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Report Number R005956

Emission Testing Report - 2018 Compliance
DP2 - Propellant Afterburner
Pentarch Pty Ltd, Oaklands



Document Information

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 Report Number: R005956
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 Attention: Annie Bushnell
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 Testing Laboratory: Ektimo Pty Ltd, ABN 86 600 381 413

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Glenn Easterby
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 Pentarch Pty Ltd to determine emissions to air from the Propellant Afterburner (DP2) at the Oaklands, NSW plant.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
DP2 - Propellant Afterburner	16 May 2018	Hydrogen chloride, solid particles, fine particulate matter (PM ₁₀ & PM _{2.5} via particle sizing analysis), metals (Type 1 & 2 substances) including zinc, nitrogen oxides, sulfur dioxide, carbon monoxide, carbon dioxide, oxygen, volatile organic compounds (VOC)

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

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

2 LICENCE COMPARISON

The following table compares the results with the limits referenced in NSW EPA Licence 11947 (last amended on 12/06/2015). Analytes highlighted in green are below the licence limits.

EPA	Location Description	Parameter	Units	Licence limit	2018 Detected values
Point 2	Propellant Afterburner	Hydrogen chloride	mg/m ³	100	0.52
		Nitrogen oxides	mg/m ³	350	200
		Solid particles	mg/m ³	50	36
		Type 1 & 2 substances in aggregate	mg/m ³	1	≤0.12
		Zinc	mg/m ³	0.5	0.085

Note: Solid particles is compared to a licence limit of 50mg/m³ as advised by Pentarch Pty Ltd personnel.

3 RESULTS

3.1 DP2 – Propellant Afterburner

Date	16/05/2018	Client	Pentarch Pty Ltd
Report	R005956	Stack ID	DP2 - Propellant Furnace
Licence No.	11947	Location	Oaklands
Ektimo Staff	D.Corbett, B.Minchinton	State	NSW
Process Conditions	Processing 200g bags of 105mm propellant. Approximately 3 per minute.		180430

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m ²
Sampling port size, number & depth	4" Flange (x2), 100 mm
Access & height of ports	Roof via forklift 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Junction 3 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1	Compliant but non-ideal

Comments
<p>The sampling plane is deemed to be non-ideal due to the following reasons:</p> <p>The highest to lowest gas velocity ratio exceeds 1.6:1</p> <p>The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D</p>

Stack Parameters		
Moisture content, %v/v	2.6	
Gas molecular weight, g/g mole	28.9 (wet)	29.2 (dry)
Gas density at STP, kg/m ³	1.29 (wet)	1.30 (dry)
Gas Flow Parameters		
Flow measurement time(s) (hhmm) *	1035	
Temperature, °C	399	
Velocity at sampling plane, m/s	13	
Volumetric flow rate, discharge, m ³ /s	3.8	
Volumetric flow rate (wet STP), m ³ /s	1.5	
Volumetric flow rate (dry STP), m ³ /s	1.5	
Mass flow rate (wet basis), kg/hour	7100	

Gas Analyser Results	Sampling time	Average	
		Concentration	Mass Rate
		mg/m ³	g/min
Combustion Gases			
Nitrogen oxides (as NO ₂)		200	18
Sulfur dioxide		<5	<0.4
Carbon monoxide		17	1.6
		Concentration	
		%	
Carbon dioxide		2	
Oxygen		18.2	

* Flow measurements were not performed at the end of sampling due to a change in process conditions. Please note the process change did not occur during the manual sampling time periods.

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Process Conditions	Processing 200g bags of 105mm propellant. Approximately 3 per minute.		

