

# Report for the Periodic Monitoring of Emissions to Atmosphere

Stack Emissions Test Report Commissioned by: Environmental Monitoring Solutions Ltd

## Bakkavör Group Plc

### Oven Extraction Flue

Permit No: N/A  
Installation: Spalding  
Monitoring Dates: 5th May 2021  
Site Address: West Marsh Road, Spalding, Lincolnshire, PE11 2BB

Report Number: ES-0434                      Version: 1                      Visit: 1 in 2021  
Date of Report: 7th June 2021  
Report Author: Thomas Arden  
MCERTS No: MM 18 1478                      MCERTS Level: 2 (TE1, TE3, TE4)

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# Executive Summary

## Monitoring Objectives

Envirocare Technical Consultancy were contracted by Bakkavör Group Plc to carry out emissions monitoring, to investigate the emissions to atmosphere of Oven Extraction Flue. The methodologies utilised and the results obtained form the basis of this report.

The substances requested for monitoring are listed below.

## Emission Point Identification

Substances to be Monitored	Oven Extraction Flue
Total Particulate Matter	✓
Carbon Monoxide	✓
Oxides of Nitrogen (as NO <sub>2</sub> )	✓
Total VOC	✓
Oxygen	✓
Volumetric Flow	✓
VOC Screen	✓
Sulphur Dioxide	✓

Special requirements: none.

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancy's MCERTS and UKAS accreditation. Envirocare accepts no responsibility for information in this report that was provided by the client, the client's representative or employees of the client. Where such information has been provided by external sources this is identified in footnotes of the respective tables.

# Executive Summary

## Monitoring Results

where MU = Measurement Uncertainty associated with the result (95% Confidence)

Substance	Limit (mg/m <sup>3</sup> )	Concentration			Mass Emission			Sampling Date	Sampling Times	
		Result (mg/m <sup>3</sup> )	Measurement Uncertainty (MU) +/-	Reference Conditions	Limit (g/hr)	Result (g/hr)	Measurement Uncertainty (MU) +/-			
Total Particulate Matter	R1	-	2.7	0.18	273K, 101.3kPa, DRY	-	2.0	0.17	05/05/2021	17:05-18:05
Carbon Monoxide	R1	-	0.18	8.3	273K, 101.3kPa, DRY	-	0.13	6.0	05/05/2021	17:04-18:04
Oxides of Nitrogen (as NO <sub>2</sub> )	R1	-	0.23	3.3	273K, 101.3kPa, DRY	-	0.16	2.4	05/05/2021	17:04-18:04
Total VOC	R1	-	3.7	1.1	273K, 101.3kPa, DRY	-	2.7	0.83	05/05/2021	17:04-18:04
Oxygen	R1	-	20.8%	0.28	273K, 101.3kPa, DRY	-	-	-	05/05/2021	17:04-18:04
Volumetric Flow	R1	-	728 m <sup>3</sup> /h	42.6	273K, 101.3kPa, DRY	-	-	-	05/05/2021	16:55-16:58
VOC Screen	R1	-	<0.94	-	273K, 101.3kPa, DRY	-	0.71	-	05/05/2021	17:05-17:35
Sulphur Dioxide	R1	-	0.03	0.01	273K, 101.3kPa, DRY	-	0.02	0.003	05/05/2021	17:05-18:05

## Operating Information

### Oven Extraction Flue

Date	Process Type	Fuel	Feedstock	Abatement	Load	Operating Status
05/05/2021	Continuous - Extraction from the cooking process	Natural gas	Food production	None	-	Normal

\*information provided by Site

## Monitoring Deviations

### Oven Extraction Flue

Substance Deviations	Monitoring Deviations	Other Relevant Issues
None	None	None

# Supporting Information

## Appendix 1: General Information

### Monitoring Organisation Staff Details

Personnel	Position	MCERTS Level	MCERTS Number
Mr T Arden	Team Leader	2 (TE1, TE3, TE4)	MM 18 1478
Mr J Perrin	Technician	Trainee	MM 19 1572

