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**Stack Emissions Testing Report Commissioned by**  
Gwynedd Council

**Installation Name & Address**  
Gwynedd Council  
Ffidd Rasmus Landfill Site  
Harlech  
LL46 2UW

PPC Permit: GP333OBY, Variation Notice: QP3134LY

**Stack Reference**  
Flare Stack

**Dates of the Monitoring Campaign**  
24th March 2016

**Job Reference Number**  
CAT-2599

<b>Report Written by</b>
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<b>Report Approved by</b>
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<b>Report Date</b>
20th April 2016

<b>Version</b>
Version 1

<b>Signature of Report Approver</b>

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## Executive Summary

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### MONITORING OBJECTIVES

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack  
24th March 2016

#### Overall Aim of the Monitoring Campaign

Exova Catalyst were commissioned by Gwynedd Council to carry out stack emissions testing on the Flare Stack at Ffidd Rasmus Landfill Site.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

#### Special Requirements

There were no special requirements.

#### Target Parameters

Total VOCs (as Carbon), Oxides of Nitrogen (as NO<sub>2</sub>), Carbon Monoxide

## Executive Summary

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### MONITORING RESULTS

Gwynedd Council, Ffidd Rasmus Landfill Site

Flare Stack

24th March 2016

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration			
	Units	Result	MU * +/-	Limit **
Total VOCs (as Carbon)	<sup>1</sup> mg/m <sup>3</sup>	0.55	0.22	10
Oxides of Nitrogen (as NO <sub>2</sub> )	<sup>1</sup> mg/m <sup>3</sup>	130	38.9	150
Carbon Monoxide	<sup>1</sup> mg/m <sup>3</sup>	0.46	0.09	50
Oxygen	% v/v	<b>Dry</b> 9.00	0.36	
Water Vapour	% v/v	11.9	0.60	

<sup>1</sup> Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 3% oxygen.

\* The MU is calculated from values in LFTGN 05 [2010]. i.e. 20% of the Result for CO, 30% of the Result for NO<sub>x</sub> & 40% of the Result for TVOCs)

\*\* The result is considered to be an 'Approach to Limit' if it is above the Limit, but below the Limit once the MU is subtracted from it. The Result is considered to be Non-Compliant if, even after subtracting the MU from the Result, the Result is still above the Limit in LFTGN 05 [2010] or the calculated MU (See the Measurement Uncertainty Calculations in Appendix 2 of this Test Report) is above 6% for CO, 10% for NO<sub>x</sub> & 15% for TVOCs

## Executive Summary

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### MONITORING DATE(S) & TIMES

Gwynedd Council, Ffidd Rasmus Landfill Site

Flare Stack

24th March 2016

Parameter	Units	Concentration		Sampling Date(s)	Sampling Times	Duration mins
Total VOCs (as Carbon)	R1 mg/m <sup>3</sup>	0.55		24/03/2016	11:20 - 12:20	60
Oxides of Nitrogen (as NO <sub>2</sub> )	R1 mg/m <sup>3</sup>	130		24/03/2016	11:20 - 12:20	60
Carbon Monoxide	R1 mg/m <sup>3</sup>	0.46		24/03/2016	11:20 - 12:20	60
Oxygen	R1 % v/v	8.99		24/03/2016	11:20 - 12:20	60
Water Vapour	R1 % v/v	11.9		24/03/2016	11:20 - 11:50	60

All results are expressed at the respective reference conditions.

## Executive Summary

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### PROCESS DETAILS

Gwynedd Council, Ffidd Rasmus Landfill Site

Flare Stack

24th March 2016

#### Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	~ 100 m <sup>3</sup> /hr
Continuous or Batch Process	Continuous
Feedstock (if applicable)	N/A
Abatement System	N/A
Abatement System Running Status	N/A
Fuel	Landfill Gas
Plume Appearance	Heat Haze Visible

## Executive Summary

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### MONITORING & ANALYTICAL METHODS

Gwynedd Council, Ffidd Rasmus Landfill Site

Flare Stack

24th March 2016

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	ISO 17025 Testing	Testing Lab	Analytical Procedure	Analytical Technique	ISO 17025 Analysis	Analysis Lab		
Water Vapour	EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.32 mg/m <sup>3</sup>
Oxides of Nitrogen (as NO <sub>2</sub> )	EN 14792	CAT-TP-21	Yes	CAT	Chemiluminescence by Horiba PG-250				Yes	0.41 mg/m <sup>3</sup>
Carbon Monoxide	EN 15058	CAT-TP-21	Yes	CAT	NDIR by Horiba PG-250				Yes	0.30 mg/m <sup>3</sup>
Oxygen	EN 14789	CAT-TP-21	Yes	CAT	Dry Zirconia Cell by Horiba PG-250				Yes	0.20 % v/v

### ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Exova Catalyst (CAT)	ISO 17025 Accreditation Number: 4279
Scientific Analysis Laboratories Ltd (SAL)	ISO 17025 Accreditation Number: 1549

### SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	There are no deviations associated with the sampling employed.

