



EML AIR PTY LTD ABN 98 006 878 342

Melbourne (Head Office)

PO Box 466, Canterbury, Victoria 3126

427 Canterbury Road, Surrey Hills, Victoria 3127

T. +61 3 9836 1999 F. +61 3 9830 0670

E. emlair@emlair.com.au W. www.emlair.com.au

Our reference: **N90851**

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7 May 2013

Terminals Pty Ltd
PO Box 148
MATRAVILLE NSW 2036

Attention Mr Geoff Millard

PORT BOTANY PLANT

Emission Testing Report - APRIL 2013

Tests were performed at the request of Terminals Pty Ltd to determine emissions to air as detailed below;

Test Summary		
Location	Test Date	Test Parameters*
Benzene Combuster	17 April 2013	Total particulate matter, speciated volatile organic compounds (VOC's) including benzene, hydrogen sulfide, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

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

Please refer to the following pages for results, plant operating conditions, test methods, quality assurance / quality control information and definitions.

Heath Thatcher DipAppSc
Client Manager
jw doc:n90851.doc

Zac Xavier BSc BEng
Managing Director



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RESULTS

Date	17/04/2013	Client	Terminals Pty Ltd
Report	N90851	Stack ID	Benzene Combustor
Licence No.	-	Location	Port Botany
EML Staff	HT		State NSW
Process Conditions	Please refer to client records.		
Reason for testing:	Client requested testing to determine emissions to air		

Sampling Plane Details			
Sampling plane dimensions (mm) & area	1300	1.33 m ²	
Sampling port size, number & depth	4" Flange (x2)		
Access & height of ports	Fixed ladder	12.5 m	
Duct orientation & shape	Vertical	Circular	
Downstream disturbance	Exit cone	2 D	
Upstream disturbance	Change in diameter	5 D	
No. traverses & points sampled	2	16	
Traverse method & compliance	AS4323.1	Compliant but non-ideal	

Comments	
Flow to Combustor - 670 m ³ /hr. Online temperature ~990°C	
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D	
All results reported on a dry basis at NTP	

Stack Parameters			
Moisture content, %v/v	1.7		
Gas molecular weight, g/g mole	29.2 (wet)	29.4 (dry)	
Gas density at NTP, kg/m ³	1.30 (wet)	1.31 (dry)	
Gas Flow Parameters			
Temperature, K	1305		
Velocity at sampling plane, m/s	15		
Volumetric flow rate, discharge, m ³ /s	20		
Volumetric flow rate (wet NTP), m ³ /s	4.3		
Volumetric flow rate (dry NTP), m ³ /s	4.2		
Mass flow rate (wet basis), kg/hour	20000		
Velocity difference, %	<1		

Isokinetic	Sampling time	Results	
		1045-1205	
		Concentration mg/m ³	Mass Rate g/s
Total particulate matter		<0.83	<0.0035

Hydrogen Sulfide	Sampling time	Results	
		1105-1205	
		Concentration mg/m ³	Mass Rate g/s
Hydrogen sulfide		<0.0039	<0.000016



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Reason for testing:	Client requested testing to determine emissions to air		

Gases	Sampling time	Average		Minimum		Maximum	
		1025-1125		1025-1125		1025-1125	
		Concentration	Mass Rate	Concentration	Mass Rate	Concentration	Mass Rate
		mg/m ³	g/s	mg/m ³	g/s	mg/m ³	g/s
Nitrogen oxides (as NO ₂)		260	1.1	68	0.29	440	1.9
Sulfur dioxide		630	2.6	<5.7	<0.024	1200	5.1
Carbon monoxide		44	0.19	11	0.047	210	0.87
		Concentration		Concentration		Concentration	
		%		%		%	
Carbon dioxide		6.6		5.6		7	
Oxygen		5.6		4.3		6.8	

VOC's (as n-Propane)	Sampling time	Results	
		1045-1145	
		Concentration	Mass Rate
		mg/m ³	g/s
Total		<0.041	<0.00017

VOC's (speciated)	Sampling time	Results	
		1045-1145	
		Concentration	Mass Rate
		mg/m ³	g/s
Detection limit ⁽¹⁾		<0.043	<0.00018
Benzene		<0.043	<0.00018

(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



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.

Testing was performed during benzene ship discharge operations to provide peak load rate between 1045 and 1210 on Wednesday, 17th April 2013

TEST METHODS

Unless otherwise stated, the following methods meet the requirements of 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*). All sampling and analysis was performed by EML Air unless otherwise specified. Specific details of the methods are available upon request.

Parameter	NSW Test Method	Reference Method	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample Plane Criteria	TM-1	AS 4323.1	-	✓	NA
Flow rate, temperature and velocity	TM-2	USEPA 2	8%, 2%, 7%	✓	NA
Moisture content	TM-22	USEPA 4	8%	✓	✓
Sulfur dioxide	TM-4	USEPA 6C	12%	✓	✓
Hydrogen sulfide	TM-5	USEPA 11	not specified	✓	✓
Nitrogen oxides (NO _x)	TM-11	USEPA 7E	12%	✓	✓
Particulate matter	TM-15	AS 4323.2	5%	✓	✓
Carbon dioxide	TM-24	USEPA 3A	13%	✓	✓
Oxygen	TM-25	USEPA 3A	13%	✓	✓
Speciated volatile organic compounds	TM-34	USEPA 18	19%	✓	✓

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

AS – Australian Standard
USEPA – United States Environmental Protection Agency
TM - Test Method

QUALITY ASSURANCE / QUALITY CONTROL INFORMATION

EML Air Pty Ltd is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources (Accreditation number 2732). Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for EML Air at NATA's website www.nata.asn.au.

EML Air is accredited to Australian Standard 17025 – General Requirements for the Competence of Testing and Calibration Laboratories. Australian Standard 17025 requires that a laboratory have a quality system similar to ISO 9002. More importantly it also 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 Assurance Manager.

A formal Quality Control program is in place at EML Air 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.



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DEFINITIONS

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

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.
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.
BSP	British standard pipe
NA	Not applicable
D	Duct diameter or equivalent duct diameter for rectangular ducts
<	Less than
>	Greater than
≥	Greater than or equal to
~	Approximately

