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Report for the Periodic Monitoring of Emissions to Air	
Part 1: Executive Summary	
Permit Number:	EPR/BN6137IK/V004
Operator:	Saputo Dairy UK
Installation:	Boiler 3

Test Report:	ALL108654/24/PR-1
Monitoring Dates:	22/10/2024
Client / Organisation:	Mr Stuart Carhart
Address:	Veolia
	Davidstow Creamery
	Davidstow
	Cornwall
Date of Report:	28/10/2024
Report Approved By:	Phillip Ruck *BSc*
MCERTS Number/Level/Technical Endorsement	MM 11 1117 Level 2, TE1, TE2, TE3, TE4
Designation:	Stack Emissions Co-ordinator
Signed:	Phillip Ruck
Reviewed:	Robert Lethbridge

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Part 2 – Supporting information

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N/A	Appendix 1
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N/A	Appendix 2
N/A	Boiler 3 stack details including gas measurements (29 pages)
N/A	Appendix 3 (Uncertainty)
N/A	Appendix 4 (Instrumental analyser details)
N/A	Appendix 5 (Annual calibration details & analysis data retained at permanent laboratory)

Monitoring objectives

At the request of Mr Stuart Carhart of Veolia, Anchem Laboratories Limited has carried out an “emissions to atmosphere” monitoring regime in the exhaust ductwork of the boiler 3 process stack at Saputo Dairy UK in Davidstow. This monitoring regime has been undertaken for internal process control purposes only.

Emission point	Reference number	Substance to be monitored	Special requirements
Boiler 3	108654/1-4	Oxides of Nitrogen	40 Minute Sampling
		Sulphur dioxide	
		Carbon Monoxide	
		Oxygen	

Monitoring results

Emission Point	Boiler 3			
Sample Number	108654/1			
Substance to be Monitored	Sulphur Dioxide	Oxides of Nitrogen	Carbon Monoxide	Oxygen
Emission Limit Value	1000	1000	N/A	N/A
Periodic Monitoring Result	3.1	125.0	8.4	8.1
Uncertainty	±0.8	±2.9	±0.9	±0.2
Units	mg/Nm^3			
Reference Conditions	273K, 101.3kPa, 3% oxygen & dry gas			
Date of Sampling	22/10/2024			
Start/End Time	11:10 – 11:52			
Average Volumetric flow @ reference conditions / m^3/hr	1026			
Standard Reference Method	CEN/TS 17021	BS EN 14792	BS EN 15058	BS EN 14791
Technical Procedure Reference	ANC/S/29			ANC/S/26
Accreditation Status	MCERTS			
Process Status (Load/Feedstock)	See Process Status (page 9)			

Monitoring results continued

Emission Point	Boiler 3			
Sample Number	108654/2			
Substance to be Monitored	Sulphur Dioxide	Oxides of Nitrogen	Carbon Monoxide	Oxygen
Emission Limit Value	1000	1000	N/A	N/A
Periodic Monitoring Result	12.1	141	3.3	6.8
Uncertainty	±1.0	±3.0	±0.8	±0.2
Units	mg/Nm^3			
Reference Conditions	273K, 101.3kPa, 3% oxygen & dry gas			
Date of Sampling	22/10/2024			
Start/End Time	12:02 – 12:44			
Average Volumetric flow @ reference conditions / m^3/hr	1324			
Standard Reference Method	CEN/TS 17021	BS EN 14792	BS EN 15058	BS EN 14791
Technical Procedure Reference	ANC/S/29			ANC/S/26
Accreditation Status	MCERTS			
Process Status (Load/Feedstock)	See Process Status (page 9)			

Monitoring results continued

Emission Point	Boiler 3			
Sample Number	108654/3			
Substance to be Monitored	Sulphur Dioxide	Oxides of Nitrogen	Carbon Monoxide	Oxygen
Emission Limit Value	1000	1000	N/A	N/A
Periodic Monitoring Result	12.8	157.8	2.8	5.6
Uncertainty	±1.0	±3.1	±0.7	±0.2
Units	mg/Nm^3			
Reference Conditions	273K, 101.3kPa, 3% oxygen & dry gas			
Date of Sampling	22/10/2024			
Start/End Time	12:55 – 13:37			
Average Volumetric flow @ reference conditions / m^3/hr	1737			
Standard Reference Method	CEN/TS 17021	BS EN 14792	BS EN 15058	BS EN 14791
Technical Procedure Reference	ANC/S/29			ANC/S/26
Accreditation Status	MCERTS			
Process Status (Load/Feedstock)	See Process Status (page 9)			

Monitoring results continued

Emission Point	Boiler 3			
Sample Number	108654/4			
Substance to be Monitored	Sulphur Dioxide	Oxides of Nitrogen	Carbon Monoxide	Oxygen
Emission Limit Value	1000	1000	N/A	N/A
Periodic Monitoring Result	12.7	159.5	3.3	3.9
Uncertainty	±0.9	±2.8	±0.6	±0.1
Units	mg/Nm^3			
Reference Conditions	273K, 101.3kPa, 3% oxygen & dry gas			
Date of Sampling	22/10/2024			
Start/End Time	13:40 – 14:20			
Average Volumetric flow @ reference conditions / m^3/hr	2309			
Standard Reference Method	CEN/TS 17021	BS EN 14792	BS EN 15058	BS EN 14791
Technical Procedure Reference	ANC/S/29			ANC/S/26
Accreditation Status	MCERTS			
Process Status (Load/Feedstock)	See Process Status (page 9)			

Process status

With regards to the monitoring carried out on the Boiler 3 Exhaust, the process ran in a continuous state during sampling with no unusual occurrences reported by the operators.

108654/1 – 25% Process Load

108654/2 – 50% Process Load

108654/3 – 75% Process Load

108654/4 – 100% Process Load

Operating information

Nature of process (continuous or batch)	Continuous in nature
What part of the batch was sampled or whole batch (if applicable)	N/A
What fuel was used (if applicable)	N/A
What feedstock was used during the monitoring (if applicable)	Boiler 1 utilises Kerosene as fuel
"Normal" load, throughput or continuous rating of plant	Continuous
What type of abatement system and whether operating	N/A
The periodic monitoring result and the results from the operators CEMS	There are no CEMs fitted for the purpose of monitoring emissions to air.

Monitoring Deviations:

Why any substance(s) in the monitoring objectives were not monitored.

N/A

Why any substance(s) were not monitored in accordance with the monitoring method and any other issues relevant to the monitoring results.

Velocity recorded during Run 1 was less 5Pa as required by the method.

Part 2: Supporting information

APPENDIX 1

Sampling personnel

Name	Function*	MCERTS number	MCERTS level	Technical endorsements
P Ruck	Team Leader	MM 11 1117	Level 2	TE1, TE2, TE3, TE4
L Liguz	Emissions Analyst	MM 24 1851	Trainee	-

Method specifications

Substance	Standard reference method	Anchem technical procedure
Velocity	ISO 16911	ANC/S/36
Oxides of nitrogen	BS EN 14792	ANC/S/29
Carbon Monoxide	BS EN 15058	ANC/S/29
Sulphur dioxide	CEN/TS 17021	ANC/S/29
Oxygen	BS EN 14789	ANC/S/26
Moisture	BS EN 14790	ANC/S/11

Equipment checklist

Please see relevant appendices and site-specific protocol associated with monitoring campaign for equipment utilised during monitoring & checklist.