## Executive Summary

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### SUITABILITY OF SAMPLING LOCATION

#### Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	1.18
Width	m	-
Area	m <sup>2</sup>	1.09
Port Depth	cm	31
Orientation of Duct	-	Vertical
Sample Port Size	-	5" BSP

#### Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Temporary
Inside / Outside	Outside

#### Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
Platform has vertical base boards (approx. 0.25m high)	Yes
Platform has chains / self closing gates at top of ladders	Yes
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

#### Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and EN 15259, and therefore there are no improvement recommendations.

#### EN 15259 Homogeneity Test Requirements

There is no requirement to perform a EN 15259 Homogeneity Test on this Stack.

# Executive Summary

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## PLANT PHOTOS

Photo 1



Photo 2



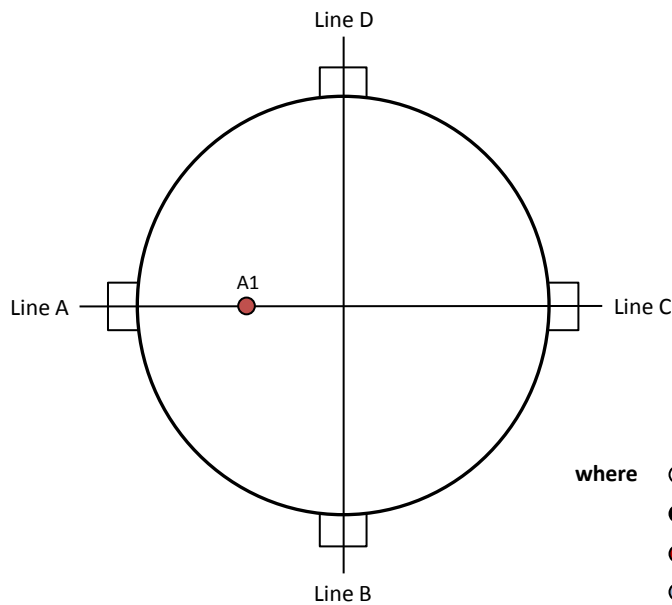
Photo 3



Photo 4



## SAMPLE POINTS



**where**

- = isokinetic point sampled at
- = isokinetic point not sampled at
- (red) = combustion gases sample point
- (blue) = non-isokinetic sample point

APPENDICES

**APPENDIX CONTENTS**

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

### STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Ian Baggley	MCERTS Level 2	MM 05 653	TE1 TE2 TE3 TE4
Trainee	Joe Cartmell	MCERTS Trainee	MM 15 1355	None

### LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM (1)	-	Horiba PG-250	CAT 9.7	Digital Manometer (1)	CAT 3.125
Control Box DGM (2)	-	Horiba PG-350E	-	Digital Manometer (2)	-
Box Thermocouples (1)	-	Servomex 4900	-	Digital Temperature Meter	CAT 3.125
Box Thermocouples (2)	-	Eco Physics CLD 822Mh	-	Stopwatch	CAT 14.92
Umbilical (1)	-	ABB AO2020-URAS26	-	Barometer	CAT 13.29
Umbilical (2)	-	Servomex 5200MP	-	Stack Thermocouple (1)	-
Oven Box (1)	-	JCT JCC P1 Cooler	CAT 4.0207	Stack Thermocouple (2)	-
Oven Box (2)	-	Gasmet DX4000	-	Stack Thermocouple (3)	-
Heated Probe (1)	-	Gasmet Sampling System	-	1m Heated Line (1)	-
Heated Probe (2)	-	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
Heated Probe (3)	-	M&C PSS	CAT 12.91	1m Heated Line (3)	-
S-Pitot (1)	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 201.9
S-Pitot (2)	-	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	CAT 20.89
L-Pitot	-	Mass View (1)	CAT 25.1	20m Heated Line (1)	-
500g Check Weight	CAT 17.2	Mass View (2)	CAT 25.2	20m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Easylogger EN-EL-12 Bit	CAT 11.52	Dual Channel Heater Controller	CAT 3.18
Last Impinger Arm	CAT 4.65	Hioki 5043 (V)	-	Single Channel Heater Controller	-
Callipers	CAT 23.7	Bioaerosols Temperature Logger	-	Laboratory Balance	CAT 1.18 / 1.18a
Tubes Kit Thermocouple	CAT 4.442	Electronic Refrigerator	-	Tape Measure	CAT 16.27

### METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Water Vapour	EN 14790	CAT-TP-05
Total VOCs (as Carbon)	EN 12619:2013	CAT-TP-20
Oxides of Nitrogen (as NO <sub>2</sub> )	EN 14792	CAT-TP-21
Carbon Monoxide	EN 15058	CAT-TP-21
Oxygen	EN 14789	CAT-TP-21

## WATER VAPOUR: RESULTS SUMMARY

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack

### Sample Runs

Parameter	Units	Run 1	Mean
Concentration	% v/v	11.9	11.9
Uncertainty	±% v/v	0.60	0.60

