Ektimo

Santos Limited, Wilga Park

Emission Testing Report

Report Number R012308

Document Information

Template Version 211117

Client Name:	Santos Limited
Report Number:	R012308
Date of Issue:	22 March 2022
Attention:	Abigail Kahi
Address:	Level 22, 32 Turbot Street Brisbane QLD 4000
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Aaron Davis
Ektimo Signatory

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.

Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by Santos Limited to perform emission testing from gas-fired engines situated at their Wilga Park plant.

1.2 Project Objective

The objectives of the project were to conduct a monitoring programme to quantify emissions from multiple discharge points to determine compliance with Santos Limited's Development Approval DA07-0023.

Monitoring was performed as follows:

Location	Test Date	Test Parameters*
GO3B	7 December 2021	Nitrogen oxides (as NO_2) Oxygen
GO4B		
GO5B		
GO6B		
GO2A	8 December 2021	
GO5A		
GO6A		
GO1A	17 March 2022	
GO3A		

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

Emission testing was conducted on all engines at Wilga Park that were operational on the designated occasion for monitoring.

Engine GO4A was offline due to mechanical issues during both the December 2021 and March 2022 testing occasions and was not tested.

All results are reported on a dry basis at STP.

Plant operating conditions have been noted in the report.

1.3 Results Summary

The following licence comparison table shows that all analytes highlighted in green are within the licence limit set by the Department of Planning DA 07_0023.

Location Description	Pollutant	Units	Department Planning limit	Detected values	Corrected to 3% O_2
GO1A	Oxides of Nitrogen (as NO_2)	mg/m^3	450	260	430
GO2A	Oxides of Nitrogen (as NO_2)	mg/m^3	450	220	420
GO3A	Oxides of Nitrogen (as NO_2)	mg/m^3	450	290	430
GO3B	Oxides of Nitrogen (as NO_2)	mg/m^3	450	230	430
GO4B	Oxides of Nitrogen (as NO_2)	mg/m^3	450	230	420
GO5A	Oxides of Nitrogen (as NO_2)	mg/m^3	450	230	350
GO5B	Oxides of Nitrogen (as NO_2)	mg/m^3	450	220	420
GO6A	Oxides of Nitrogen (as NO_2)	mg/m^3	450	230	350
GO6B	Oxides of Nitrogen (as NO_2)	mg/m^3	450	220	430

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

Refer to the Test Methods table for the measurement uncertainties.

2 Results

2.1 GO3B

Date	7/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO3B
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		*211203*

Sampling Plane Details	
Sampling plane dimensions	600 mm
Sampling plane area	0.283 m²
Sampling port size, number	4" Flange (x2)
Access & height of ports	Elevated work platform 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 8 D
Upstream disturbance	Change in diameter 3 D
No. traverses & points sampled	2 12
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal

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	8.4	
Gas molecular weight, g/g mole	28.5 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.52	
% Oxygen correction & Factor	3 %	1.89
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1115 & 1225	
Temperature, °C	372	
Temperature, K	646	
Velocity at sampling plane, m/s	37	
Volumetric flow rate, actual, m³/s	11	
Volumetric flow rate (wet STP), m³/s	4.3	
Volumetric flow rate (dry STP), m³/s	4	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average		
Sampling time	1123 - 1222		
	Concentration	Corrected to 3% O2	Mass Rate
	mg/m³	mg/m³	g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	230	430	54
	Concentration %v/v		
Oxygen	11.4		

2.2 GO4B

Date	7/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO4B
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		*211203*

Sampling Plane Details		
Sampling plane dimensions	600 mm	
Sampling plane area	0.283 m²	
Sampling port size, number	4" Flange (x2)	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	8 D
Upstream disturbance	Change in diameter	3 D
No. traverses & points sampled	2	12
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal	

