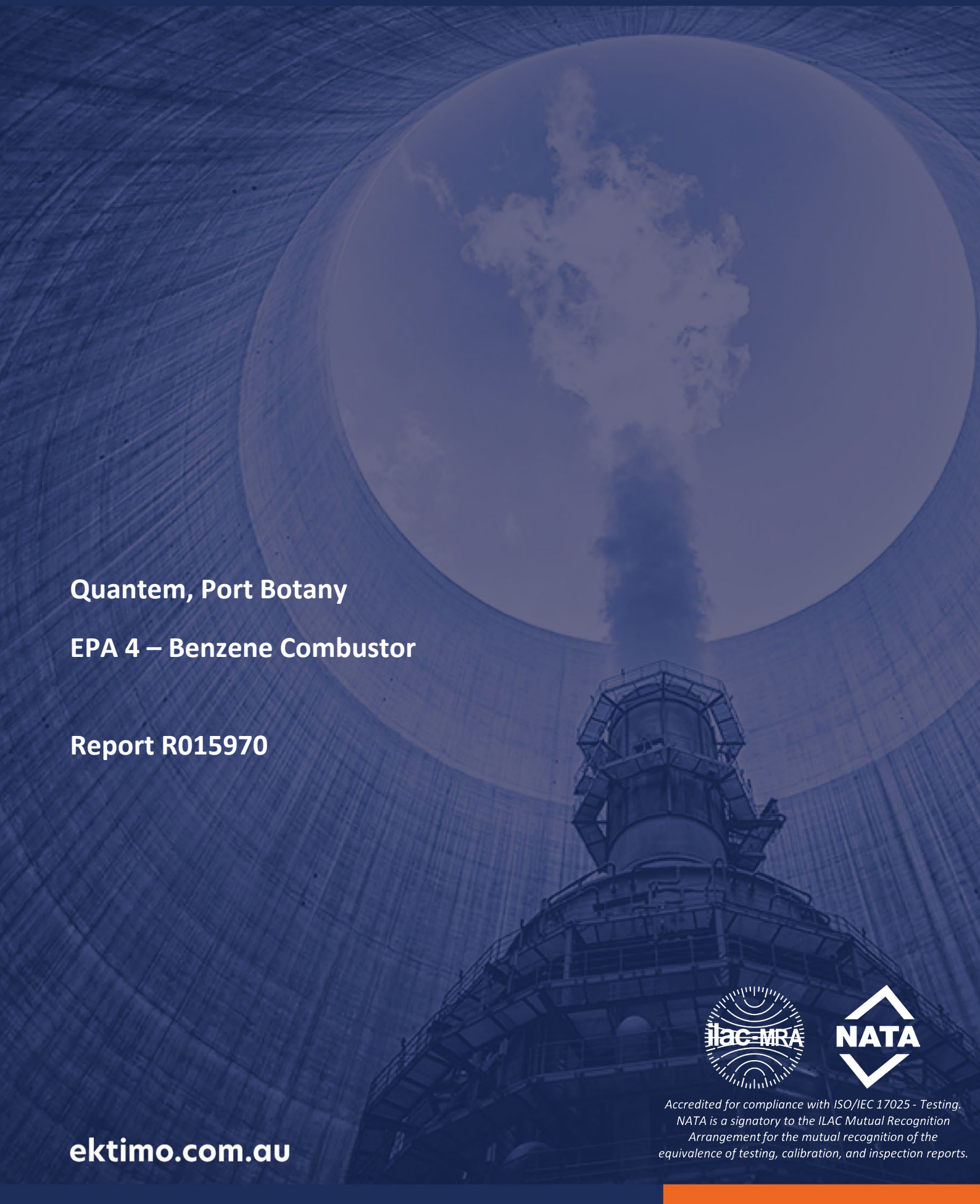
Ektimo



Quantem, Port Botany

EPA 4 – Benzene Combustor

Report R015970

Ektimo

Document Information

Client Name:	Quantem
Report Number:	R015970
Date of Issue:	30 November 2023
Attention:	Eoghain Maguire
Address:	Gate 38B, 45 Friendship Rd Port Botany NSW 2036
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Steven Cooper
Senior Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo terms of NATA accreditation as described in the Test Methods table. This does not include calculations that use data supplied by third-parties, comments, conclusions, or recommendations based upon the results. Refer to Test Methods section for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by Quantem to perform emission testing at their Port Botany plant. Testing was carried out in accordance with Environment Protection Licence 1048.

1.2 Project Objective & Overview

The objective of the project is to quantify emissions from one (1) discharge point to determine compliance with Quantem's Environmental Licence.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
EPA 4 - Benzene Combustor Stack (Thermal Oxidiser)	08 November 2023	Benzene Volatile organic compounds (VOCs as n-propane) Oxygen (O_2), Carbon dioxide (CO_2) Nitrogen oxides (as NO_2)

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

All results are reported on a dry basis at STP (Dry, 273^{o}K, 101.3kPa).