### General Sampling Information

Parameter	Value
Standard	EN 14790
Technical Procedure	CAT-TP-05

## WATER VAPOUR: SAMPLING DETAILS

### Sample Runs

Parameter	Units	Run 1
Sampling Times	-	11:20 - 11:50
Sampling Dates	-	24/03/2016
Sampling Device	-	MFC / MV
Duration	mins	60
Volume Sampled (STP, Dry)	m <sup>3</sup>	0.0984
Volume Sampled (STP, Wet)	m <sup>3</sup>	0.1118
Sample Flow Rate	l/min	1.60
Liquid Trap Start Mass	g	4081.1
Liquid Trap End Mass	g	4090.2
Silica Trap Start Mass	g	1506.3
Silica Trap End Mass	g	1507.9
Total Mass Of Water Vapour	g	10.7
Calculated Water Vapour	% v/v	11.93

**Where:** MFC stands for Mass Flow Controller, MV stands for Mass View Flowmeter

## WATER VAPOUR: QUALITY ASSURANCE

### Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	1.60	
Pre-Sampling Leak Rate	l/min	0.05	
Post-Sampling Leak Rate	l/min	0.03	
Allowable Leak Rate	l/min	0.03	
Leak Test Acceptable	-	Yes	

Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	

Measurement Uncertainty	Units	Run 1	
Measurement Uncertainty (MU)	%	5.1	
Allowable MU	%	20	
MU Acceptable	%	Yes	

Silica Gel	Units	Run 1	
Less than 50% Faded	%	Yes	

Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

### Method Deviations

Nature of Deviation	Run Number	
	(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x	

**WATER VAPOUR: MEASUREMENT UNCERTAINTY CALCULATIONS**

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (STP)	V <sub>m</sub>	0.10		uV <sub>m</sub>	m <sup>3</sup>	0.002	
Repeatability of Weighing	R <sub>w</sub>	10.7		uR <sub>w</sub>	g	0.12	
Reading of Balance	R <sub>b</sub>	10.7		uR <sub>b</sub>	g	0.05	
Leak	L	1.88			%	-	

Measured Quantities	Uncertainty as a Percentage			Requirement of Standard
	Units	Run 1		
Sampled Volume (STP)	%	2.00		≤2%
Repeatability of Weighing	%	1.12		No Requirement
Reading of Balance	%	0.50		No Requirement
Leak	%	1.88		≤2%

Measured Quantities	Uncertainty in Measurement Units				Sensitivity Coefficient	
	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V <sub>m</sub>	m <sup>3</sup>	0.10		121	
Repeatability of Weighing	R <sub>w</sub>	g	10.7		1.11	
Reading of Balance	R <sub>b</sub>	g	10.7		1.11	
Leak	L	% v/v	0.13		1.00	

Measured Quantities	Uncertainty in Result		
	Units	Run 1	
Sampled Volume (STP)	% v/v	0.24	
Repeatability of Weighing	% v/v	0.13	
Reading of Balance	% v/v	0.06	
Leak	% v/v	0.13	

Parameter	Units	Run 1	
Combined uncertainty	% v/v	0.31	
Expanded uncertainty (95% confidence)	% v/v	0.60	
Expanded uncertainty (95% confidence), estimated with Method Deviations	% v/v	0.60	
Uncertainty if Water Droplets are present	% v/v	N/A	
Reported Uncertainty	% v/v	0.60	
Expanded uncertainty (95% confidence)	%	5.1	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	5.1	
Uncertainty if Water Droplets are present	%	N/A	
Reported Uncertainty	%	5.1	

## TOTAL VOCs (as CARBON): RESULTS SUMMARY

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack

### Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m <sup>3</sup>	0.55	0.55
Uncertainty	±mg/m <sup>3</sup>	0.84	0.84
Mass Emission	g/hr		
Uncertainty	±g/hr		

### General Sampling Information

Parameter	Value
Standard	EN 12619:2013
Technical Procedure	CAT-TP-20
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Propane in 8% O <sub>2</sub> in N <sub>2</sub> (5 Grade)
Span Gas Reference Number	CYL 1.0175 in N <sub>2</sub>   CYL 1.0205 in AIR
Span Gas Expiry Date	15/07/2020   10/01/2021
Span Gas Start Pressure (bar)	100   80
Gas Cylinder Concentration (ppm)	77.26   80.3
Span Gas Set Point (ppm)	78.42
Span Gas Uncertainty (%)	2   2
Zero Gas Type	8% O <sub>2</sub> in N <sub>2</sub> (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B2