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	8.5	
Gas molecular weight, g/g mole	28.6 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.52	
% Oxygen correction & Factor	3 %	1.82
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1430 & 1540	
Temperature, °C	376	
Temperature, K	650	
Velocity at sampling plane, m/s	38	
Volumetric flow rate, actual, m³/s	11	
Volumetric flow rate (wet STP), m³/s	4.3	
Volumetric flow rate (dry STP), m³/s	4	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average		
Sampling time	1434 - 1533		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	230	420	55
	Concentration %v/v		
Oxygen	11.1		

2.3 GO5B

Date	7/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO5B
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		211203

Sampling Plane Details		
Sampling plane dimensions	600 mm	
Sampling plane area	0.283 m²	
Sampling port size, number	4" Flange (x2)	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	8 D
Upstream disturbance	Change in diameter	3 D
No. traverses & points sampled	2	12
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal	

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	27.7 (wet)	28.6 (dry)
Gas density at STP, kg/m³	1.24 (wet)	1.28 (dry)
Gas density at discharge conditions, kg/m³	0.52	
% Oxygen correction & Factor	3 %	1.94
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0945 & 1050	
Temperature, °C	360	
Temperature, K	634	
Velocity at sampling plane, m/s	37	
Volumetric flow rate, actual, m³/s	10	
Volumetric flow rate (wet STP), m³/s	4.4	
Volumetric flow rate (dry STP), m³/s	4	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average		
Sampling time	0948 - 1047		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	220	420	53
	Concentration %v/v		
Oxygen	11.7		

2.4 GO6B

Date	7/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO6B
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		211203

Sampling Plane Details		
Sampling plane dimensions	600 mm	
Sampling plane area	0.283 m²	
Sampling port size, number	4" Flange (x2)	
Access & height of ports	Elevated work platform 10 m	
Duct orientation & shape	Vertical Circular	
Downstream disturbance	Exit 8 D	
Upstream disturbance	Change in diameter 3 D	
No. traverses & points sampled	2 12	
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal	

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	8.6	
Gas molecular weight, g/g mole	28.5 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.53	
% Oxygen correction & Factor	3 %	1.95
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1305 & 1410	
Temperature, °C	362	
Temperature, K	635	
Velocity at sampling plane, m/s	37	
Volumetric flow rate, actual, m³/s	11	
Volumetric flow rate (wet STP), m³/s	4.4	
Volumetric flow rate (dry STP), m³/s	4	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average		
Sampling time	1310 - 1409		
	Concentration	Corrected to 3% O2	Mass Rate
	mg/m³	mg/m³	g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	220	430	53
	Concentration		
	%v/v		
Oxygen	11.7		

2.5 GO2A

Date	8/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO2A
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		211203

Sampling Plane Details		
Sampling plane dimensions	600 mm	
Sampling plane area	0.283 m²	
Sampling port size, number	4" Flange (x2)	
Access & height of ports	Elevated work platform 10 m	
Duct orientation & shape	Vertical Circular	
Downstream disturbance	Exit 8 D	
Upstream disturbance	Change in diameter 3 D	
No. traverses & points sampled	2 12	
Sample plane compliance to AS4323.1 (1995)	Compliant but non-ideal	

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	8.6	
Gas molecular weight, g/g mole	28.5 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.52	
% Oxygen correction & Factor	3 %	1.90
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0850 & 0910	
Temperature, °C	368	
Temperature, K	641	
Velocity at sampling plane, m/s	37	
Volumetric flow rate, actual, m³/s	11	
Volumetric flow rate (wet STP), m³/s	4.4	
Volumetric flow rate (dry STP), m³/s	4	
Mass flow rate (wet basis), kg/hour	20000	

Gas Analyser Results	Average		
Sampling time	0900 - 0959		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	220	420	53
		Concentration %v/v	
Oxygen		11.5	

2.6 GO5A

Date	8/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO5A
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 1000kW		211203