### Monitoring Methods

Pollutant Species	Standard	Technical Procedure	Testing MCERTS	Analysis Laboratory	Analytical Procedure	Analytical Technique	Analysis MCERTS
Volumetric Flow	BS EN ISO 16911-1	ETC-SE-24a	Yes	Pitot Tube and Thermocouple			
Total Particulate Matter	BS EN 13284-1	ETC-SE-01	Yes	ENV	ETC-AP-01	Gravimetric	Yes
Sulphur Dioxide	BS EN 14791	ETC-SE-14	Yes	RPS	C27(U)	IC	Yes
Carbon Monoxide	BS EN 15058	ETC-SE-10 (a/b)	Yes	NDIR by Horiba PG-250 or PG350E			
Oxides of Nitrogen	BS EN 14792	ETC-SE-10 (a/b)	Yes	Chemiluminescence by Horiba PG-250 or Hiroba PG-350			
Oxygen	BS EN 14789	ETC-SE-10 (a/b)	Yes	Dry Zirconia Cell by Horiba PG-250 or Dry Paramagnetic by Horiba PG-350E			
Total VOC	BS EN 12619	ETC-SE-04	Yes	Flame Ionisation Detector by M&C Thermo FID or Sick 3006 FID			
VOC Screen	PD CEN TS/13649-1	ETC-SE-06 (a/b)	Yes	RPS	M109	GC-MS	No

RPS Laboratories Ltd (RPS) - Accreditation Number: 0605 | Marchwood Scientific Services - Accreditation Number: 1668

### Equipment Checklist

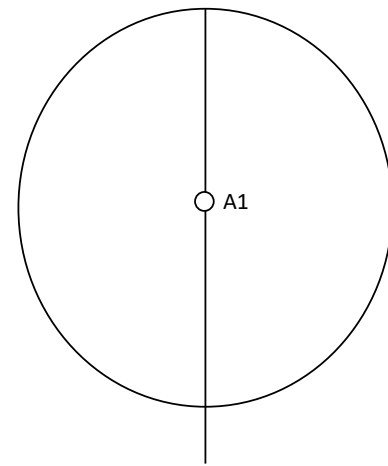
Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	ETC-S8.03/8.05(B)	Horiba PG-250	-	Tape Measure	ETC-S17.02
Box Thermocouples	ETC-S2.03	Horiba PG-250 SRM	ETC-S12.04	Bevel Box	-
Box Thermocouple In	ETC-S3.22	Horiba PG-350	ETC-S12.01	Stopwatch	ETC-S10.03/10.11
Box Thermocouple Out	ETC-S3.25	JCT JCC Cooler	-	Barometer	ETC-S11.04
Control Box Timer	ETC-S10.03	MAK10 Cooler	-	Digital Manometer	ETC-S24.a/b
Umbilical	ETC-SS.3	Horiba PS200 Cooler	-	Digital Temperature Meter	ETC-S24.a/b
Oven Box	ETC-S9.04	M&C PSS Gas Preparation	ETC-S3.42b	Dual Channel Heat Controller	-
Heated Probe (1)	ETC-S4.05	Gasmet DX4000 FTIR	-	1m Heated Line	-
Heated Probe (2)	ETC-S4.06	Gasmet Sampling System	-	3m Heated Line	-
Stack Thermocouple (1)	ETC-S4670	SK-Thermo FID	ETC-S13.07	5m Heated Line	ETC-S5.09
Stack Thermocouple (2)	ETC-S4.05	Bernath 3006 FID	-	10m Heated Line	ETC-S5.05
S-Type Pitot (1)	ETC-S4670	Testo 350XL	-	20m Heated Line	ETC-S5.11
S-Type Pitot (2)	ETC-S10-17-19-1	M&C PSP 4000	ETC-S7.03	30m Heated Line	-
L-Type Pitot	ETC-SL-Type 03	Easylogger EN-EL-12 Bit	-	Impinger Arm Thermocouple (1)	ETC-S3.05
Site Balance	ETC-SETC-S18.03	Hicki 5043 (V)	-	Impinger Arm Thermocouple (2)	ETC-S3.09
500g Check Weight	ETC-S18229	Analyser Temperature Logger	-	Dioxins Kit Thermocouple	-
1KG Check Weight	ETC-S143069	-	-	Sample Temperature Logger	-
Digital Callipers	ETC-S16.01	-	-	Laboratory Balance	-

## Appendix 2: Oven Extraction Flue Results and Calculations

Picture of the sampling location



Sampling Points Diagram



Sampling Line A

### Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.295
Width	m	-
Area	m <sup>2</sup>	0.07
Port Depth	cm	5
Orientation of Stack / Duct	-	Vertical
Sampling Port Size	-	4" BSP
Number of Ports	-	1