Plant operating conditions have been noted in this report.

1.3 Licence Comparison

The following licence comparison table shows all analytes are within the licence limit set by the NSW EPA as per licence 1048 (last amended on 28 September 2023).

Results have also been corrected to 7% oxygen as stipulated in Schedule 3 of the *Protection of the Environment Operations (Clean Air) Regulation*, (NSW) 2022.

EPA No.	Location Description	Parameter	Units	Licence limit	Detected values 08-Nov-23	Detected values (corrected to 7% O_2) 08-Nov-23
4	Benzene Combustor	Nitrogen oxides (as NO_2)	mg/m^3 at STP dry	350	140	140
		Volatile organic compounds (VOCs)	mg/m^3 at STP dry	20	0.45	0.45
		Benzene	mg/m^3 at STP dry	1	<0.07	<0.07

Please note that the measurement uncertainty associated with the test results was not considered when determining whether the results were compliant or non-compliant.

2 Results

2.1 EPA 4 - Benzene Combustor Stack

Date	8/11/2023	**Client**	Quantem
Report	R015970	**Stack ID**	EPA 4 - Benzene Combustor Stack
Licence No.	1048	**Location**	Port Botany
Ektimo Staff	Steven Cooper & James Cullen	**State**	NSW
Process Conditions	Ship: Golden Prelude - Product unloaded: BTEX (Benzene)		*231018*

Stack Parameters		
Moisture content, %v/v	4	
Gas molecular weight, g/g mole	28.8 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.33	
% Oxygen correction & Factor	7 %	0.99
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0942 & 1109	
Temperature, °C	798	
Temperature, K	1071	
Velocity at sampling plane, m/s	3.7	
Volumetric flow rate, actual, m³/s	3	
Volumetric flow rate (wet STP), m³/s	0.76	
Volumetric flow rate (dry STP), m³/s	0.73	
Mass flow rate (wet basis), kg/h	3500	

Gas Analyser Results	Average			Minimum			Maximum		
Sampling time	0957 - 1058			0957 - 1058			0957 - 1058		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Combustion Gases									
Nitrogen oxides (as NO_2)	140	140	6.1	88	87	3.9	180	180	8.1
		Concentration % v/v			Concentration % v/v			Concentration % v/v	
Carbon dioxide		5.2			4.6			5.8	
Oxygen		6.8			4.5			8.6	

Total VOCs (as n-Propane)	Results		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Total	0.45	0.45	0.02

VOC (speciated)	Results		
Sampling time	0958-1058		
	Concentration mg/m³	Corrected to 7% O2 mg/m³	Mass Rate g/min
Detection limit[1]	<0.07	<0.07	<0.003
Benzene	<0.07	<0.07	<0.003
Toluene	0.29	0.29	0.013
Residuals as Toluene	0.66	0.65	0.029

(1) Unless otherwise reported, the following target compounds were found to be below detection:
Ethanol, Acetone, Isopropanol, Pentane, 1,1-Dichloroethene, Acrylonitrile, Dichloromethane, trans-1,2-Dichloroethene, Methyl ethyl ketone, n-Hexane, cis-1,2-Dichloroethene, Ethyl acetate, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Cyclohexane, Benzene, Carbon tetrachloride, Butanol, Isopropyl acetate, 2-Methylhexane, 2,3-Dimethylpentane, 1-Methoxy-2-propanol, 3-Methylhexane, Heptane, Ethyl acrylate, Trichloroethylene, Methyl methacrylate, Propyl acetate, Methylcyclohexane, Methyl Isobutyl Ketone, 1,1,2-Trichloroethane, 2-Hexanone, Octane, Tetrachloroethene, Butyl acetate, Chlorobenzene, Ethylbenzene, m + p-Xylene, 1-Methoxy-2-propyl acetate, Styrene, o-Xylene, Butyl acrylate, Nonane, 2-Butoxyethanol, Cellosolve acetate, 1,1,2,2-Tetrachloroethane, Isopropylbenzene, alpha-Pinene, Propylbenzene, 1,3,5-Trimethylbenzene, beta-Pinene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, Decane, 3-Carene, 1,2,3-Trimethylbenzene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane

3 Sample Plane Compliance

3.1 EPA 4 - Benzene Combustor Stack

Sampling Plane Details	
Source tested	Displaced vapour
Pollution control equipment	Thermal oxidiser
Sampling plane dimensions	1010 mm
Sampling plane area	0.801 m²
Sampling port size, number	4" Flange (x2)
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 conformance to AS 4323.1	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The differential pressure at one or more sampling points is less than 5 Pa
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

4 Plant Operating Conditions

The below plant operating conditions have been supplied by Quantem personnel.