APPENDIX 2

Boiler 3

(29 Pages)

Stack diagram

Stack Dimension (m)	0.63m
Homogeneity test previously carried out (yes/no)	No
Is the gas stream homogeneous? (yes/no/unknown)	Unknown

Combustion Gas Monitoring Summary

Sample Number	108654/1
Date	22/10/2024
Customer name	Saputo Dairy
Site location	Davidstow
Emission point	Boiler 3
Emission point dimension (m)	0.62m
Emission point C.S.A. (m^2)	0.3019
Team leader	Phil Ruck
Analyst(s)	Louie Liguz
Average Ambient pressure (mb)	994
Average Ambient temperature (°C)	13
Instrument number	A/S545 (PG-350)
Probe length (m)	1.0m
Timer	A/S685
Homogeneity test previously conducted? (Yes/No)	No
Is the gas stream homogeneous? (Yes/No/Unknown)	Unknown
Test start time	11:10:00
Test end time	11:52:00
Volumetric flow @ reference conditions (m^3/hour)	1040

Reference conditions

Temperature (K)	273
Pressure (kPa)	101.3
Moisture	Dry
Oxygen (%)	3

Carbon Monoxide

Average concentration CO (mg/m^3)	8.4
Maximum concentration CO (mg/m^3)	10.4
Minimum concentration CO (mg/m^3)	7.2
Mass Emission CO (Kg/hour)	0.01
% Uncertainty of measurement	10.6
Uncertainty Concentration mg/m^3	0.9

Oxides of Nitrogen (as NO_2)

Average concentration NOx (mg/m^3)	125.0
Maximum concentration NOx (mg/m^3)	126.5
Minimum concentration NOx (mg/m^3)	123.6
Mass Emission NOx (Kg/hour)	0.13
% Uncertainty of measurement	2.3
Uncertainty Concentration mg/m^3	2.9

Sulphur Dioxide

Average concentration SO_2 (mg/m^3)	3.1
Maximum concentration SO_2 (mg/m^3)	23.0
Minimum concentration SO_2 (mg/m^3)	0.0
Mass Emission SO_2 (Kg/hour)	0.00
% Uncertainty of measurement	24.7
Uncertainty Concentration mg/m^3	0.8

Oxygen

Average concentration O_2 (% vol)	8.1
Maximum concentration O_2 (% vol)	8.2
Minimum concentration O_2 (% Vol)	7.9
% Uncertainty of measurement	3.0
Uncertainty Concentration % vol	0.2

Combustion Gas Site Data

Customer	Saputo Dairy
Emission Point	Boiler 3
Date	22/10/2024
Sample No	108654/1

Pre test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero through analyser (ppm)	0	0	0	0
Span Through analyser (ppm)	101.2	145.5	144.0	6.1
Zero through analyser (ppm)	0.2	0.0	0.6	-0.01
Zero Through line (ppm)	0.20	0.00	0.20	0.01
Span Through line (ppm)	101.2	145.2	143.1	6.1
Residence Time (seconds)	42.0	45.0	48.0	42.0
System T90 (seconds)	62	62	83	56
T90 Value (ppm)	91.1	131.0	129.6	5.5
Initial leak test	0.0	0.2	0.6	0.0
Post test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero Through Analyser	0.00	0.00	0.10	0.02
Span Through Analyser (ppm)	101.4	144.70	145.20	6.13
Span Drift (%)	0.2	0.3	1.5	0.5
Zero Drift (%)	0.2	0.0	0.1	0.2

Oxygen cylinder grade/reference	VC1978130 6.10%
Nitrogen Monoxide cylinder grade/reference	VC12997 145.5ppm
Sulphur Dioxide cylinder grade/reference	VC12997 144.0ppm
Carbon Monoxide cylinder grade/reference	VC12997 101.2ppm

Gas conditioning Temperature Validation

Temperature @ Start of Test (°C)	N/A
Temperature During Test (°C)	N/A
Temperature @ End of Test (°C)	N/A
Temperature of Heated Line (°C)	120
Temperature of PD-100 oven (°C)	100

Stratification Data

Point	**CO ppm**	**NO ppm**	**SO_2 ppm**	**O_2 % vol**
1	**4.75**	**43.40**	**0.10**	**7.99**
2				
3				
4				
5				
6				
7				
8				
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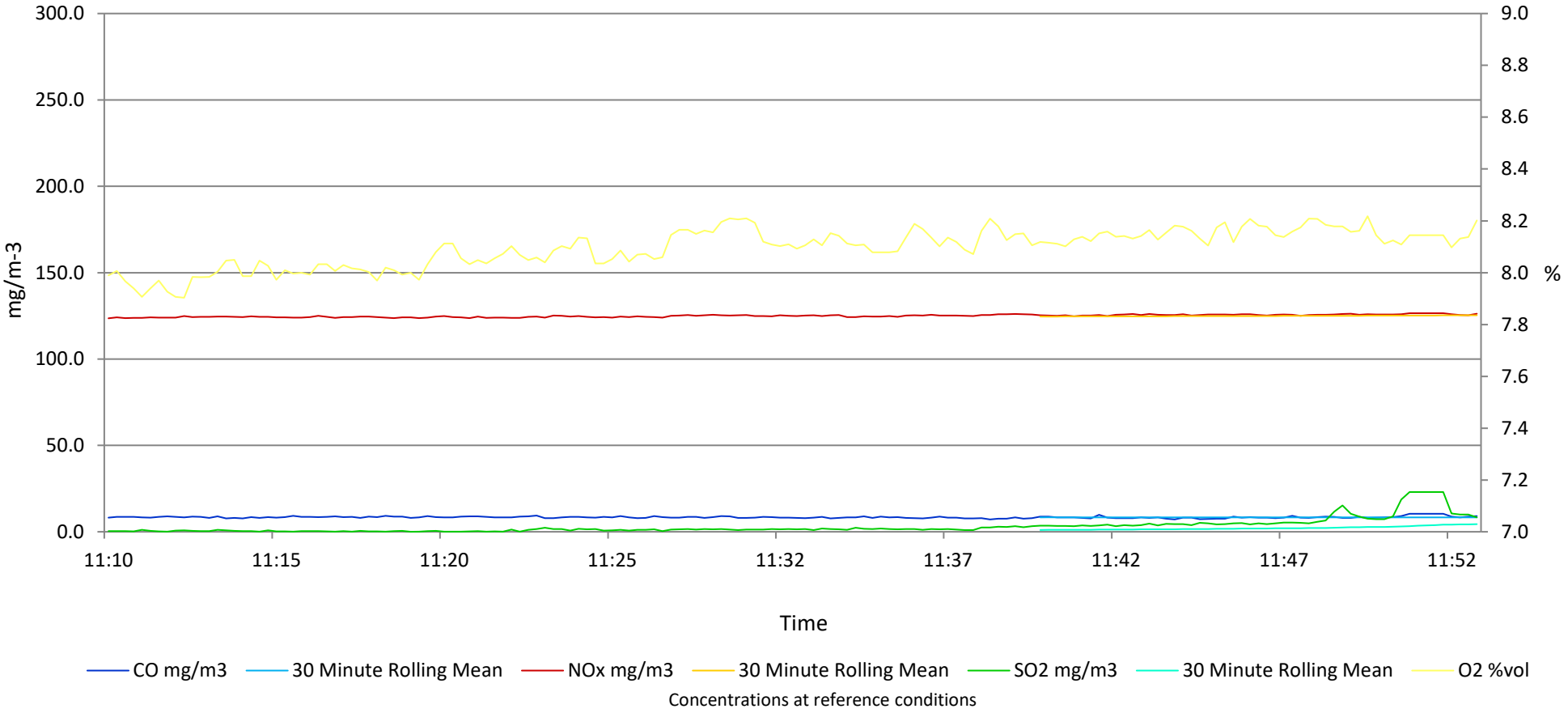
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/1