Sampling Plane Details	
Sampling plane dimensions	320 mm
Sampling plane area	0.0804 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Platform ladder 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Exit 0 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	8.9	
Gas molecular weight, g/g mole	28.6 (wet)	29.6 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.46	
% Oxygen correction & Factor	3 %	1.51
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1215 & 1325	
Temperature, °C	455	
Temperature, K	728	
Velocity at sampling plane, m/s	40	
Volumetric flow rate, actual, m³/s	3.2	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1.1	
Mass flow rate (wet basis), kg/hour	5400	

Gas Analyser Results	Average		
Sampling time	1215 - 1314		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	230	350	15
		Concentration %v/v	
Oxygen		9	

2.7 GO6A

Date	8/12/2021	**Client**	Santos Limited
Report	R011119	**Stack ID**	GO6A
Licence No.	DA 07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 1000kW		211203

Sampling Plane Details	
Sampling plane dimensions	320 mm
Sampling plane area	0.0804 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Platform ladder 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Exit 0 D
No. traverses & points sampled	2 8
Sample plane compliance to AS4323.1 (1995)	Non-compliant

The sampling plane is deemed to be non-compliant due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	8.8	
Gas molecular weight, g/g mole	28.6 (wet)	29.6 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.43	
% Oxygen correction & Factor	3 %	1.52
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1035 & 1145	
Temperature, °C	516	
Temperature, K	789	
Velocity at sampling plane, m/s	45	
Volumetric flow rate, actual, m³/s	3.6	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1.1	
Mass flow rate (wet basis), kg/hour	5600	

Gas Analyser Results	Average		
Sampling time	1040 - 1139		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	230	350	15
		Concentration %v/v	
Oxygen		9.1	

2.8 GO1A

Date	17/03/2022	**Client**	Santos Limited
Report	R012308	**Stack ID**	GO1A
Licence No.	DA07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 3000kW		220315

Sampling Plane Details		
Sampling plane dimensions	600 mm	
Sampling plane area	0.283 m²	
Sampling port size, number	Sampled at exit	
Access & height of ports	Elevated work platform	10 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	8 D
Upstream disturbance	Change in diameter	3 D
No. traverses & points sampled	2	16
Sample plane conformance to AS4323.1 (2021)	Conforming but non-ideal	

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	8.5	
Gas molecular weight, g/g mole	28.5 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.50	
% Oxygen correction & Factor	3 %	1.68
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1200 & 1320	
Temperature, °C	400	
Temperature, K	673	
Velocity at sampling plane, m/s	36	
Volumetric flow rate, actual, m³/s	10	
Volumetric flow rate (wet STP), m³/s	4	
Volumetric flow rate (dry STP), m³/s	3.7	
Mass flow rate (wet basis), kg/hour	18000	

Gas Analyser Results	Average		
Sampling time	1207 - 1306		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	260	430	56
		Concentration %v/v	
Oxygen		10.2	

2.9 GO3A

Date	17/03/2022	**Client**	Santos Limited
Report	R012308	**Stack ID**	GO3A
Licence No.	DA07_0023	**Location**	Wilga Park
Ektimo Staff	Aaron Davis / Scott Woods	**State**	NSW
Process Conditions	Engine operating at 1000kW		220315

Sampling Plane Details	
Sampling plane dimensions	320 mm
Sampling plane area	0.0804 m²
Sampling port size, number	Sampled at exit
Access & height of ports	Platform ladder 4 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 0 D
Upstream disturbance	Exit 0 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The downstream disturbance is <1D from the sampling plane
The upstream disturbance is <2D from the sampling plane
The stack or duct does not have the required number of access holes (ports)

Stack Parameters		
Moisture content, %v/v	8.9	
Gas molecular weight, g/g mole	28.5 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.27 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.44	
% Oxygen correction & Factor	3 %	1.48
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0910 & 1030	
Temperature, °C	490	
Temperature, K	764	
Velocity at sampling plane, m/s	48	
Volumetric flow rate, actual, m³/s	3.9	
Volumetric flow rate (wet STP), m³/s	1.4	
Volumetric flow rate (dry STP), m³/s	1.2	
Mass flow rate (wet basis), kg/hour	6200	

Gas Analyser Results	Average		
Sampling time	0924 - 1023		
	Concentration mg/m³	Corrected to 3% O2 mg/m³	Mass Rate g/min
Combustion Gases			
Nitrogen oxides (as NO_2)	290	430	22
		Concentration %v/v	
Oxygen		8.8	

3 Plant Operating Conditions

The below plant operating conditions have been supplied by Santos Limited personnel.