This is the blended concentration of both propane cylinders

FORMAT: Number Used / Number Required

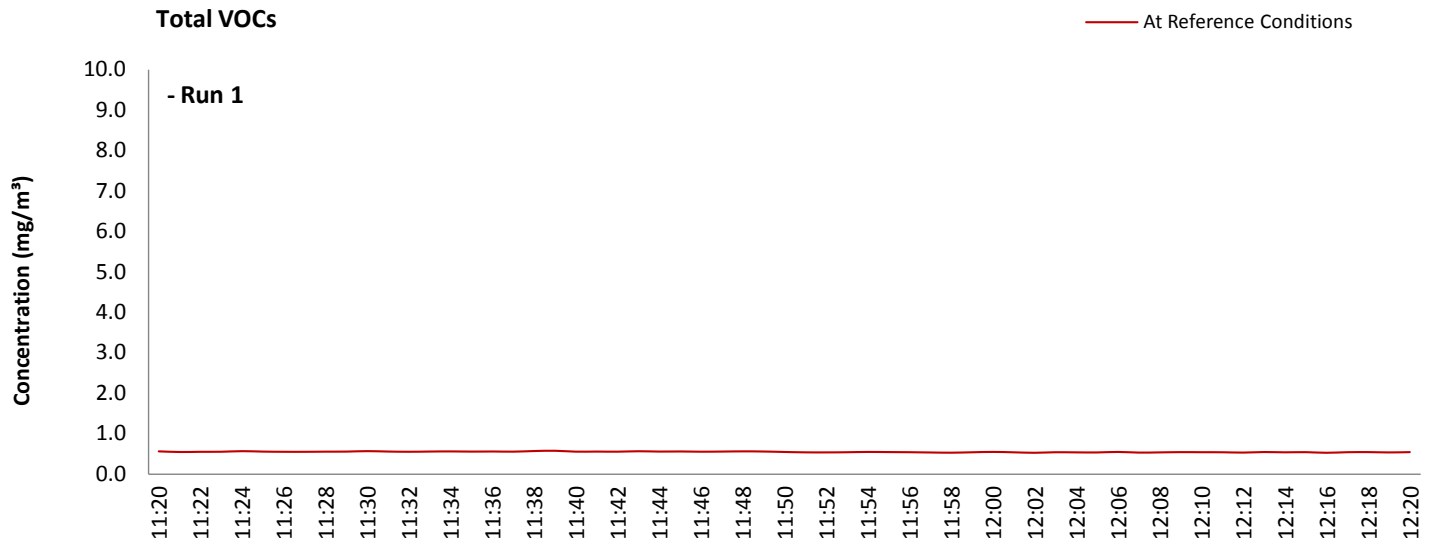
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 3% oxygen.

### TOTAL VOCs (as CARBON): DATA TREND

Graphical Trend of Data



**TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE**

**Sampling Details**

Parameter	Units	Run 1	
Sampling Times	-	11:20 - 12:20	
Sampling Dates	-	24/03/2016	
Instrument Range	ppm	100	
Span Gas Value	ppm	78.4	

**Quality Assurance**

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.10	
	Zero Drift	ppm	-0.20	
	Allowable Zero Drift	± ppm	3.92	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	77.6	
	Span Down Sampling Line (Post)	ppm	74.3	
	Span Drift	ppm	-3.30	
	Allowable Span Drift	± ppm	3.92	
	Span Drift Acceptable	-	Yes	

	Test Conditions	Units	Run 1	
	Run Ambient Temperature Range	°C	9 - 10	

**Method Deviations**

Nature of Deviation	Run Number	
	(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x	

**TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS**

Performance characteristics	RUN 1	Units
Limit value	10.0	mg/m <sup>3</sup> (REF)
TGN M2 Allowable MU	15.0	%
Measured concentration	0.36	mg/m <sup>3</sup> (STP, dry)
Range Used	100.0	ppm
Range Used [A]	160.6	mg/m <sup>3</sup>
Cal gas conc.	78.4	ppm
Conversion	1.61	ppm to mg/m <sup>3</sup>
MCERTS Range [B]	15.0	mg/m <sup>3</sup>
Lower of [A] or [B]	15.0	mg/m <sup>3</sup>
Cal gas conc.	126.0	mg/m <sup>3</sup>

Performance characteristics	RUN 1	Units
Response time	45	seconds
Number of readings in measurement	60	-
Repeatability at zero	2.00	% full scale
Repeatability at span level	0.00	% full scale
Deviation from linearity	0.09	% of value
Zero drift	-0.26	% full scale
Span drift	0.00	% full scale
Volume or pressure flow dependence	1.60	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	1.40	% full scale/10K
Combined interference	0.45	% range
Dependence on voltage	0.50	% full scale/10V
Losses in the line (leak)	1.07	% of value
Uncertainty of calibration gas	2.83	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m <sup>3</sup>
Standard deviation of repeatability at span level	0.00	mg/m <sup>3</sup>
Lack of fit	0.01	mg/m <sup>3</sup>
Drift	-0.19	mg/m <sup>3</sup>
Volume or pressure flow dependence	0.00	mg/m <sup>3</sup>
Atmospheric pressure dependence	0.01	mg/m <sup>3</sup>
Ambient temperature dependence	0.20	mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.04	mg/m <sup>3</sup>
Dependence on voltage	0.06	mg/m <sup>3</sup>
Losses in the line (leak)	0.00	mg/m <sup>3</sup>
Uncertainty of calibration gas	0.01	mg/m <sup>3</sup>

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		0.36	mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	0.29	mg/m <sup>3</sup>
Expanded uncertainty		0.56	mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		0.84	mg/m <sup>3</sup> (REF)

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	154.35	% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	5.63	% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	15.0	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	N/A	-

	RUN 1	Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	154.40	% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	9.34	% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	15.5	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>COMPLIANT</b>	-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 15% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

## OXIDES OF NITROGEN (as NO<sub>2</sub>): RESULTS SUMMARY

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack

### Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m <sup>3</sup>	130	130
Uncertainty	±mg/m <sup>3</sup>	9.1	9.1
Mass Emission	g/hr		
Uncertainty	±g/hr		