Manual Sampling Points	Used / Required
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1
Instrumental Sampling Points	Used / Required
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1

Platform Type and Location	
Platform Type - Permanent / Temporary	Permanent
Location - Inside / Outside	Inside

EA Technical Guidance Note M1 Platform Requirements		
Load Baring Capacity	Load baring capacity of platform sufficient to fulfil the measurement objective	Yes
Position & Work Space	Sufficient work area to manipulate probe & operate the measurement instruments	Yes
	Depth of work area > internal diameter of stack and wall thickness plus 1.5m	Yes
	Ports on vertical ducts 1.2m to 1.5m above platform floor	Yes
	Platform has chains / self closing gates at top of ladders	N/A
Fall Prevention	Platform has adequate drainage to prevent accumulation of free-standing water	Yes
	Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
	Gaps between handrails not >0.5m	Yes
Access	Platform has vertical base boards (approx. 0.25m high)	Yes
	Access to sampling ports unhindered by obstructions	Yes
	Easy & safe access and egress available	Yes

### Sampling Location / Platform Recommendations

The Sampling location meets all the requirements specified in Environment Agency Guidance Note M1 and BS EN 15259, and no improvement actions are required.

## Flow Criteria Measurements

Duct Diameter (m)	Cross Sectional Area (m <sup>2</sup> )	Barometric Pressure (mbar)	Ambient Temperature (°C)	Mean Oxygen (%)	Mean Carbon Dioxide (%)	Mean Water Vapour (%)	Stack Gas Molecular mass (g/mol)	Pitot Coefficient
0.30	0.07	1008	22.0	20.8	0.06	3.2	28.5	0.862

Sample Line	Traverse Point	Position (cm)	Differential Pressure Reading (cmH <sub>2</sub> O)				Stack Velocity (m/s)	Stack Temp (°C)	Angle of Swirl
			1	2	3	Average			
A	A1	14.75	0.10	0.10	0.10	0.10	3.7	60.0	3

Parameter	Mean Duct Velocity	Velocity Ratio (Max:Min)	Mean Stack Temperature	Mean Stack Temperature	Stack Gas Volume Flow	Corrected Stack Gas Volume Flow @ STP WET	-
Value	3.7	1.0:1	60	333	922	752	-
Units	m/s	-	°C	K	m <sup>3</sup> /hr	Nm <sup>3</sup> /hr	Nm <sup>3</sup> /hr

## Total Particulate Matter - Run 1 Calculations

Parameter	Value	Unit
Meter Box Number	ES-8.03	-
Gas Meter Coefficient	1.05	-
Pitot Coefficient	0.862	-
Stack Gas Molecular Weight	28.9	g/mole
Static Pressure in Stack	0.12	cmH <sub>2</sub> O

Parameter	Value	Unit
Nozzle Diameter	7.8	mm
Average Gas Meter Temperature	21.1	°C
Average Stack Temperature	56.6	°C
Average Stack Velocity	3.4	m/s
Isokineticity	106.0	%
Total Sampling Time	60	min
Gas Meter Difference	511	L
Corrected Gas Meter Volume	536	L
Mean Sampling Rate	8.9	L/min

Date	Operators
05/05/2021	TA/JP

Parameter	Before	After	Unit
Barometric Pressure	1008	1008	mbar
Ambient Temperature	22.0	21.0	°C
Leak Check	0.02	-	L/min
Time	17:05	18:05	-

Parameter	Value	Unit
STP Dry Gas Meter Volume	495	NL
Mass of Water Vapour Collected	12.6	g
Volume of Water Vapour Collected	15.7	NL
Stack Gas Water Vapour Content	3.1	% v/v
Corrected TPM Emission	2.7	mg/Nm <sup>3</sup>
Corrected to 11% Oxygen	N/A	mg/Nm <sup>3</sup>

## Total Particulate Matter - Analysis Results

Sampling Run Number	Actual Probe Wash Mass (mg)	Probe Wash Mass (mg)
Blank	<0.25	<0.25
1	0.74	0.74

Sampling Run Number	Filter Reference	Filter Type	Filter Mass	Probe Wash Mass (mg)	Total Mass Deposit (mg)
			Change (mg)		
Blank	ETC-47-0494	47mm QMA	<0.03	<0.25	<0.28
1	ETC-47-0493	47mm QMA	0.6	0.74	1.34