180430

Isokinetic Results	Sampling time	Results	
		1035-1136	
		Concentration	Mass Rate
		mg/m ³	g/min
Solid Particles		36	3.2
Fine particulates (PM10)	(PSA)	17	1.5
Fine particulates (PM2.5)	(PSA)	7.6	0.68
Chloride (as HCl)		0.52	0.047
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		101	

Isokinetic Results	Sampling time	Results	
		1035-1136	
		Concentration	Mass Rate
		mg/m ³	g/min
Antimony		<0.006	<0.0005
Arsenic		<0.002	<0.0002
Beryllium		<0.001	<0.0001
Cadmium		<0.0006	<0.00005
Chromium		0.018	0.0017
Cobalt		<0.0009	<0.00008
Lead		0.063	0.0056
Manganese		0.012	0.001
Mercury		0.00043	0.000039
Nickel		0.0034	0.0003
Selenium		<0.006	<0.0005
Tin		0.0073	0.00065
Vanadium		<0.001	<0.0001
Zinc		0.085	0.0077
Type 1 & 2 Substances			
Upper Bound			
Total Type 1 Substances		≤0.072	≤0.0064
Total Type 2 Substances		≤0.05	≤0.0045
Total Type 1 & 2 Substances		≤0.12	≤0.011
Isokinetic Sampling Parameters			
Sampling time, min		60	
Isokinetic rate, %		101	

VOC (speciated)	Sampling time	Results	
		1045-1115	
		Concentration	Mass Rate
		mg/m ³	g/min
Detection limit ⁽¹⁾		<0.2	<0.02

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

Ethanol, Isopropanol, 1,1-Dichloro ethene, 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, tert-Butylbenzene, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, Acetone, Pentane, Acrylonitrile, n-Hexane, Methyl ethyl ketone, Ethyl acetate, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, Isopropyl acetate, 3-Methylhexane, Ethyl acrylate, Heptane, Methyl methacrylate, Propyl acetate, Methylcyclohexane, MIBK, 2-Hexanone, Octane, Butyl acetate, 1-methoxy-2-propyl acetate, Butyl acrylate, Nonane, Cello solve acetate, alpha-Pinene, beta-Pinene, Decane, 3-Carene, D-Limonene, Undecane, Dodecane, Tridecane, Tetradecane, Residuals as Toluene

4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See Pentarch Pty Ltd's records for complete process conditions.

Test Date	Process Conditions
16 May 2018	- Processing 200g bags of 105mm propellant - Approximately 3 bags processed per minute

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%	✓	✓
Sulfur dioxide	NSW TM-4	NSW TM-4	12%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34	Ektimo 344	19%	✓	✓ [†]
Total Metals (Zn)	USEPA 29	Envirolab inhouse: Metals-006, Metals-022	15%	✓	✓ [‡]
Type 2 substances (Non Listed - USEPA29) (Sn, V)	NSW TM-13	Envirolab inhouse: Metals-006, Metals-022	15%	x ^{‡‡}	✓ [‡]
Hydrogen chloride	NSW TM-8	Ektimo 235	14%	✓	✓ [†]
Particulate matter	NSW TM-15	NSW TM-15	5%	✓	✓
Particulate matter < 10µm (PM ₁₀) by particle size analysis	-	HRL inhouse	-	-	x ^{**}
Particulate matter < 2.5µm (PM _{2.5}) by particle size analysis	-	HRL inhouse	-	-	x ^{**}
Type 1 substances (Sb, As, Cd, Pb, Hg)	NSW TM-12	Envirolab inhouse: Metals-006, Metals-021, Metals-022	15%	✓	✓ [‡]
Type 2 substances (Be, Cr, Co, Mn, Ni, Se)	NSW TM-13	Envirolab inhouse: Metals-006, Metals-022	15%	✓	✓ [‡]

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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 31 May 2018 in report number R004772-Halides_Halogens. Laboratory analytical results were reported on 4 June 2018 in report number R005956_SVOCs.

[‡] Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 24 May 2018 in report number 192009.

^{‡‡} Specified metals are not listed in USEPA Method 29 and therefore not covered by NATA accreditation for sampling.

^{**} Analysis performed by HRL Technology using a Malvern Instruments Mastersizer laser particle size analyser. Results were reported to Ektimo on 7 June 2018 – HRL Job No. 180709. NATA Accreditation does not cover the performance of this service.

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.

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.

7 DEFINITIONS

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

~	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
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
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
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