### General Sampling Information

Parameter	Value
Standard	EN 14792
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Date & Result of Last Converter Check	14/07/2015 - 96.8%
Span Gas Type	Nitrogen Monoxide
Span Gas Reference Number	CYL 4.0155
Span Gas Expiry Date	15/07/2019
Span Gas Start Pressure (bar)	110
Gas Cylinder Concentration (ppm)	404.89
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B2

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

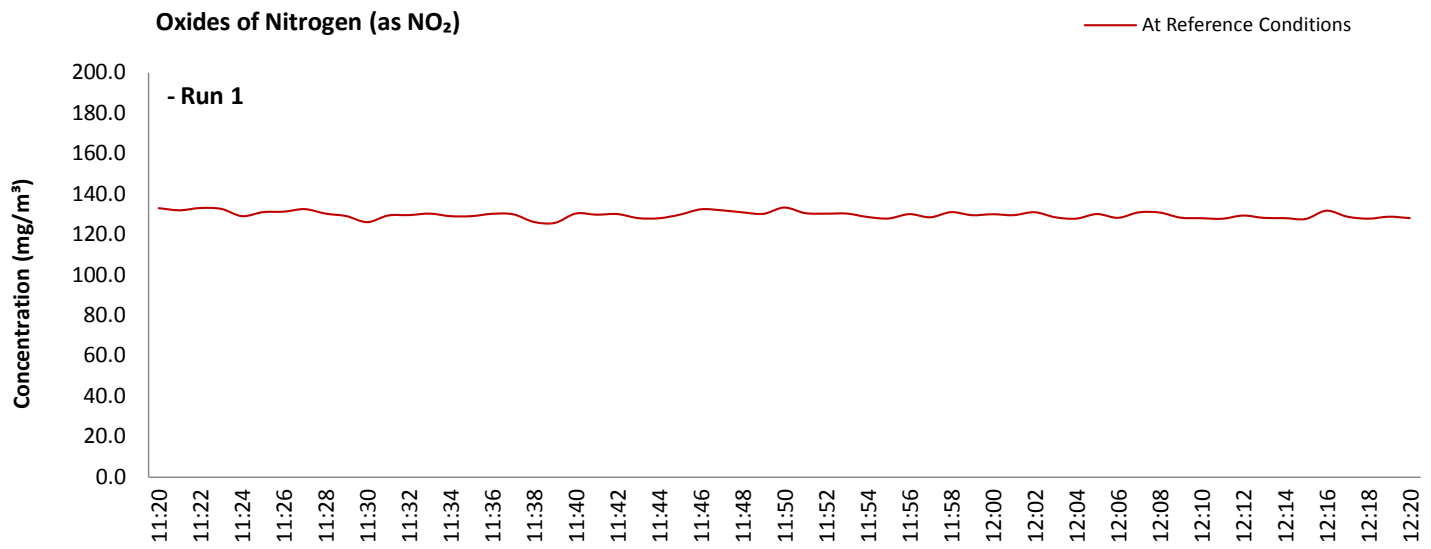
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 3% oxygen.

### OXIDES OF NITROGEN (as NO<sub>2</sub>): DATA TREND

Graphical Trend of Data



**OXIDES OF NITROGEN (as NO<sub>2</sub>): SAMPLING DETAILS & QUALITY ASSURANCE**

**Sampling Details**

Parameter	Units	Run 1	
Sampling Times	-	11:20 - 12:20	
Sampling Dates	-	24/03/2016	
Instrument Range	ppm	250	
Span Gas Value	ppm	73.1	

**Quality Assurance**

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.0	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.40	
	Zero Down Sampling Line (Post)	ppm	0.40	
	Zero Drift	ppm	0.00	
	Allowable Zero Drift	± ppm	3.65	
	Zero Drift Acceptable	-	Yes	

Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	ppm	70.1	
	Span Down Sampling Line (Post)	ppm	69.1	
	Span Drift	ppm	-1.00	
	Allowable Span Drift	± ppm	3.65	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	9 - 10	

**Method Deviations**

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

**OXIDES OF NITROGEN (as NO<sub>2</sub>): MEASUREMENT UNCERTAINTY CALCULATIONS**

Performance characteristics	RUN 1	Units
Limit value	150.0	mg/m <sup>3</sup> (REF)
TGN M2 Allowable MU	10.0	%
Measured concentration	86.53	mg/m <sup>3</sup> (STP, dry)
Ration NO / NO <sub>2</sub>	5	%
Range Used	250.0	ppm
Range Used [A]	513.1	mg/m <sup>3</sup>
Cal gas conc.	73.1	ppm
Conversion	2.05	ppm to mg/m <sup>3</sup>
MCERTS Range [B]	125.0	mg/m <sup>3</sup>
Lower of [A] or [B]	125.0	mg/m <sup>3</sup>
Cal gas conc.	150.0	mg/m <sup>3</sup>