Sampling Run Number	Measured	Impinger Mass (g)				Collected Mass (g)
		1	2	3	4	
1	Before	503.6	495.6	493.1	288.6	12.6
	After	503.0	492.7	491.3	306.5	

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Overall Blank Value (OBV)	0.57	mg/m <sup>3</sup>
OBV <10% of ELV	-	-

Date of Analysis	12/05/2021
Analytical Laboratory	ETC
Analytical Method	Gravimetric
Accreditation	MCERTS



## Instrumental Gas Analyser Calibrations

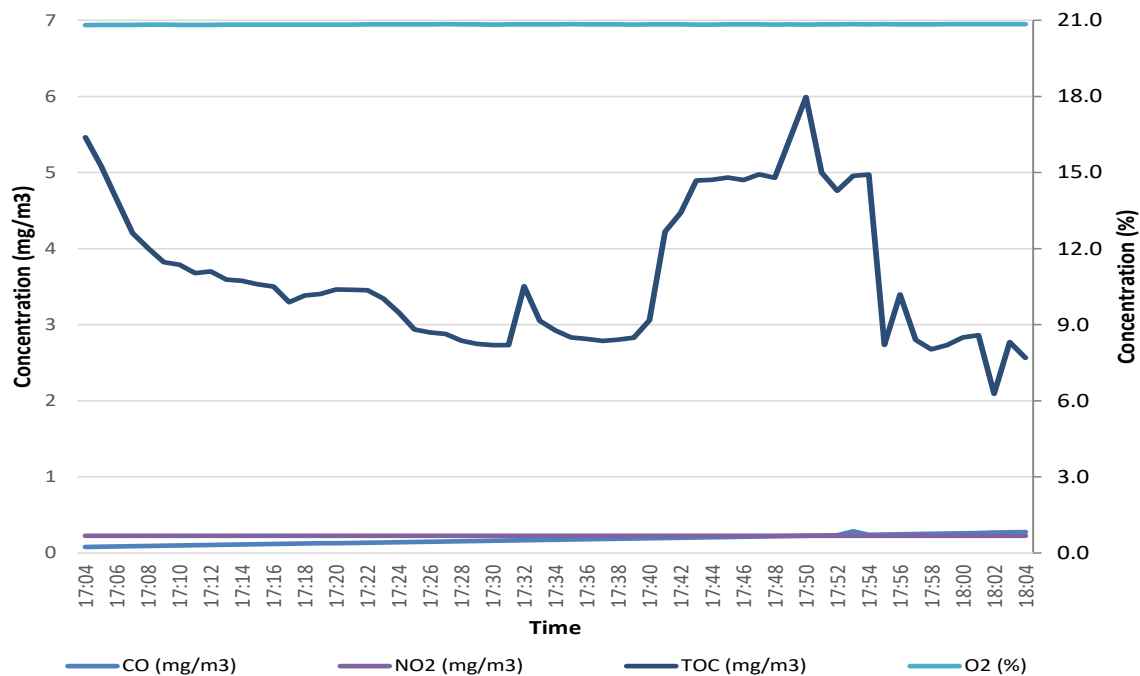
Date	Operators	Combustion Gas Analyser	Flame Ionisation Detector
05/05/2021	TA/JP	ETC-S12.08	ETC-S13.07

Calibration Gas	Certified Concentration	T90 Time	Analyser Span	Pre-sample Cal		Post-sample Cal		Adjustment Required	Data Valid
				Zero	Span	Zero	Span		
Carbon Monoxide	157ppm	21	200	0	200	-0.5	194.2	Yes	Yes
Nitric Oxide	200ppm	22	200	0	200	0	199	No	Yes
Propane	82.95ppm	14	83	0.4	82.95	0.08	83.1	No	Yes
Oxygen	21.18%	21	21.18	-0.01	21.18	0.05	21.2	No	Yes

