



REPORT NUMBER R008147

**Emission Testing Report
Enwave Mascot Pty Ltd, Mascot**

Document Information

Client Name: Enwave Mascot Pty Ltd
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Mascot NSW 2020
Testing Laboratory: Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation



NATA Accredited Laboratory
No. 14601

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Ektimo Signatory

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

1.1 Background

Ektimo was engaged by Enwave Mascot Pty Ltd to perform emission testing at the trigeneration facility located at Mascot NSW to satisfy conditions within NSW Environment Protection licence 20246.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
DP 1 – Unit 1	4 September 2019	Nitrogen oxides, oxygen Volatile organic compounds (VOC's) includes n-propane equivalent
DP 2 – Unit 2		

* 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.

1.2 Licence Summary

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by the NSW EPA as per licence 20246 (last amended on 14/11/17).

EPA No.	Pollutant	Units	Licence limit	Detected values (Corrected to 3% O ₂)
DP 1-Unit 1	Nitrogen Oxides	mg/m ³	250	240
	Volatile Organic Compounds (as n-propane)	mg/m ³	40	0.14
DP 2-Unit 2	Nitrogen Oxides	mg/m ³	250	190
	Volatile Organic Compounds (as n-propane)	mg/m ³	40	1.7

2 RESULTS

2.1 DP 1 – Unit 1

Date	4/09/2019	Client	Enwave
Report	20246	Stack ID	DP 1 - Unit 1
Licence No.	R008147	Location	Mascot
Ektimo Staff	Scott Woods	State	NSW
Process Conditions	Load: 100%, Chiller On		90902

Sampling Plane Details

Sampling plane dimensions	900 mm
Sampling plane area	0.636 m ²
Sampling port size, number	2" BSP (x2)
Access & height of ports	Stairs 25 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 10 D
Upstream disturbance	Junction 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	11
Gas molecular weight, g/g mole	28.3 (wet) 29.5 (dry)
Gas density at STP, kg/m ³	1.26 (wet) 1.32 (dry)
% Oxygen correction & Factor	3 % 1.64

Gas Flow Parameters

Flow measurement time(s) (hhmm)	0930 & 1031
Temperature, °C	390
Temperature, K	663
Velocity at sampling plane, m/s	17
Volumetric flow rate, actual, m ³ /s	11
Volumetric flow rate (wet STP), m ³ /s	4.5
Volumetric flow rate (dry STP), m ³ /s	4.1
Mass flow rate (wet basis), kg/hour	21000
Velocity difference, %	-4

Gas Analyser Results	Sampling time	Average 0942 - 1043			Minimum 0942 - 1043			Maximum 0942 - 1043		
		Corrected to			Corrected to			Corrected to		
Combustion Gases		Concentration mg/m ³	3% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	3% O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	3% O ₂ mg/m ³	Mass Rate g/min
Nitrogen oxides (as NO ₂)		150	240	36	120	200	29	180	300	44
Oxygen			Concentration %v/v			Concentration %v/v			Concentration %v/v	
			10			9.9			12.8	

Total VOCs (as n-Propane)	Sampling time	Results 0947-1047		
Lower Bound		Corrected to		
		Concentration mg/m ³	3% O ₂ mg/m ³	Mass Rate g/min
Total		0.082	0.14	0.02

VOC (speciated) ⁽¹⁾	Sampling time	Results 0947-1047		
		Corrected to		
		Concentration mg/m ³	3% O ₂ mg/m ³	Mass Rate g/min
Detection limit ⁽¹⁾		<0.08	<0.1	<0.02
Toluene		0.17	0.28	0.042

(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, 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, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 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

2.2 DP 2 – Unit 2

Date	4/09/2019	Client	Enwave
Report	20246	Stack ID	DP 2 - Unit 2
Licence No.	R008147	Location	Mascot
Ektimo Staff	Scott Woods	State	NSW
Process Conditions	Load: 100%, Chiller On		#0902

Sampling Plane Details	
Sampling plane dimensions	900 mm
Sampling plane area	0.636 m ²
Sampling port size, number	2" BSP (x2)
Access & height of ports	Stairs 25 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 10 D
Upstream disturbance	Junction 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	8.2	
Gas molecular weight, g/g mole	28.6 (wet)	29.6 (dry)
Gas density at STP, kg/m ³	1.28 (wet)	1.32 (dry)
% Oxygen correction & Factor	3 %	1.64
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1123 & 1126	
Temperature, °C	237	
Temperature, K	510	
Velocity at sampling plane, m/s	16	
Volumetric flow rate, actual, m ³ /s	9.9	
Volumetric flow rate (wet STP), m ³ /s	5.3	
Volumetric flow rate (dry STP), m ³ /s	4.9	
Mass flow rate (wet basis), kg/hour	24000	
Velocity difference, %	<1	

Gas Analyser Results	Sampling time	Average 1124 - 1225			Minimum 1124 - 1225			Maximum 1124 - 1225		
		Corrected to 3% O2			Corrected to 3% O2			Corrected to 3% O2		
Combustion Gases		Concentration mg/m ³	Mass Rate g/min	Concentration mg/m ³	Mass Rate g/min	Concentration mg/m ³	Mass Rate g/min	Concentration mg/m ³	Mass Rate g/min	
Nitrogen oxides (as NO ₂)		120	35	94	27	140	42			
Oxygen		Concentration %v/v 10		Concentration %v/v 9.9		Concentration %v/v 10				

Total VOCs (as n-Propane) Lower Bound	Sampling time	Results 1125-1225		
		Corrected to		
		Concentration mg/m ³	3% O2 mg/m ³	Mass Rate g/min
Total		1	1.7	0.31

VOC (speciated)	Sampling time	Results 1125-1225		
		Corrected to		
		Concentration mg/m ³	3% O2 mg/m ³	Mass Rate g/min
Detection limit ⁽¹⁾		<0.08	<0.1	<0.02
Toluene		0.64	1	0.19
Acetone		0.97	1.6	0.28

(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, 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, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, 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

3 PLANT OPERATING CONDITIONS

Testing was conducted on DP1 - Unit 1 under 100% load, chilling unit on and DP 2 - Unit 2 under 100% load, chilling unit on.

See Enwave Mascot Pty Ltd's records for complete process conditions.

4 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	✓	NA
Flow rate, temperature and velocity	NA	NSW TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW TM-22	NSW TM-22	8%	✓	✓
Nitrogen oxides	NSW TM-11	NSW TM-11	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	13%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34 ^d	Ektimo 344	19%	✓	✓ [†]

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

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

[†] Analysis conducted at the Ektimo Mitcham, VIC laboratory, NATA accreditation number 14601. Results were reported to Ektimo on 17 September 2019 in report number R008147_SVOCs.

5 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.

6 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)
Velocity Difference	The percentage difference between the average of initial flows and afterflows.
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.
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.

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