Concentrations at reference conditions

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/1

Concentration	CO mg/m^3	30 Minute Rolling Mean	NOx mg/m^3	30 Minute Rolling Mean	SO2 mg/m^3	30 Minute Rolling Mean	O_2 %vol
Minimum	7.2	8.3	123.6	124.6	0.0	1.0	7.9
Maximum	10.4	8.4	126.5	125.3	23.0	4.4	8.2
Average	8.4	8.3	125.0	124.9	3.1	2.2	8.1

EN ISO 16911 S-Type Pitot Summary Page

Customer	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date Measured	22-Oct-24
Sample Number	108654/1
X-Sectional Area	0.302
DH@	52.56
DY_d	N/A
Average sqrt DP (mmH_2O)	0.569
Average % Oxygen	8.1
Average % Carbon Dioxide	9.0
Average % Carbon Monoxide	0.0
Average % Nitrogen	82.9
Barometric Pressure (mb)	994
Duct Static Pressure (mmH2O)	-10.00
Absolute Stack Gas Pressure (KPa)	99.3
Average Stack Gas Temperature (K)	435
Moisture % (estimated)	10.00
Velocity in Stack (m/s)	2.4
Volumetric Flow at Stack Conditions (m^3/sec)	0.71
Volumetric Flow at Stack Conditions (m^3/hour)	2560.45
Volumetric flow rate STP, Wet (m^3/sec)	0.44
Volumetric flow rate at STP, Wet (m^3/hour)	1575.12
Volumetric flow rate STP, Dry (m^3/sec)	0.39
Volumetric flow rate at STP, Dry (m^3/hour)	1417.61
Volumetric flow rate at reference conditions (m^3/sec)	0.28
Volumetric flow rate at reference conditions (m^3/hour)	1025.87
% Uncertainty of Measurement	5.3

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/1
Probe Operator	LL
Console Operator	PR

DGM Inlet (°C)	25
DGM Outlet (°C)	25
Mean Temp (°C)	25
Bar Pressure (mb)	994
Moisture (%)	8.92
Dimension (m)	0.62
Stack C.S.A (m^2)	0.3019

Gas Flow	Out
Port Nipple (cm)	60
Console No.	A/S694
Pitot No.	A/S849
Tape Measure	A/S544
Timer	A/S685
Barometer No.	A/S543

Traverse Line 1

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.4	0.632	161	7	N/A
2	53.8	0.3	0.548	162	5	N/A

Traverse Line 2

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.3	0.548	162	10	N/A
2	53.8	0.3	0.548	162	9	N/A

% O_2	8.1
% CO_2	9
% CO	0

Traverse Line 3

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Traverse Line 4

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Average DP (mmH_2O)	0.3
Average sqrt DP	0.569
Average Stack Temp (°C)	162

Field Performance Criteria	OK?
Pitch <±10°	N/A
Swirl <±15°	Yes
Stack internal Area	Yes
Field Repeatability	N/A
Static Pressure Check	Yes

Is Negative Flow Present?	No
Minimum Velocity >5pa	No
Ratio of gas Velocities <3:1	Yes

Flow Characteristics Meet Requirements of EN ISO 16911?
Yes

Number of Sample Points
4

Combustion Gas Monitoring Summary

Sample Number	108654/2
Date	22/10/2024
Customer name	Saputo Dairy
Site location	Davidstow
Emission point	Boiler 3
Emission point dimension (m)	0.62m
Emission point C.S.A. (m^2)	0.3019
Team leader	Phil Ruck
Analyst(s)	Louie Liguz
Average Ambient pressure (mb)	994
Average Ambient temperature (°C)	14
Instrument number	A/S545 (PG-350)
Probe length (m)	1.0m
Timer	A/S685
Homogeneity test previously conducted? (Yes/No)	No
Is the gas stream homogeneous? (Yes/No/Unknown)	Unknown
Test start time	12:02:00
Test end time	12:44:00
Volumetric flow @ reference conditions (m^3/hour)	1367

Reference conditions

Temperature (K)	273
Pressure (kPa)	101.3
Moisture	Dry
Oxygen (%)	3

Carbon Monoxide

Average concentration CO (mg/m^3)	3.3
Maximum concentration CO (mg/m^3)	4.0
Minimum concentration CO (mg/m^3)	2.7
Mass Emission CO (Kg/hour)	0.00
% Uncertainty of measurement	23.0
Uncertainty Concentration mg/m^3	0.8

Oxides of Nitrogen (as NO_2)

Average concentration NOx (mg/m^3)	141.0
Maximum concentration NOx (mg/m^3)	150.9
Minimum concentration NOx (mg/m^3)	139.7
Mass Emission NOx (Kg/hour)	0.19
% Uncertainty of measurement	2.1
Uncertainty Concentration mg/m^3	3.0

Sulphur Dioxide

Average concentration SO_2 (mg/m^3)	12.1
Maximum concentration SO_2 (mg/m^3)	31.9
Minimum concentration SO_2 (mg/m^3)	10.0
Mass Emission SO_2 (Kg/hour)	0.02
% Uncertainty of measurement	8.4
Uncertainty Concentration mg/m^3	1.0

Oxygen

Average concentration O_2 (% vol)	6.8
Maximum concentration O_2 (% vol)	6.9
Minimum concentration O_2 (% Vol)	6.7
% Uncertainty of measurement	3.1
Uncertainty Concentration % vol	0.2

Customer	Saputo Dairy
Emission Point	Boiler 3
Date	22/10/2024
Sample No	108654/2

Pre test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero through analyser (ppm)	0	0	0	0
Span Through analyser (ppm)	101.2	145.5	144.0	6.1
Zero through analyser (ppm)	0.2	0.0	0.6	-0.01
Zero Through line (ppm)	0.20	0.00	0.20	0.01
Span Through line (ppm)	101.2	145.2	143.1	6.1
Residence Time (seconds)	0.0	0.0	0.1	0.0
System T90 (seconds)	101	145	145	6
T90 Value (ppm)	91.1	131.0	129.6	5.5
Initial leak test	0.0	0.2	0.6	0.0
Post test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero Through Analyser	0.00	0.00	0.10	0.02
Span Through Analyser (ppm)	101.4	144.70	145.20	6.13
Span Drift (%)	0.2	0.3	1.5	0.5
Zero Drift (%)	0.2	0.0	0.1	0.2

Oxygen cylinder grade/reference	VC1978130 6.10%
Nitrogen Monoxide cylinder grade/reference	VC12997 145.5ppm
Sulphur Dioxide cylinder grade/reference	VC12997 144.0ppm
Carbon Monoxide cylinder grade/reference	VC12997 101.2ppm