## Instrumental Gas Analyser Results

Substance	Run	Corrected Concentration			Units	Basis	Zero Drift	Span Drift	Drift Acceptable?	O <sub>2</sub> Correction
		Average	Max	Min						
Carbon Monoxide	1	0.2	0.3	0.1	mg/m <sup>3</sup>	-	-0.26%	-3.38%	Yes	-
Oxides of Nitrogen (as NO <sub>2</sub> )	1	0.23	0.23	0.23	mg/m <sup>3</sup>	NO <sub>x</sub> as NO <sub>2</sub>	0.00%	-0.50%	Yes	-
Total VOC	1	3.7	6.0	2.1	mg/m <sup>3</sup>	VOC as C	-0.39%	0.6%	Yes	-
Oxygen	1	20.84	20.85	20.81	%	-	0.28%	-0.19%	Yes	-

## Instrumental Gas Analyser Chart - Run 1



## VOC Screen

Sampling Details		
Collection Media	SKC 226-09	-
Sampling Rate	200	mL/min
Test Duration	30.0	min
Sample Volume	6.0	L
Corrected Sample Volume	5.3	NL

Date	Operators
05/05/21	TA/JP

Parameter	Value	Unit
Barometric Pressure	1008	mbar
Operating Temperature	34.0	°C
Time	17:05	17:35
		-

Species	1st Media Conc. (ug)	2nd Media Conc. (ug)	Collection Efficiency	Blank Media Conc. (ug)	Blank Conc. (mg/m3)	Emission (mg/m3)	O <sub>2</sub> Corr. Emission
VOC Screen	< 5	< 5	100%	< 5	< 0.94	< 0.94	< -
			100%		< 0.94	< 0.94	< 0.00

## Sulphur Dioxide - Run 1 Calculations

Sampling Details		
Meter Box Number	ES-8.03	-
Gas Meter Coefficient	1.05	-
Pitot Coefficient	0.862	-
Stack Gas Molecular Weight	28.9	g/mole
Static Pressure in Stack	0.12	cmH <sub>2</sub> O

Date	Operators
05/05/2021	TA/JP

Parameter	Before	After	Unit
Barometric Pressure	1008	1008	mbar
Ambient Temperature	22.0	21.0	°C
Leak Check	0.02	-	L/min
Time	17:05	18:05	-

Analysis Details		
Collection Media	H2O2	
1st Collector Reference	S1.2	
1st Collector Concentration	15.205	µg
2nd Collector Reference	S1.3	
2nd Collector Concentration	<5.875	µg
Blank Concentration	<0.04	mg/Nm <sup>3</sup>
Has breakthrough occurred?	No	-

Emissions Calculations		
Total Sampling Time	60.0	min
Gas Meter Difference	469	L
Corrected Gas Meter Volume	492	L
Mean Sampling Rate	8.2	L/min
STP Dry Gas Meter Volume	455	NL
Mass of Water Vapour Collected	12.6	g
Volume of Water Vapour Collected	15.7	NL
Stack Gas Water Vapour Content	3.3	% v/v
Emission Limit Value	-	mg/Nm <sup>3</sup>
Corrected SO <sub>2</sub> Emission	0.03	mg/Nm <sup>3</sup>
Corrected to 11% Oxygen	N/A	mg/Nm <sup>3</sup>

Isokineticity Details		
Nozzle Diameter	7.8	mm
Average Gas Meter Temperature	21.1	°C
Average Stack Temperature	56.6	°C
Average Stack Velocity	3.4	m/s
Isokineticity	106.1	%

## Uncertainty

### Uncertainty of Total Particulate Matter - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Mean Sampling Rate	8.9	L/min
Leak Rate	0.02	L/min
Barometric Pressure	1008	mbar
Average Stack Temperature	56.6	°C
Sampled Stack Gas Volume	511	L

Parameter	Value	Unit
Mean Emission Concentration	2.7	mg/m <sup>3</sup>
Monitoring Duration	60	min
Console ID	ES-8.03	-
Temperature Uncertainty	0.24	°C
Gas Meter Uncertainty	0.37	%
Barometer Uncertainty	1.0	mbar