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.40	% full scale
Repeatability at span level	0.40	% full scale
Deviation from linearity	0.53	% of value
Zero drift	0.00	% full scale
Span drift	-1.43	% full scale
Volume or pressure flow dependence	0.40	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	0.18	% full scale/10K
Combined interference	0.60	% range
Dependence on voltage	0.40	% full scale/10V
Converter efficiency	96.8	%
Losses in the line (leak)	3.97	% of value
Uncertainty of calibration gas blending	1.40	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m <sup>3</sup>
Standard deviation of repeatability at span level	0.05	mg/m <sup>3</sup>
Lack of fit	0.38	mg/m <sup>3</sup>
Drift	-0.71	mg/m <sup>3</sup>
Volume or pressure flow dependence	0.00	mg/m <sup>3</sup>
Atmospheric pressure dependence	0.11	mg/m <sup>3</sup>
Ambient temperature dependence	0.03	mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.43	mg/m <sup>3</sup>
Dependence on voltage	0.05	mg/m <sup>3</sup>
Converter efficiency	0.08	mg/m <sup>3</sup>
Losses in the line (leak)	1.98	mg/m <sup>3</sup>
Uncertainty of calibration gas blending	0.70	mg/m <sup>3</sup>
Uncertainty of calibration gas	1.00	mg/m <sup>3</sup>

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		86.53	mg/m <sup>3</sup>
Expanded uncertainty		2.54	mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	4.99	mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		7.47	mg/m <sup>3</sup> (REF)

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	5.76	% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	3.32	% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	10.0	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>N/A</b>	-

	RUN 1	Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	7.01	% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	6.38	% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	10.8	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>COMPLIANT</b>	-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 10% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

## CARBON MONOXIDE: RESULTS SUMMARY

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack

### Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m <sup>3</sup>	0.46	0.46
Uncertainty	±mg/m <sup>3</sup>	1.9	1.9
Mass Emission	g/hr		
Uncertainty	±g/hr		

### General Sampling Information

Parameter	Value
Standard	EN 15058
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Carbon Monoxide
Span Gas Reference Number	CYL 2.0080
Span Gas Expiry Date	16/10/2018
Span Gas Start Pressure (bar)	100
Gas Cylinder Concentration (ppm)	4014.48
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B2

NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

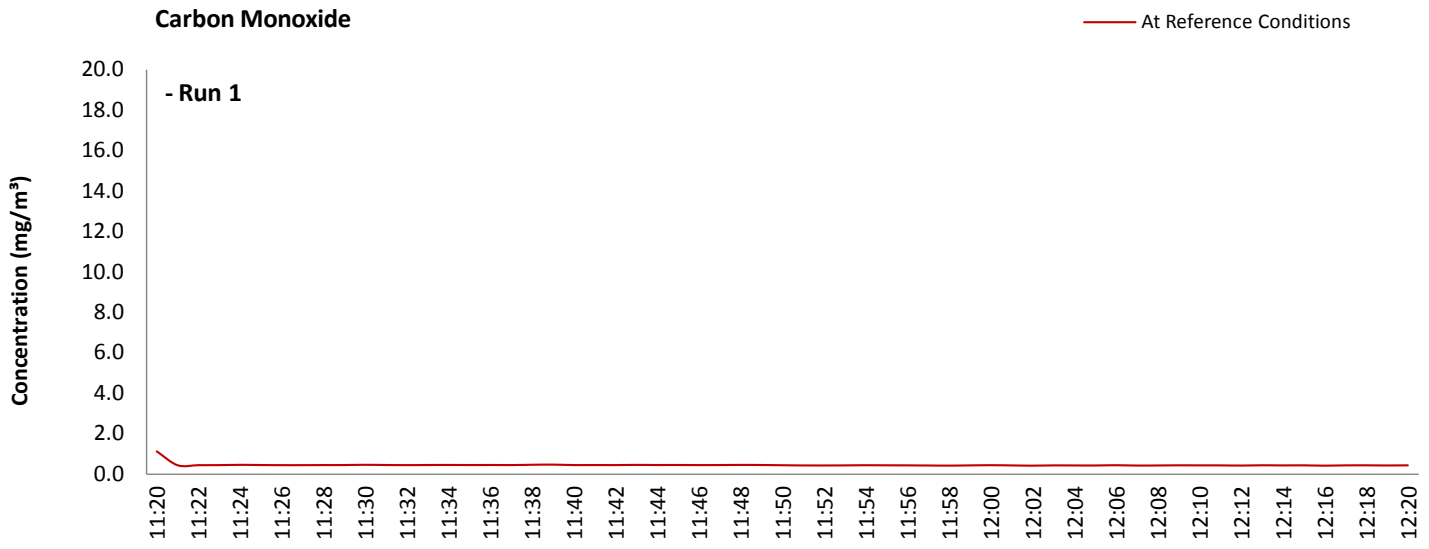
FORMAT: Number Used / Number Required

### Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 3% oxygen.