Gas conditioning Temperature Validation

Temperature @ Start of Test (°C)	N/A
Temperature During Test (°C)	N/A
Temperature @ End of Test (°C)	N/A
Temperature of Heated Line (°C)	120
Temperature of PD-100 oven (°C)	100

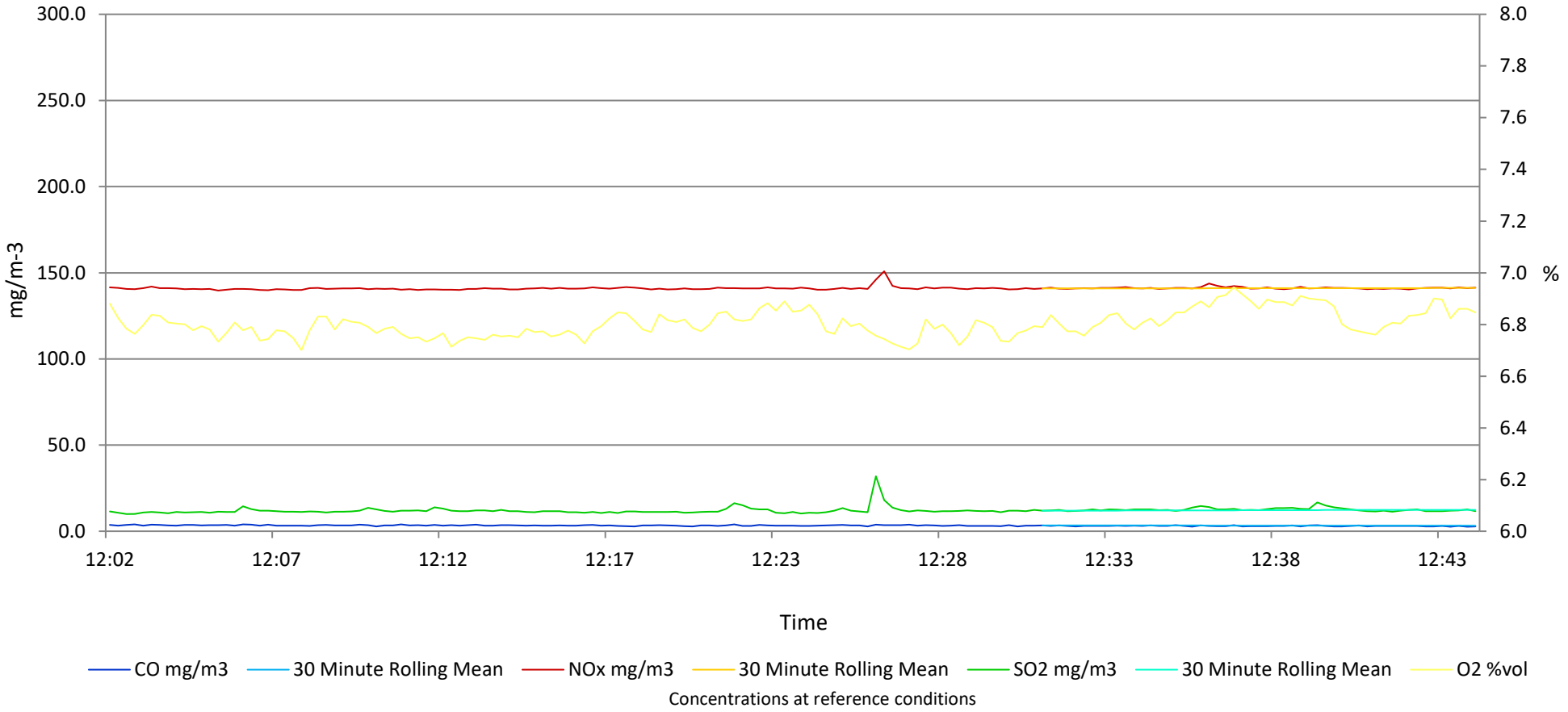
Stratification Data

Point	**CO ppm**	**NO ppm**	**SO_2 ppm**	**O_2 % vol**
1	**2.29**	**53.96**	**3.15**	**6.88**
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/2



Concentrations at reference conditions

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/2

Concentration	CO mg/m^3	30 Minute Rolling Mean	NOx mg/m^3	30 Minute Rolling Mean	SO2 mg/m^3	30 Minute Rolling Mean	O_2 %vol
Minimum	**2.7**	**3.2**	**139.7**	**140.9**	**10.0**	**11.9**	**6.7**
Maximum	**4.0**	**3.4**	**150.9**	**141.2**	**31.9**	**12.4**	**6.9**
Average	**3.3**	**3.3**	**141.0**	**141.0**	**12.1**	**12.2**	**6.8**

EN ISO 16911 S-Type Pitot Summary Page

Customer	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date Measured	22-Oct-24
Sample Number	108654/2
X-Sectional Area	0.302
DH@	52.56
DY_d	N/A
Average sqrt DP (mmH_2O)	0.687
Average % Oxygen	6.8
Average % Carbon Dioxide	9.9
Average % Carbon Monoxide	0.0
Average % Nitrogen	83.3
Barometric Pressure (mb)	994
Duct Static Pressure (mmH2O)	-10.00
Absolute Stack Gas Pressure (KPa)	99.3
Average Stack Gas Temperature (K)	454
Moisture % (estimated)	10.00
Velocity in Stack (m/s)	2.9
Volumetric Flow at Stack Conditions (m^3/sec)	0.88
Volumetric Flow at Stack Conditions (m^3/hour)	3158.17
Volumetric flow rate STP, Wet (m^3/sec)	0.52
Volumetric flow rate at STP, Wet (m^3/hour)	1860.82
Volumetric flow rate STP, Dry (m^3/sec)	0.47
Volumetric flow rate at STP, Dry (m^3/hour)	1674.73
Volumetric flow rate at reference conditions (m^3/sec)	0.37
Volumetric flow rate at reference conditions (m^3/hour)	1323.75
% Uncertainty of Measurement	5.3

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/2
Probe Operator	LL
Console Operator	PR

DGM Inlet (°C)	25
DGM Outlet (°C)	25
Mean Temp (°C)	25
Bar Pressure (mb)	994
Moisture (%)	9.69
Dimension (m)	0.62
Stack C.S.A (m^2)	0.3019

Gas Flow	Out
Port Nipple (cm)	60
Console No.	A/S694
Pitot No.	A/S849
Tape Measure	A/S544
Timer	A/S685
Barometer No.	A/S543

Traverse Line 1

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.4	0.632	180	7	N/A
2	53.8	0.5	0.707	181	5	N/A

Traverse Line 2

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.4	0.632	181	10	N/A
2	53.8	0.6	0.775	182	9	N/A

% O_2	6.8
% CO_2	9.9
% CO	0

Traverse Line 3

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Traverse Line 4

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Average DP (mmH_2O)	0.5
Average sqrt DP	0.687
Average Stack Temp (°C)	181

Field Performance Criteria	OK?
Pitch <±10°	N/A
Swirl <±15°	Yes
Stack internal Area	Yes
Field Repeatability	N/A
Static Pressure Check	Yes

Is Negative Flow Present?	No
Minimum Velocity >5pa	Yes
Ratio of gas Velocities <3:1	Yes