Date	Ship name	Product unloaded	Unloading Operation
8 November 2023	Golden Prelude	BTEX (Benzene)	Treating displaced vapour from the Golden Prelude.

Based on information received from Quantem personnel, it is our understanding that samples were collected during typical plant operations.

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
Sampling points - Selection	NSW EPA TM-1 (AS 4323.1)	NA	NA	✓	NA
Flow rate, temperature & velocity	NSW EPA TM-2 (USEPA Method 2)	NSW EPA TM-2 (USEPA Method 2)	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22 (USEPA Alt-Method 008)	NSW EPA TM-22 (USEPA Alt-Method 008)	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23 (USEPA Method 3)	not specified	NA	✓
Carbon dioxide	NSW EPA TM-24 (USEPA Method 3A)	NSW EPA TM-24 (USEPA Method 3A)	13%	✓	✓
Nitrogen oxides	NSW EPA TM-11 (USEPA Method 7E)	NSW EPA TM-11 (USEPA Method 7E)	12%	✓	✓
Oxygen	NSW EPA TM-25 (USEPA Method 3A)	NSW EPA TM-25 (USEPA Method 3A)	13%	✓	✓
Speciated volatile organic compounds (VOCs)	NSW EPA TM-34[d] (USEPA Method 18)	Ektimo 344	19%	✓	✓†

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* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

† Analysis performed by Ektimo. Results were reported to Ektimo on 20 November 2023 in report LV-005143.

d Excludes recovery study as specified in section 8.4.3 of USEPA Test Method 18.

6 Deviations to Test Methods

TM-34 VOLATILE ORGANIC COMPOUNDS

Ektimo notes that the sampling and analysis of Volatile Organic Compounds (VOCs), per USEPA Method 18 has excluded the recovery study as specified in Section 8.4.3. Performing the recovery study described in Section 8.4.3 of USEPA Method 18 for analytes present at low levels is problematic. Given this, Ektimo applies a threshold of 50µg as a lower-bound mass, below which the 'spiking' of specific volatile organic compounds is not performed. For the purposes of this round of monitoring, the following compound was present above the detection limit (0.1 µg) but were below 50µg. Therefore, recovery studies for the following analyte was not performed:

- Toluene (4.2 µg)

7 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 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 APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

Unless specifically noted, all samples were collected and handled in accordance with Ektimo's QA/QC standards.

8 Definitions

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

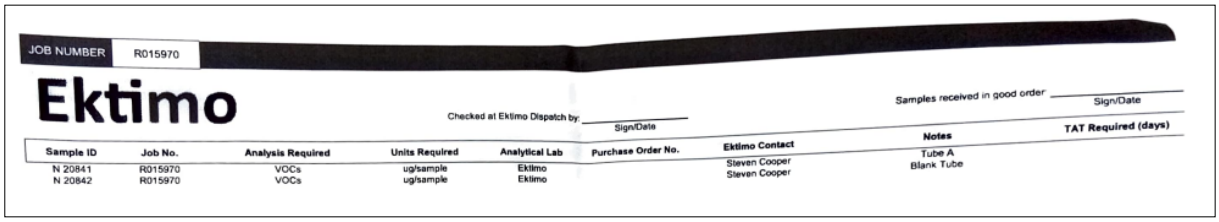
% v/v	Volume to volume ratio.
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
AS	Australian Standard
CEM/CEMS	Continuous emission monitoring/Continuous emission monitoring system
D	Duct diameter or equivalent duct diameter for rectangular ducts
DECC	Department of Environment & Climate 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.
EPA	Environment Protection Authority
FTIR	Fourier transform infra-red
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of 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	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
Semi-quantified VOCs	Unknown VOCs (those for which an analytical standard is not available), 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 is determined by matching the 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.
TM	Test method
TOC	Total organic carbon. This is 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
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

9 Appendices

Appendix A: Site Images

EPA 4 - Benzene Combustor Stack

Appendix B: Chain of Custody



JOB NUMBER R015970

Ektimo

Checked at Ektimo Dispatch by: _____ Sign/Date

Samples received in good order: _____ Sign/Date

Sample ID	Job No.	Analysis Required	Units Required	Analytical Lab	Purchase Order No.	Ektimo Contact	Notes	TAT Required (days)
N 20841	R015970	VOCs	ug/sample	Ektimo		Steven Cooper	Tube A	
N 20842	R015970	VOCs	ug/sample	Ektimo		Steven Cooper	Blank Tube	