Source of Uncertainty	ASD*	BS EN 13284-1		Envirocare Certified Value	Units	% Actual Value	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
		Uncertainty Criteria	Max. Value					
Weighing Procedure	Std	5% of limit value	-	0.09	mg	-	0.09	0.008
Leak Rate	Rect	<2% of sampling rate	0.18	0.02	L/min	0.22	0.003	0.00001
Time	Std	1sec in 1 hour = 0.028%	2.0	1.0	sec	0.03	0.001	0.0000006
Gasmeter Volume	Std	<2%	10.2	1.9	L	0.37	0.01	0.0001
Temperature	Std	1% of value	3.3	0.24	°C	0.42	0.01	0.0001
Pressure	Std	1% of value	10.1	1.0	mbar	0.10	0.003	0.000007
<b>Total</b>								0.009
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>								0.09
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>								6.7
<b>Expanded Total Uncertainty (mg/m<sup>3</sup>) (95% confidence)</b>								0.18
<b>Expanded Total Uncertainty as a % of emission limit value (95% confidence)</b>								-

### Uncertainty of Carbon Monoxide by Horiba Analyser

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Reading	0.14	ppm
Span Gas Certified Value	157	ppm
Range	200	ppm

Cal Gas
CO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Zero Drift/Lower limit of detection (ppm)	0.30	Rectangular	1.7	0.17	0.03
Span Drift (ppm)	5.8	Rectangular	1.7	3.3	11.2
Linearity (% of value)	0.36	Rectangular	1.7	0.0003	0.0000009
Setting Gas Divider (% of value)	0.35	Normal	1.0	0.0005	0.0000002
Interference (% of value)	2.9	Rectangular	1.7	0.002	0.000006
Standard deviation of repeatability at zero point (% of range)	0.08	Rectangular	-	0.16	0.03
Standard deviation of repeatability at span point (% of range)	0.21	Rectangular	-	0.42	0.18
<b>Total</b>					11.4
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>					3.4
<b>Expanded Total Uncertainty (ppm) (95% confidence)</b>					6.6
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>					4716
<b>Expanded Total Uncertainty (mg/m<sup>3</sup>) (95% confidence)</b>					8.3
<b>Expanded Total Uncertainty as a % of emission limit value (95% confidence)</b>					-

## Uncertainty of Oxides of Nitrogen by Horiba gas Analyser

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Reading	0.11	ppm
Span Gas Certified Value	200	ppm
Range	250	ppm

Cal Gas
NO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Zero Drift/Lower limit of detection (ppm)	0.00	Rectangular	1.7	0.00	0.00
Span Drift (ppm)	1.0	Rectangular	1.7	0.58	0.33
Linearity (% of value)	0.84	Rectangular	1.7	0.0005	0.0000003
Setting Gas Divider (% of value)	0.35	Normal	1.0	0.0004	0.0000001
Interference (% of value)	1.2	Rectangular	1.7	0.0008	0.0000006
Standard deviation of repeatability at zero point (% of range)	0.11	Rectangular	-	0.28	0.08
Standard deviation of repeatability at span point (% of range)	0.21	Rectangular	-	0.53	0.28
<b>Total</b>					0.68
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>					0.83
<b>Expanded Total Uncertainty (ppm) (95% confidence)</b>					1.6
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>					1474
<b>Expanded Total Uncertainty (mg/m<sup>3</sup>) (95% confidence)</b>					3.3
<b>Expanded Total Uncertainty as a % of emission limit value (95% confidence)</b>					-

## Uncertainty of Total VOC by SK - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Reading	2.3	ppm
Span Gas Certified Value	83.0	ppm
Range	100	ppm

Cal Gas
C <sub>3</sub> H <sub>8</sub>

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Zero Drift/Lower limit of detection (ppm)	0.32	Rectangular	1.7	0.18	0.03
Span Drift (ppm)	-0.15	Rectangular	1.7	-0.09	0.008
Linearity (% of value)	0.53	Rectangular	1.7	0.007	0.00005
Setting Gas Divider (% of value)	0.35	Normal	1.0	0.008	0.00006
Noise (ppm)	0.10	Rectangular	1.7	0.06	0.003
Temperature Drift (% of value)	1.0	Rectangular	1.7	0.01	0.0002
Standard deviation of repeatability at zero point (% of range)	0.20	Rectangular	-	0.20	0.04
Standard deviation of repeatability at span point (% of range)	0.20	Rectangular	-	0.20	0.04
<b>Total</b>					0.13
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>					0.35
<b>Expanded Total Uncertainty (ppm) (95% confidence)</b>					0.69
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>					30.5
<b>Expanded Total Uncertainty (mg/m<sup>3</sup>) (95% confidence)</b>					1.1
<b>Expanded Total Uncertainty as a % of emission limit value (95% confidence)</b>					-