Flow Characteristics Meet Requirements of EN ISO 16911?
Yes

Number of Sample Points
4

Combustion Gas Monitoring Summary

Sample Number	108654/3
Date	22/10/2024
Customer name	Saputo Dairy
Site location	Davidstow
Emission point	Boiler 3
Emission point dimension (m)	0.62m
Emission point C.S.A. (m^2)	0.3019
Team leader	Phil Ruck
Analyst(s)	Louie Liguz
Average Ambient pressure (mb)	994
Average Ambient temperature (°C)	14.5
Instrument number	A/S545 (PG-350)
Probe length (m)	1.0m
Timer	A/S685
Homogeneity test previously conducted? (Yes/No)	No
Is the gas stream homogeneous? (Yes/No/Unknown)	Unknown
Test start time	12:55:00
Test end time	13:37:00
Volumetric flow @ reference conditions (m^3/hour)	1806

Reference conditions

Temperature (K)	273
Pressure (kPa)	101.3
Moisture	Dry
Oxygen (%)	3

Carbon Monoxide

Average concentration CO (mg/m^3)	2.8
Maximum concentration CO (mg/m^3)	3.6
Minimum concentration CO (mg/m^3)	2.1
Mass Emission CO (Kg/hour)	0.01
% Uncertainty of measurement	24.3
Uncertainty Concentration mg/m^3	0.7

Oxides of Nitrogen (as NO_2)

Average concentration NOx (mg/m^3)	157.8
Maximum concentration NOx (mg/m^3)	159.6
Minimum concentration NOx (mg/m^3)	156.4
Mass Emission NOx (Kg/hour)	0.28
% Uncertainty of measurement	2.0
Uncertainty Concentration mg/m^3	3.1

Sulphur Dioxide

Average concentration SO_2 (mg/m^3)	12.8
Maximum concentration SO_2 (mg/m^3)	20.4
Minimum concentration SO_2 (mg/m^3)	10.4
Mass Emission SO_2 (Kg/hour)	0.02
% Uncertainty of measurement	7.5
Uncertainty Concentration mg/m^3	1.0

Oxygen

Average concentration O_2 (% vol)	5.6
Maximum concentration O_2 (% vol)	5.8
Minimum concentration O_2 (% Vol)	5.5
% Uncertainty of measurement	3.2
Uncertainty Concentration % vol	0.2

Customer	Saputo Dairy
Emission Point	Boiler 3
Date	22/10/2024
Sample No	108654/3

Pre test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero through analyser (ppm)	0	0	0	0
Span Through analyser (ppm)	101.2	145.5	144.0	6.1
Zero through analyser (ppm)	0.2	0.0	0.6	-0.01
Zero Through line (ppm)	0.20	0.00	0.20	0.01
Span Through line (ppm)	101.2	145.2	143.1	6.1
Residence Time (seconds)	0.0	0.0	0.1	0.0
System T90 (seconds)	101	145	145	6
T90 Value (ppm)	91.1	131.0	129.6	5.5
Initial leak test	0.0	0.2	0.6	0.0
Post test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero Through Analyser	0.00	0.00	0.10	0.02
Span Through Analyser (ppm)	101.4	144.70	145.20	6.13
Span Drift (%)	0.2	0.3	1.5	0.5
Zero Drift (%)	0.2	0.0	0.1	0.2

Oxygen cylinder grade/reference	VC1978130 6.10%
Nitrogen Monoxide cylinder grade/reference	VC12997 145.5ppm
Sulphur Dioxide cylinder grade/reference	VC12997 144.0ppm
Carbon Monoxide cylinder grade/reference	VC12997 101.2ppm

Gas conditioning Temperature Validation

Temperature @ Start of Test (°C)	N/A
Temperature During Test (°C)	N/A
Temperature @ End of Test (°C)	N/A
Temperature of Heated Line (°C)	120
Temperature of PD-100 oven (°C)	100

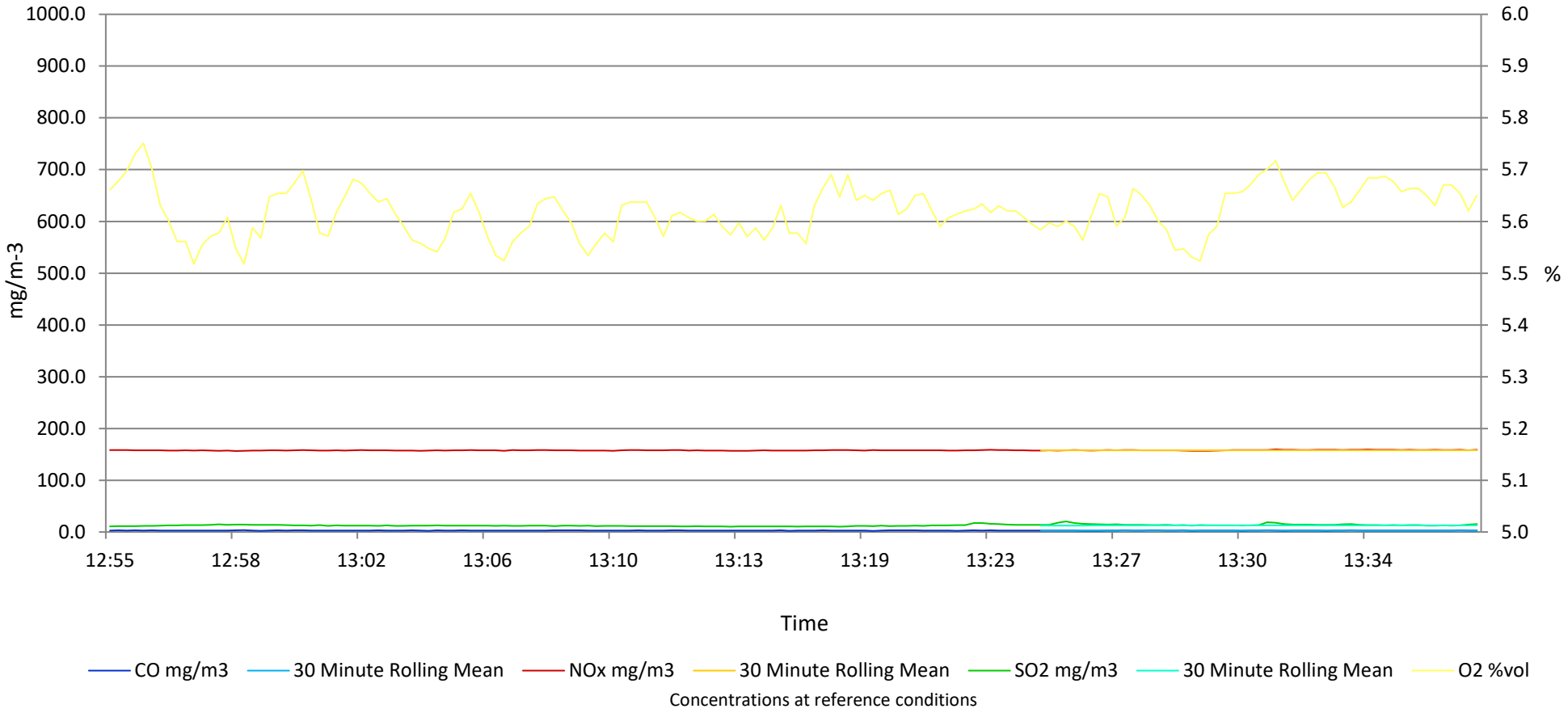
Stratification Data

Point	**CO ppm**	**NO ppm**	**SO_2 ppm**	**O_2 % vol**
1	**2.03**	**65.53**	**3.25**	**5.66**
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/3