### CARBON MONOXIDE: DATA TREND

Graphical Trend of Data



**CARBON MONOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE**

**Sampling Details**

Parameter	Units	Run 1	
Sampling Times	-	11:20 - 12:20	
Sampling Dates	-	24/03/2016	
Instrument Range	ppm	200	
Span Gas Value	ppm	40.0	

**Quality Assurance**

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.0	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1		
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.60	
	Zero Down Sampling Line (Post)	ppm	1.60	
	Zero Drift	ppm	1.00	
	Allowable Zero Drift	± ppm	2.00	
	Zero Drift Acceptable	-	Yes	

Span Drift	Units	Run 1		
CAL 1	Span Down Sampling Line (Pre)	ppm	40.7	
	Span Down Sampling Line (Post)	ppm	41.4	
	Span Drift	ppm	0.70	
	Allowable Span Drift	± ppm	2.00	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	9 - 10	

**Method Deviations**

Nature of Deviation	Run Number	
	(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x	

**CARBON MONOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS**

Performance characteristics	RUN 1	Units
Limit value	50.0	mg/m <sup>3</sup> (REF)
TGN M2 Allowable MU	6.0	%
Measured concentration	0.31	mg/m <sup>3</sup> (STP, dry)
Range Used	200.0	ppm
Range Used [A]	249.8	mg/m <sup>3</sup>
Cal gas conc.	40.0	ppm
Conversion	1.25	ppm to mg/m <sup>3</sup>
MCERTS Range [B]	95.0	mg/m <sup>3</sup>
Lower of [A] or [B]	95.0	mg/m <sup>3</sup>
Cal gas conc.	50.0	mg/m <sup>3</sup>

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.40	% full scale
Repeatability at span level	0.40	% full scale
Deviation from linearity	0.59	% of value
Zero drift	0.00	% full scale
Span drift	1.72	% full scale
Volume or pressure flow dependence	0.40	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	0.05	% full scale/10K
Combined interference	0.73	% range
Dependence on voltage	0.40	% full scale/10V
Losses in the line (leak)	0.00	% of value
Uncertainty of calibration gas blending	1.40	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	mg/m <sup>3</sup>
Standard deviation of repeatability at span level	0.05	mg/m <sup>3</sup>
Lack of fit	0.32	mg/m <sup>3</sup>
Drift	0.00	mg/m <sup>3</sup>
Volume or pressure flow dependence	0.00	mg/m <sup>3</sup>
Atmospheric pressure dependence	0.08	mg/m <sup>3</sup>
Ambient temperature dependence	0.01	mg/m <sup>3</sup>
Combined interference (from MCERTS Certificate)	0.40	mg/m <sup>3</sup>
Dependence on voltage	0.05	mg/m <sup>3</sup>
Losses in the line (leak)	0.00	mg/m <sup>3</sup>
Uncertainty of calibration gas blending	0.00	mg/m <sup>3</sup>
Uncertainty of calibration gas	0.00	mg/m <sup>3</sup>

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		0.31	mg/m <sup>3</sup>
Expanded uncertainty	k = 1.96	0.66	mg/m <sup>3</sup>
Expanded uncertainty		1.29	mg/m <sup>3</sup>
Uncertainty corrected to std conds. (O <sub>2</sub> )		1.93	mg/m <sup>3</sup> (REF)

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	419.76	% of Value
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	2.58	% at ELV
Overall Allowable uncertainty (no O <sub>2</sub> ) - at 95% Confidence	6.0	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>N/A</b>	-

	RUN 1	Units
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	419.78	% of Value
Expanded uncertainty (with O <sub>2</sub> ) - at 95% Confidence	5.55	% at ELV
Overall Allowable uncertainty (with O <sub>2</sub> ) - at 95% Confidence	7.2	% at ELV
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>COMPLIANT</b>	-

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O<sub>2</sub> correction is applied less than 6% + the uncertainty associated with the O<sub>2</sub> correction (using sqrt of sum squares to add uncertainty components). Ref EA TGN M2.

**OXYGEN: RESULTS SUMMARY**

Gwynedd Council, Ffidd Rasmus Landfill Site  
Flare Stack

**Sample Runs**

Parameter	Units	Run 1	Mean
Concentration	% v/v	8.99	8.99
Uncertainty	±% v/v	0.36	0.36

**General Sampling Information**

Parameter	Value
Standard	EN 14789
Technical Procedure	CAT-TP-21
Probe Material	Stainless Steel
Filtration Type / Size	0.1µm Glass Fibre
Heated Head Filter Used	Yes
Heated Line Temperature	180°C
Span Gas Type	Synthetic Air (5 Grade)
Span Gas Reference Number	CYL 11.0244
Span Gas Expiry Date	22/02/2021
Span Gas Start Pressure (bar)	120
Gas Cylinder Concentration (% v/v)	20.97
Span Gas Uncertainty (%)	2
Zero Gas Type	Nitrogen (5 Grade)
Number of Sampling Lines Used	1 / 1
Number of Sampling Points Used	1 / 1
Sample Point I.D.'s	B2

