERATING CONDITIONS

Plant operating conditions were supplied by Terminals Pty Ltd personnel. Testing was performed during the benzene (BTX) loading operation of a ship at a time deemed to provide peak load rate.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases unless otherwise stated. Specific details of the methods are available on request.

All sampling and analysis was conducted in accordance with the test methods (TM) prescribed in NSW EPA’s *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*, Jan 2007 and in accordance with the *Protection of the Environment Operations (Clean Air) Regulation 2010* unless otherwise specified.

All parameters are reported adjusted to dry NTP conditions unless otherwise stated.

Parameter	Sampling			Analysis			
	NATA	NSW TM Method	Sampling Method	NATA	Analytical Laboratory	Analytical Method	Analytical Laboratory Report Number(s)
Selection of sampling positions	Yes	TM-1	AS4323.1	Yes	NA	NA	R000020
Flow rate	Yes	TM-2	USEPA 2	Yes	NA	NA	R000020
Velocity	Yes	TM-2	USEPA 2	Yes	NA	NA	R000020
Temperature	Yes	TM-2	USEPA 2	Yes	NA	NA	R000020
Moisture	Yes	TM-22	USEPA 4	Yes	NA	NA	R000020
Solid particles	Yes	TM-15	AS4323.2	Yes	Ektimo (ETC)	AS4323.2	R000020
Dry gas Density	Yes	TM-23	USEPA 3	Yes	Ektimo (ETC)	USEPA 3	R000020
Molecular weight	Yes	TM-23	USEPA 3	Yes	Ektimo (ETC)	USEPA 3	R000020
Carbon dioxide (CO ₂)	Yes	TM-24	USEPA 3A	Yes	Ektimo (ETC)	USEPA 3A	R000020
Oxygen (O ₂)	Yes	TM-25	USEPA 3A	Yes	Ektimo (ETC)	USEPA 3A	R000020
Carbon monoxide (CO)	Yes	TM-32	USEPA 10	Yes	Ektimo (ETC)	USEPA 10	R000020
Nitrogen oxides (NO _x) as NO ₂	Yes	TM-11	USEPA 7E	Yes	Ektimo (ETC)	USEPA 7E	R000020
Sulphur dioxide (SO ₂)	Yes	TM-4	USEPA 6C	Yes	Ektimo (ETC)	USEPA 6C	R000020
Hydrogen sulphide (H ₂ S)	Yes	TM-5	USEPA 11	Yes	Ektimo (EML Air)	EML Air 255	R000118r
Volatile organic compounds (VOC)	Yes	TM-34	USEPA 18	Yes	Ektimo (EML Air)	EML Air 344	R000118r

DEFINITIONS

The following symbols and abbreviations are used in test reports:

Concentration	Mass of analyte per cubic metre expressed at NTP dry conditions (ng, µg or mg/m ³).
Flow rate at discharge conditions	Volume of gas flow per unit time expressed at discharge temperature, pressure and moisture content (m ³ /min).
Flow rate at wet NTP conditions	Volume of gas flow per unit time expressed at 0°C, an absolute pressure of 101.325 kPa and discharge moisture content (m ³ /min).
Flow rate at dry NTP conditions	Volume of gas flow per unit time expressed at 0°C, an absolute pressure of 101.325 kPa and 0% moisture content (m ³ /min).
Mass rate	Mass of analyte per unit time (µg, mg or g/min).
Moisture content	Percentage of gaseous moisture in the gas expressed on a volume / volume percentage basis. This does not include moisture in the gas stream that is in the liquid phase (free moisture).
NA	Not applicable.
NTP	Normal 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.
Sampling plane	Location at which measurements were conducted.
Velocity	Gas velocity expressed at discharge temperature, pressure and moisture content (m/s)
VOC	Any chemical compound based on carbon in the boiling range 36 to 126°C, with a vapour pressure of at least 0.010kPa at 25°C (or having a corresponding volatility under the particular conditions of use) that adsorb onto activated charcoal and desorb into CS ₂ , or that can be collected in a tedlar bag and be quantitatively recovered, and that are detected by GCMS. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are CO, CO ₂ , carbonic acid, metallic carbides and carbonate salts.
>	Greater than.
<	Less than the minimum limit of detection using the specified method.
~	Approximately.

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