Concentrations at reference conditions

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/3

Concentration	CO mg/m^3	30 Minute Rolling Mean	NOx mg/m^3	30 Minute Rolling Mean	SO2 mg/m^3	30 Minute Rolling Mean	O_2 %vol
Minimum	**2.1**	**2.8**	**156.4**	**157.6**	**10.4**	**12.3**	**5.5**
Maximum	**3.6**	**2.9**	**159.6**	**157.9**	**20.4**	**13.0**	**5.8**
Average	**2.8**	**2.8**	**157.8**	**157.7**	**12.8**	**12.7**	**5.6**

EN ISO 16911 S-Type Pitot Summary Page

Customer	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date Measured	22-Oct-24
Sample Number	108654/3
X-Sectional Area	0.302
DH@	52.56
DY_d	N/A
Average sqrt DP (mmH_2O)	0.846
Average % Oxygen	5.6
Average % Carbon Dioxide	10.8
Average % Carbon Monoxide	0.0
Average % Nitrogen	83.6
Barometric Pressure (mb)	994
Duct Static Pressure (mmH2O)	-10.00
Absolute Stack Gas Pressure (KPa)	99.3
Average Stack Gas Temperature (K)	467
Moisture % (estimated)	10.00
Velocity in Stack (m/s)	3.6
Volumetric Flow at Stack Conditions (m^3/sec)	1.10
Volumetric Flow at Stack Conditions (m^3/hour)	3943.65
Volumetric flow rate STP, Wet (m^3/sec)	0.63
Volumetric flow rate at STP, Wet (m^3/hour)	2260.57
Volumetric flow rate STP, Dry (m^3/sec)	0.57
Volumetric flow rate at STP, Dry (m^3/hour)	2034.51
Volumetric flow rate at reference conditions (m^3/sec)	0.48
Volumetric flow rate at reference conditions (m^3/hour)	1737.06
% Uncertainty of Measurement	5.3

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/3
Probe Operator	LL
Console Operator	PR

DGM Inlet (°C)	25
DGM Outlet (°C)	25
Mean Temp (°C)	25
Bar Pressure (mb)	994
Moisture (%)	10.10
Dimension (m)	0.62
Stack C.S.A (m^2)	0.3019

Gas Flow	Out
Port Nipple (cm)	60
Console No.	A/S694
Pitot No.	A/S849
Tape Measure	A/S544
Timer	A/S685
Barometer No.	A/S543

Traverse Line 1

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.7	0.837	194	7	N/A
2	53.8	0.8	0.876	193	5	N/A

Traverse Line 2

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	0.7	0.816	193	10	N/A
2	53.8	0.7	0.856	194	9	N/A

% O_2	5.6
% CO_2	10.8
% CO	0

Traverse Line 3

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Traverse Line 4

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Average DP (mmH_2O)	0.7
Average sqrt DP	0.846
Average Stack Temp (°C)	194

Field Performance Criteria	OK?
Pitch <±10°	N/A
Swirl <±15°	Yes
Stack internal Area	Yes
Field Repeatability	N/A
Static Pressure Check	Yes

Is Negative Flow Present?	No
Minimum Velocity >5pa	Yes
Ratio of gas Velocities <3:1	Yes

Flow Characteristics Meet Requirements of EN ISO 16911?
Yes

Number of Sample Points
4

Carbon Monoxide

Average concentration CO (mg/m^3)	3.3
Maximum concentration CO (mg/m^3)	3.8
Minimum concentration CO (mg/m^3)	2.5
Mass Emission CO (Kg/hour)	0.01
% Uncertainty of measurement	19.0
Uncertainty Concentration mg/m^3	0.6

Oxides of Nitrogen (as NO_2)

Average concentration NOx (mg/m^3)	159.5
Maximum concentration NOx (mg/m^3)	166.7
Minimum concentration NOx (mg/m^3)	157.8
Mass Emission NOx (Kg/hour)	0.37
% Uncertainty of measurement	1.8
Uncertainty Concentration mg/m^3	2.8

Sulphur Dioxide

Average concentration SO_2 (mg/m^3)	12.7
Maximum concentration SO_2 (mg/m^3)	29.0
Minimum concentration SO_2 (mg/m^3)	11.0
Mass Emission SO_2 (Kg/hour)	0.03
% Uncertainty of measurement	6.8
Uncertainty Concentration mg/m^3	0.9

Oxygen

Average concentration O_2 (% vol)	3.9
Maximum concentration O_2 (% vol)	4.0
Minimum concentration O_2 (% Vol)	3.8
% Uncertainty of measurement	3.6
Uncertainty Concentration % vol	0.1

Combustion Gas Monitoring Summary

Sample Number	108654/4
Date	22/10/2024
Customer name	Saputo Dairy
Site location	Davidstow
Emission point	Boiler 3
Emission point dimension (m)	0.62m
Emission point C.S.A. (m^2)	0.3019
Team leader	Phil Ruck
Analyst(s)	Louie Liguz
Average Ambient pressure (mb)	994
Average Ambient temperature (°C)	14.5
Instrument number	A/S545 (PG-350)
Probe length (m)	1.0m
Timer	A/S685
Homogeneity test previously conducted? (Yes/No)	No
Is the gas stream homogeneous? (Yes/No/Unknown)	Unknown
Test start time	13:40:00
Test end time	14:20:00
Volumetric flow @ reference conditions (m^3/hour)	2309

Reference conditions

Temperature (K)	273
Pressure (kPa)	101.3
Moisture	Dry
Oxygen (%)	3

Combustion Gas Site Data

Customer	Saputo Dairy
Emission Point	Boiler 3
Date	22/10/2024
Sample No	108654/4

Pre test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero through analyser (ppm)	0	0	0	0
Span Through analyser (ppm)	101.2	145.5	144.0	6.1
Zero through analyser (ppm)	0.2	0.0	0.6	-0.01
Zero Through line (ppm)	0.20	0.00	0.20	0.01
Span Through line (ppm)	101.2	145.2	143.1	6.1
Residence Time (seconds)	42.0	45.0	48.0	42.0
System T90 (seconds)	62	62	83	56
T90 Value (ppm)	91.1	131.0	129.6	5.5
Initial leak test	0.0	0.2	0.6	0.0
Post test				
ANALYTE	**CO**	**NO**	**SO_2**	**O_2**
Zero Through Analyser	0.00	0.00	0.10	0.02
Span Through Analyser (ppm)	101.4	144.70	145.20	6.13
Span Drift (%)	0.2	0.3	1.5	0.5
Zero Drift (%)	0.2	0.0	0.1	0.2

Oxygen cylinder grade/reference	VC1978130 6.10%
Nitrogen Monoxide cylinder grade/reference	VC12997 145.5ppm
Sulphur Dioxide cylinder grade/reference	VC12997 144.0ppm
Carbon Monoxide cylinder grade/reference	VC12997 101.2ppm

Gas conditioning Temperature Validation

Temperature @ Start of Test (°C)	N/A
Temperature During Test (°C)	N/A
Temperature @ End of Test (°C)	N/A
Temperature of Heated Line (°C)	120
Temperature of PD-100 oven (°C)	100