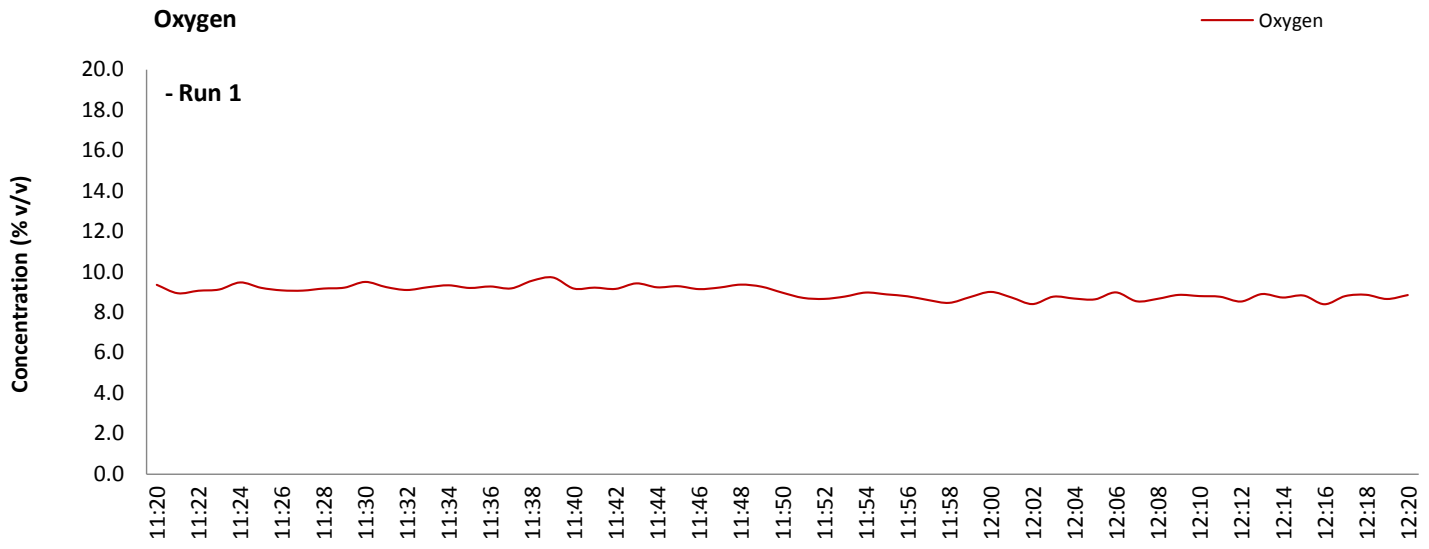
NOTE: Dilution performed to achieve correct span value

FORMAT: Number Used / Number Required

FORMAT: Number Used / Number Required

### OXYGEN: DATA TREND

Graphical Trend of Data



**OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE**

**Sampling Details**

Parameter	Units	Run 1	
Sampling Times	-	11:20 - 12:20	
Sampling Dates	-	24/03/2016	
Instrument Range	% v/v	25.0	
Span Gas Value	% v/v	10.0	

**Quality Assurance**

Conditioning Unit Temperature	Units	Run 1	
Average Temperature	°C	3.0	
Allowable Temperature	< °C	4.0	
Temperature Acceptable	-	Yes	

Zero Drift	Units	Run 1	
Zero Down Sampling Line (Pre)	% v/v	0.24	
Zero Down Sampling Line (Post)	% v/v	0.25	
Zero Drift	% v/v	0.01	
Allowable Zero Drift	± % v/v	0.50	
Zero Drift Acceptable	-	Yes	

CAL 1

Span Drift	Units	Run 1	
Span Down Sampling Line (Pre)	% v/v	10.05	
Span Down Sampling Line (Post)	% v/v	10.21	
Span Drift	% v/v	0.16	
Allowable Span Drift	± % v/v	0.50	
Span Drift Acceptable	-	Yes	

CAL 1

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	9 - 10	

**Method Deviations**

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1
There are no deviations associated with the sampling employed.	x

**OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS**

Performance characteristics	RUN 1	Units
Limit value	N/A	%vol
TGN M2 Allowable MU	6.0	%
Measured concentration	8.99	%vol
Range Used	25.0	%vol
Cal gas conc.	21.0	%vol

Performance characteristics	RUN 1	Units
Response time	60	seconds
Number of readings in measurement	60	-
Repeatability at zero	0.04	% full scale
Repeatability at span level	0.04	% full scale
Deviation from linearity	0.05	% of value
Zero drift	0.10	% full scale
Span drift	1.59	% full scale
Volume or pressure flow dependence	0.20	% of full scale
Atmospheric pressure dependence	0.30	% of value/kPa
Ambient temperature dependence	-0.07	% full scale/10K
Combined interference	0.56	% range
Dependence on voltage	0.02	% full scale/10V
Losses in the line (leak)	0.00	% of value
Uncertainty of calibration gas	2.00	% of value

Performance characteristic	RUN 1	Units
Standard deviation of repeatability at zero	use rep at span	%vol
Standard deviation of repeatability at span level	0.01	%vol
Lack of fit	0.01	%vol
Drift	0.09	%vol
Volume or pressure flow dependence	0.00	%vol
Atmospheric pressure dependence	0.02	%vol
Ambient temperature dependence	-0.01	%vol
Combined interference (from MCERTS Certificate)	0.08	%vol
Dependence on voltage	0.00	%vol
Losses in the line (leak)	0.00	%vol
Uncertainty of calibration gas	0.10	%vol

Measurement uncertainty	Result	RUN 1	Units
Combined uncertainty		8.99	%vol
Expanded uncertainty	k = 1.96	0.18	%vol
		0.36	%vol

	RUN 1	Units
Expanded uncertainty (no O <sub>2</sub> ) - at 95% Confidence	3.99	% of Value
<b>Result of Compliance with Uncertainty Requirement in M2</b>	<b>COMPLIANT</b>	-

Requirement for SRM is that Uncertainty should be 0.5%vol absolute or 6% relative whichever is the lower, on a dry gas basis. Ref EA TGN M2.