Location	Test Date	Engine Operating Conditions
GO3B	7 December 2021	3000kW
GO4B		3000kW
GO5B		3000kW
GO6B		3000kW
GO2A	8 December 2021	3000kW
GO5A		1000kW
GO6A		1000kW
GO1A	17 March 2022	3000kW
GO3A		1000kW

4 Test Methods

All sampling and analysis 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	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Dry gas density	NA	NSW EPA TM-23	not specified	NA	✓
Nitrogen oxides	NSW EPA TM-11	NSW EPA TM-11	12%	✓	✓
Oxygen	NSW EPA TM-25	NSW EPA TM-25	13%	✓	✓

220302

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

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 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.

6 Compliance Summary

Emissions monitoring was performed on each release point for a minimum of 60 minutes.

The measured parameters were found to be below the emission limits specified in the Santos Development Approval DA07-0023.

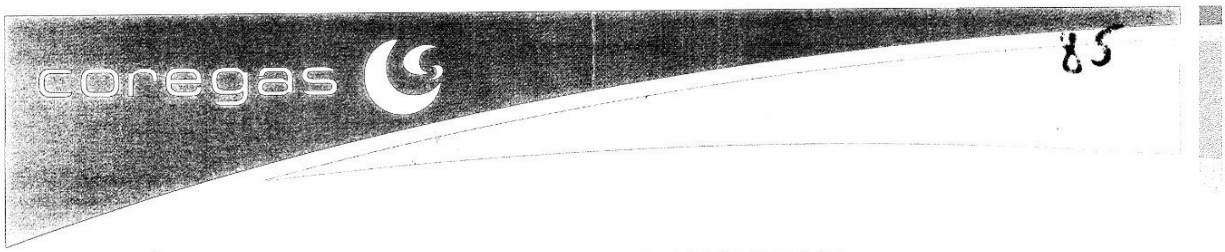
Location	Compliant/non compliant with approval conditions
• GO3B	Compliant
• GO4B	Compliant
• GO5B	Compliant
• GO6B	Compliant
• GO2A	Compliant
• GO5A	Compliant
• GO6A	Compliant
• GO1A	Compliant
• GO3A	Compliant

7 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/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
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
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
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
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
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)
Velocity difference	The percentage difference between the average of initial flows and after flows.
XRD	X-ray diffractometry
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.

8 Appendix 1: Gas Calibration Certificates



CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF ANALYSIS

Coregas Pty Ltd

Page 1

Prod. Order No.	LGP018699	**Certificate No.**	**QCSPC027296**
Prod. Order Batch No.	LGP018699-4	**Date Certified**	31/05/21
Cylinder Serial No.	660107	**Analyst Name**	Jason Yap
Cylinder Capacity	11 L	**Mixture Type**	Gas
Customer No. :	10032487	**Cylinder Content**	1.6 m3
Customer :	EKTIMO PTY LTD	**Valve Type**	BS14
Order No. :	SO02533105		

Component	Required Concentration	Actual Concentration	Concentration Unit of Measure	Measurement Uncertainty	Method
Nitric Oxide	100	104.9	ppm mol	2% rel	8085 Chemi-luminescence
Sulphur Dioxide	100	104.0	ppm mol	2% rel	7094 NDIRUltramat
Carbon Monoxide	100	100.1	ppm mol	2% rel	7050 NDIRS710
Carbon Dioxide	20	20.12	% mol	1% rel	7050 NDIRS710
Nitrogen		Balance			

All concentration are expresssed on mole fraction basis.
The certified values are traceable to Australian National Standards of mass and thus to the International System of Units (SI).
The certified gas mixture is typically for calibration of instruments. Measurement Uncertainty is calculated using a coverage factor K=2, which gives 95% Confidence Interval.