Stratification Data

Point	**CO ppm**	**NO ppm**	**SO_2 ppm**	**O_2 % vol**
1	**2.42**	**73.66**	**4.00**	**3.96**
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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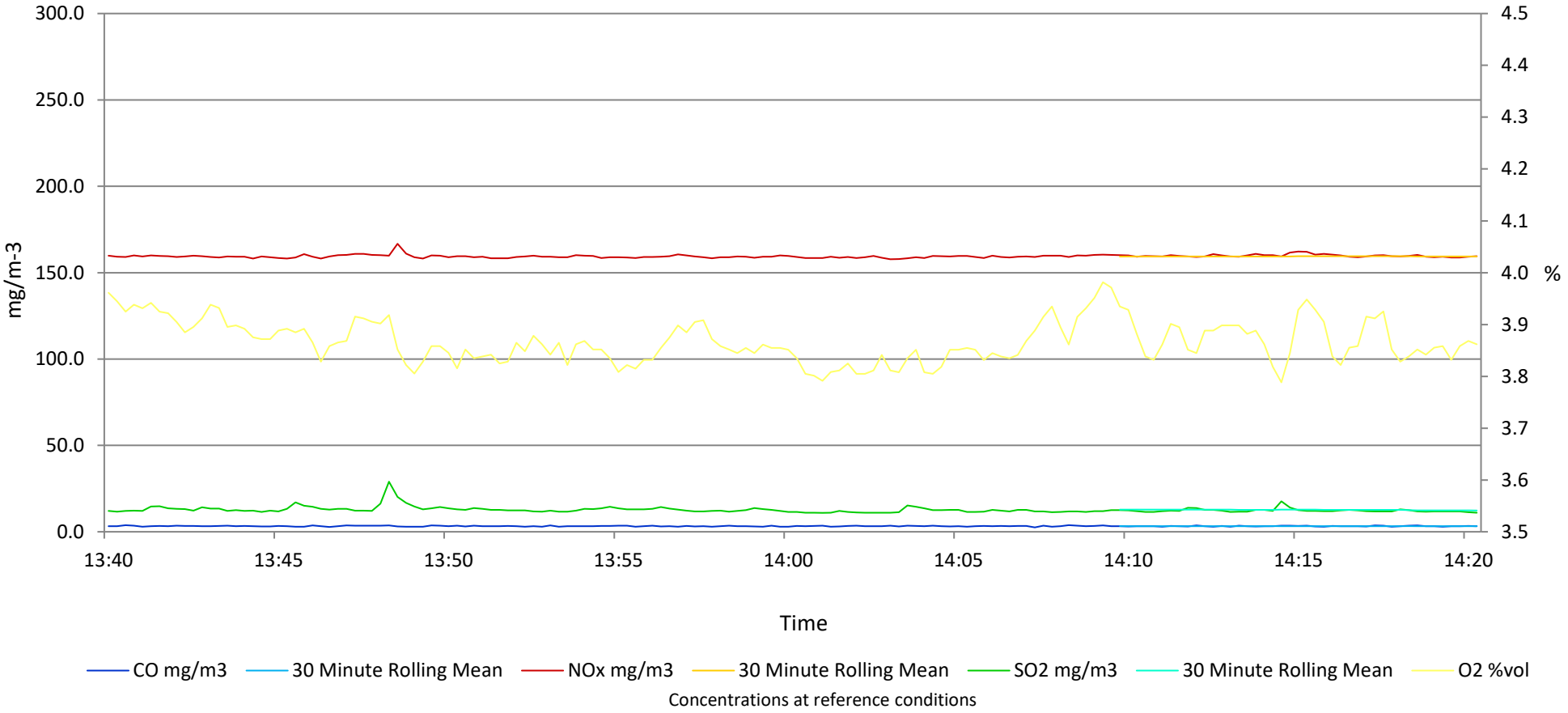
20				

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/4



Concentrations at reference conditions

Combustion Gas concentrations measured on the Boiler 3, at Saputo Dairy, Davidstow

on the 22/10/2024

Sample No: 108654/4

Concentration	CO mg/m^3	30 Minute Rolling Mean	NOx mg/m^3	30 Minute Rolling Mean	SO2 mg/m^3	30 Minute Rolling Mean	O_2 %vol
Minimum	**2.5**	**3.3**	**157.8**	**159.3**	**11.0**	**12.3**	**3.8**
Maximum	**3.8**	**3.3**	**166.7**	**159.5**	**29.0**	**12.8**	**4.0**
Average	**3.3**	**3.3**	**159.5**	**159.4**	**12.7**	**12.7**	**3.9**

EN ISO 16911 S-Type Pitot Summary Page

Customer	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date Measured	22-Oct-24
Sample Number	108654/4
X-Sectional Area	0.302
DH@	52.56
DY_d	N/A
Average sqrt DP (mmH_2O)	1.024
Average % Oxygen	3.9
Average % Carbon Dioxide	12.0
Average % Carbon Monoxide	0.0
Average % Nitrogen	84.1
Barometric Pressure (mb)	994
Duct Static Pressure (mmH2O)	-12.50
Absolute Stack Gas Pressure (KPa)	99.3
Average Stack Gas Temperature (K)	476
Moisture % (estimated)	10.00
Velocity in Stack (m/s)	4.4
Volumetric Flow at Stack Conditions (m^3/sec)	1.34
Volumetric Flow at Stack Conditions (m^3/hour)	4811.75
Volumetric flow rate STP, Wet (m^3/sec)	0.75
Volumetric flow rate at STP, Wet (m^3/hour)	2703.91
Volumetric flow rate STP, Dry (m^3/sec)	0.68
Volumetric flow rate at STP, Dry (m^3/hour)	2433.52
Volumetric flow rate at reference conditions (m^3/sec)	0.64
Volumetric flow rate at reference conditions (m^3/hour)	2308.60
% Uncertainty of Measurement	5.3

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/4
Probe Operator	LL
Console Operator	PR

DGM Inlet (°C)	25
DGM Outlet (°C)	25
Mean Temp (°C)	25
Bar Pressure (mb)	994
Moisture (%)	10.10
Dimension (m)	0.62
Stack C.S.A (m^2)	0.3019

Gas Flow	Out
Port Nipple (cm)	60
Console No.	A/S694
Pitot No.	A/S849
Tape Measure	A/S544
Timer	A/S685
Barometer No.	A/S543

Traverse Line 1

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	1.1	1.049	203	7	N/A
2	53.8	1.0	0.983	203	5	N/A

Traverse Line 2

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch
1	9.2	1.0	1.017	203	10	N/A
2	53.8	1.1	1.049	203	9	N/A

% O_2	3.9
% CO_2	12
% CO	0

Traverse Line 3

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Traverse Line 4

Traverse Number	Distance (cm)	Av Velocity Head DP (mmH_2O)	$\sqrt{\Delta P}$	Av Stack Temp (°C)	Degree of Swirl	Degree of Pitch

Average DP (mmH_2O)	1.1
Average sqrt DP	1.024
Average Stack Temp (°C)	203

Field Performance Criteria	OK?
Pitch <±10°	N/A
Swirl <±15°	Yes
Stack internal Area	Yes
Field Repeatability	N/A
Static Pressure Check	Yes

Is Negative Flow Present?	No
Minimum Velocity >5pa	Yes
Ratio of gas Velocities <3:1	Yes