Appendix C: Laboratory Results

Ektimo

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CERTIFICATE OF ANALYSIS

Testing Laboratory:	Ektimo 26 Redland Drive Mitcham, VIC 3132
Report Number:	LV-005143
Job Number:	R015970
Date of Issue:	20/11/2023
Attention:	Quantem
Address:	Gate 38B, 45 Friendship Rd Port Botany NSW 2036
Date samples received:	13/11/2023
Number of samples received:	2
Date samples analysed:	20/11/2023
No of samples analysed:	2
Test method(s) used:	Ektimo 344

Comments

QC Acceptance Criteria:

Parameter	Criteria	Pass/Fail
Standard Curve	$R^2 > 0.99$	Pass
Range	All samples <110% of highest standard	Pass
Repeat samples	Between 80% - 120%	Pass
Method Blanks	All method blanks < PQL	Pass
QC sample	2 standard deviations of theoretical	Pass
Chemical Expiry	All chemicals within expiry date	Pass

This report supersedes any previous report(s) with this reference. Sample(s) have been analysed as received.

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NATA is a member of APAC (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.

REPORT AUTHORISATION

Version 230707

Matthew Cook
Laboratory Manager

Daniel Balaam
Senior Laboratory Chemist

NATA Accredited Laboratory 14601

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

Ektimo

Analytical Results

Report No. LV-005143

Job No. R015970

Client Name: Quantem

Parameter	Units	N20841 R015970	N20842 R015970
	PQL	1.0	1.0
Ethanol	µg	<1	<1
Acetone	µg	<1	<1
Isopropanol	µg	<1	<1
Pentane	µg	<1	<1
1,1-Dichloroethene	µg	<1	<1
Acrylonitrile	µg	<1	<1
Dichloromethane	µg	<1	<1
trans-1,2-Dichloroethene	µg	<1	<1
Methyl ethyl ketone	µg	<1	<1
n-Hexane	µg	<1	<1
cis-1,2-Dichloroethene	µg	<1	<1
Ethyl acetate	µg	<1	<1
Chloroform	µg	<1	<1
1,1,1-Trichloroethane	µg	<1	<1
1,2-Dichloroethane	µg	<1	<1
Cyclohexane	µg	<1	<1
Benzene	µg	<1	<1
Carbon tetrachloride	µg	<1	<1
Butanol	µg	<1	<1
Isopropyl acetate	µg	<1	<1
2-Methylhexane	µg	<1	<1
2,3-Dimethylpentane	µg	<1	<1
1-Methoxy-2-propanol	µg	<1	<1
3-Methylhexane	µg	<1	<1
Heptane	µg	<1	<1
Ethyl acrylate	µg	<1	<1
Trichloroethylene	µg	<1	<1
Methyl methacrylate	µg	<1	<1
Propyl acetate	µg	<1	<1
Methylcyclohexane	µg	<1	<1
Methyl Isobutyl Ketone	µg	<1	<1
Toluene	µg	4.2	<1
1,1,2-Trichloroethane	µg	<1	<1
2-Hexanone	µg	<1	<1
Octane	µg	<1	<1
Tetrachloroethene	µg	<1	<1
Butyl acetate	µg	<1	<1
Chlorobenzene	µg	<1	<1
Ethylbenzene	µg	<1	<1
m + p-Xylene	µg	<1	<1
1-Methoxy-2-propyl acetate	µg	<1	<1
Styrene	µg	<1	<1
o-Xylene	µg	<1	<1
Butyl acrylate	µg	<1	<1
Nonane	µg	<1	<1

* Results marked with an asterisk are outside the acceptable calibration range of the instrument.

NATA Accredited Laboratory 14601

Ektimo

Analytical Results

Report No. LV-005143

Job No. R015970

Client Name: Quantem

Parameter	Units	N20841 R015970	N20842 R015970
	PQL	1.0	1.0
2-Butoxyethanol	µg	<1	<1
Cellosolve acetate	µg	<1	<1
1,1,2,2-Tetrachloroethane	µg	<1	<1
Isopropylbenzene	µg	<1	<1
alpha-Pinene	µg	<1	<1
Propylbenzene	µg	<1	<1
1,3,5-Trimethylbenzene	µg	<1	<1
beta-Pinene	µg	<1	<1
tert-Butylbenzene	µg	<1	<1
1,2,4-Trimethylbenzene	µg	<1	<1
Decane	µg	<1	<1
3-Carene	µg	<1	<1
1,2,3-Trimethylbenzene	µg	<1	<1
D-Limonene	µg	<1	<1
Undecane	µg	<1	<1
Dodecane	µg	<1	<1
Tridecane	µg	<1	<1
Tetradecane	µg	<1	<1
Residuals as Toluene	µg	9.4	<1

* Results marked with an asterisk are outside the acceptable calibration range of the instrument.

NATA Accredited Laboratory 14601

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