Technical Note :

Filling Pressure	150	BAR
Min. Useable Pressure	5	BAR
Min. Storage Temperature	10	C
Period of Validity	3 Years	

Analyst

Jason Yap
Chemist

NATA Signatory

Mark Qin
Manager Spec. Gas Lab

NATA
ACCREDITED FOR
TECHNICAL COMPETENCE

Accredited Reference Material Producer
Number: 12803
Site Number: 15135

Accredited for compliance with ISO17034

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutal recognition of the equivalence of reference material certificates

<CMS-10-SOP-8115-F3 Approved by SG&QC Manager 13/10/2020>

Print Date : 31/05/21

---End of Document---

Coregas Pty Ltd
Phone (+61) 1800 807 203 | coregas.com.au

coregas

CERTIFIED REFERENCE MATERIAL
CERTIFICATE OF ANALYSIS

Coregas Pty Ltd

Prod. Order No.	LGP018944	Certificate No.	QCSPC027747
Prod. Order Batch No.	LGP018944-1	Date Certified	05/08/21
Cylinder Serial No.	660075	Analyst Name	Victor Sun
Cylinder Capacity	11 L	Mixture Type	Gas
Customer No. :	10032487	Cylinder Content	1.5m3
Customer :	EKTIMO PTY LTD	Valve Type	BS14
Order No. :	SO02584574		

Component	Required Concentration	Actual Concentration	Concentration Unit of Measure	Measurement Uncertainty	Method
Nitrogen Dioxide	50	51.4	ppm mol	5% rel	8085 Chemi-luminescence
Nitrogen		Balance			

Comments : Mixture contains 1% of oxygen for nitrogen dioxide stability.

All concentration are expresssed on mole fraction basis.
The certified values are traceable to Australian National Standards of mass and thus to the International System of Units (SI).
The certified gas mixture is typically for calibration of instruments. Measurement Uncertainty is calculated using a coverage factor K=2, which gives 95% Confidence Interval.

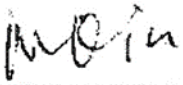
Technical Note :

Filling Pressure	150	BAR
Min. Useable Pressure	5	BAR
Min. Storage Temperature	10	C
Period of Validity	2 Years	

Analyst

Victor Sun
Chemist

NATA Signatory



Mark Qin
Manager Spec. Gas Lab

NATA
ACCREDITED FOR
TECHNICAL COMPETENCE

Accredited Reference Material Producer
Number: 12803
Site Number: 15135

Accredited for compliance with ISO17034

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutal recognition of the equivalence of reference material certificates

<CMS-10-SOP-8115-F3 Approved by SG&QC Manager 13/10/2020>

Print Date : 05/08/21

---End of Document---

Coregas Pty Ltd
66 Loftus Road, Yennora NSW 2161, Australia
Phone (+61) 1800 807 203 | coregas.com.au

9 Appendix 2. Sampling locations

GO 1A, 2A, 3B, 4B, 5B, 6B

GO 3A, 5A, 6A

Ektimo

ektimo.com.au
1300 364 005

MELBOURNE (Head Office)
26 Redland Drive
Mitcham
VIC 3132
AUSTRALIA

SYDNEY
6/78 Reserve Road,
Artarmon
NSW 2064
AUSTRALIA

WOLLONGONG
1/251 Princes Highway
Unanderra
NSW 2526
AUSTRALIA

PERTH
52 Cooper Road
Cockburn Central
WA 6164
AUSTRALIA

BRISBANE
3/109 Riverside Place
Morningside
QLD 4170
AUSTRALIA