## Uncertainty of Oxygen by Horiba Analyser

Parameter	Value	Unit
Reading	20.8	%
Span Gas Certified Value	21.2	%
Range	25.0	%

Cal Gas
O <sub>2</sub>

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Zero Drift/Lower limit of detection (%vol)	0.05	Rectangular	1.7	0.03	0.0008
Span Drift (%vol)	-0.02	Rectangular	1.7	-0.01	0.0001
Linearity (% of value)	0.79	Rectangular	1.7	0.10	0.009
Setting Gas Divider (% of value)	0.35	Normal	1.0	0.07	0.005
Interference (% of value)	0.56	Rectangular	1.7	0.07	0.005
Standard deviation of repeatability at zero point (% of range)	0.09	Rectangular	-	0.02	0.0005
Standard deviation of repeatability at span point (% of range)	0.11	Rectangular	-	0.03	0.0008
<b>Total</b>					0.02
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>					0.15
<b>Expanded Total Uncertainty (%) (95% confidence)</b>					0.28
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>					1.4

## Uncertainty of Sulphur Dioxide - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m <sup>3</sup>
Mean Sampling Rate	8.2	L/min
Leak Rate	0.02	L/min
Barometric Pressure	1008	mbar
Average Stack Temperature	56.6	°C
Sampled Stack Gas Volume	469	L

Parameter	Value	Unit
Mean Emission Concentration	0.05	mg/m <sup>3</sup>
Monitoring Duration	60	min
Console ID	ES-8.03	-
Temperature Uncertainty	0.24	°C
Gas Meter Uncertainty	0.37	%
Barometer Uncertainty	1.0	mbar

Source of Uncertainty	ASD*	BS EN 14791		Envirocare Certified Value	Units	% Actual Value	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
		Uncertainty Criteria	Max. Value					
Analysis Procedure	Std	<2.5% of measured value	-	11.9	%	6.1	0.003	0.00001
Leak Rate	Rect	<2% of sampling rate	0.16	0.02	L/min	0.24	0.00007	0.000000005
Time	Std	1sec in 1hour = 0.028%	2.0	1.0	sec	0.03	0.00001	0.0000000002
Gasmeter Volume	Std	<2.5% volume of gas	11.7	1.7	L	0.37	0.0002	0.00000003
Temperature	Std	<1% absolute temperature	3.3	0.24	°C	0.07	0.00004	0.000000001
Pressure	Std	<1% absolute pressure	10.1	1.0	mbar	0.10	0.00005	0.000000002
<b>Total</b>								0.00001
<b>Combined Standard Uncertainty [(sum u<sup>2</sup>)<sup>0.5</sup>]</b>								0.003
<b>Expanded Total Uncertainty as a % of emission conc. (95% confidence)</b>								11.9
<b>Expanded Total Uncertainty (mg/m<sup>3</sup>) (95% confidence)</b>								0.01
<b>Expanded Total Uncertainty as a % of emission limit value (95% confidence)</b>								-

Uncertainty of Volumetric Flow - Run 1

Parameter	Value	Unit
Measured Volumetric Flow Rate Actual	922	L/min
Performance Characteristics & Source Value		
	Value	Units
Standard Uncertainty - Pitot tube Coefficient	0.005	-
Standard Uncertainty - Mean Local Dynamic Pressure	1.1	Pa
Standard Uncertainty - Molar Mass of Stack Gas	0.00003	-
Standard Uncertainty - Stack Gas Temperature	0.50	K
Standard Uncertainty - Absolute Pressure in Duct	176	Pa
Standard Uncertainty - Density of Stack Gas	0.009	-
Standard Uncertainty - Mean Velocity	0.07	m/s
<b>Expanded Uncertainty Mean Velocity (95% confidence)</b>	0.14	m/s
<b>Expanded Uncertainty Mean Velocity (95% Confidence), Relative</b>	3.7	%
<b>Standard Uncertainty - Volumetric Flow Rate</b>	27	-
<b>Standard Uncertainty - Volumetric Flow Rate (95% Confidence)</b>	53.9	m <sup>3</sup> /hr
<b>Standard Uncertainty - Volumetric Flow Rate (95% Confidence), Relative</b>	5.8	%
95% confidence interval factor - 1.96		

Document Version Number	Record of change within different version numbers
V1	Original version of the document issued to client.