Flow Characteristics Meet Requirements of EN ISO 16911?
Yes

Number of Sample Points
4

APPENDIX 3

(Uncertainty)

(20 Pages)

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/1

Measured NOx concentration (mg/m^3)	124.97	**Calibration Value (mg/m^3)**	298.28
ELV	1000	**Scale used (mg/m^3)**	512.50

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	33	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.04	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.08	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.06
Zero Drift (During Measurement)	0.00	% full scale	u_{0dr}	0.43
Span Drift (During Measurement)	0.34	% full scale		
Losses in the Line (Leak)	0.21	<2% of value	u_{leak}	0.15
Sensitivity to Atmospheric Pressure	0.1	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	1.53	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	0.04	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.23	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.3	<2% of value	u_{calib}	0.94
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	1.04			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	2.09			
Expanded uncertainty to std conditions (mg/m^3)	2.92			
Expanded Uncertainty (% ELV)	**0.29**			
Expanded uncertainty (mg/m^3)	**2.92**			
Expanded uncertainty (% Value)	**2.33**			
Requirement in standard is for uncertainty to be < ±10% at ELV at standard conditions				

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/1

Measured CO concentration (mg/m^3)	8.41	Calibration Value (mg/m^3)	126.50
ELV	N/A	Scale used (mg/m^3)	250.00

Performance Characteristic		Specification	Uncertainty	
Response Time (seconds)	28	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.16	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.35	≤±2.0% Range	u_{rs}	0.03
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.03
Zero Drift (During Measurement)	0.20	% full scale	u_{0dr}	0.30
Span Drift (During Measurement)	0.20	% full scale		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.22	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.2	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.35	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.53	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.7	<2% of value	u_{calib}	0.08
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.32			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.64			
Expanded uncertainty to std conditions (mg/m^3)	0.89			
Expanded Uncertainty (% ELV)	**N/A**			
Expanded uncertainty (mg/m^3)	**0.89**			
Expanded uncertainty (% Value)	**10.56**			
Requirement in standard is for uncertainty to be < ±6% at ELV at standard conditions				

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/1

Measured SO_2 concentration (mg/m^3)	3.14	**Calibration Value (mg/m^3)**	411.84
ELV	1000	**Scale used (mg/m^3)**	572.00

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	60	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.09	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.12	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.07
Zero Drift (During Measurement)	0.07	% full scale	u_{0dr}	0.27
Span Drift (During Measurement)	1.47	% full scale		
Losses in the Line (Leak)	0.63	<5% of value	u_{leak}	0.01
Sensitivity to Atmospheric Pressure	N/A	N/A	u_{apres}	N/A
Sensitivity to Sample Gas Flow	0.3	<2.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2.4	<5.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	2.1	<5.0% of the certification range		0.00
Sensitivity to Electric Voltage	1.00	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity @ Reference (Interferents)	-1.82	<4% of the certification range	u_{int}	0.00
Cross Sensitivity @ Zero (Interferents)	-0.48	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.8	<2% of value	u_{calib}	0.03
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.28			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.56			
Expanded uncertainty to std conditions (mg/m^3)	0.78			
Expanded Uncertainty (% ELV)	**0.08**			
Expanded uncertainty (mg/m^3)	**0.78**			
Expanded uncertainty (% Value)	**24.73**			
Requirement in standard is for uncertainty to be < ±20% at ELV at standard conditions				

Uncertainty Budget for Oxygen

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/1

Measured oxygen concentration (% Vol)	8.10	Calibration Value (% Vol)	6.10
ELV	N/A	Scale used (% Vol)	25.00

Performance Characteristic		Specification	Uncertainty	% Vol
Response Time (seconds)	25	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.05	≤±0.2% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.03	≤±0.4% Range	u_{rs}	0.00
Deviation from Linearity (±)	0.02	≤±0.3% Range	u_{fit}	0.01
Zero Drift (During Measurement)	0.16	% vol at zero level	u_{0dr}	0.12
Span Drift (During Measurement)	0.49	% vol at span level		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.19	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	0.11	<0.30% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.21	<0.30% of the certification range		0.00
Sensitivity to Electric Voltage	0.02	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<2% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	0.5	<2% of value	u_{calib}	0.02
Measurement Uncertainty				
Combined Uncertainty (% vol)	0.12			
% of Value	1.49			
Coverage Factor k	2			
Expanded uncertainty (% of value)	**2.98**			
Expanded uncertainty (% Vol)	**0.24**			
Requirement for SRM is that uncertainty should be < ±6% of value, on a dry gas basis (absolute value of approx. 0.5%)				

ISO 16911 S-Type Pitot Uncertainty

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/1

Uncertainty	Estimated Value %	Measued Value %		sqr est	sqr meas
Equipment Sources					
Master System Velocity Measurements		1		0	1
Master System Air Density Measurement		0.15		0	0.0225
Tape Measure		2		0	4
Dual Incline Manometer		0.05		0	0.0025
Thermocouples		1		0	1
Sensitivity to Atmospheric Pressure	2			4	0
Sensitivity to Ambient Temperature	2			4	0
Site Sources					
Stack Internal Area		2.60014E-06		0	6.76073E-12
Uncertainty in Flow Measurement Device Calibration	1			1	0
Uncertainty in Differential Pressure Device Calibration	1			1	0
Time	0			0	0
S-Type Reference/Stagnation Check		0.00		0	0
Repeatability at single point				0	0
Swirl/Pitch Meter Position	2			4	0
Temperature on site				0	0
Pressure on Site				0	0
Humidity on Site	0			0	0
Laboratory Sources					
Uncertainty due to Caibration	2			4	0
Repeatability (hPa)		0.66		0	0.4356
Repeatability (m/s)		0.14			
Linearity		0.15		0	0.0225
Measurement of Duct Diameter		0.67		0	0.4489
Effect of Swirl Angle (Clockwise)		0.16		0	0.0256
Effect of Swirl Angle (Anti-clockwise)		1.82		0	3.3124
Sum of squares				28.27	
		Total Uncertainty		**5.3**	

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/2

Measured NOx concentration (mg/m^3)	141.00	**Calibration Value (mg/m^3)**	298.28
ELV	1000	**Scale used (mg/m^3)**	512.50

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	33	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.04	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.08	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.06
Zero Drift (During Measurement)	0.00	% full scale	u_{0dr}	0.48
Span Drift (During Measurement)	0.34	% full scale		
Losses in the Line (Leak)	0.21	<2% of value	u_{leak}	0.17
Sensitivity to Atmospheric Pressure	0.1	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	1.53	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	0.04	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.23	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.3	<2% of value	u_{calib}	1.06
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	1.18			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	2.35			
Expanded uncertainty to std conditions (mg/m^3)	2.99			
Expanded Uncertainty (% ELV)	**0.30**			
Expanded uncertainty (mg/m^3)	**2.99**			
Expanded uncertainty (% Value)	**2.12**			
Requirement in standard is for uncertainty to be < ±10% at ELV at standard conditions				

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/2

Measured CO concentration (mg/m^3)	3.28	Calibration Value (mg/m^3)	126.50
ELV	N/A	Scale used (mg/m^3)	250.00

Performance Characteristic		Specification	Uncertainty	
Response Time (seconds)	28	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.16	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.35	≤±2.0% Range	u_{rs}	0.03
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.03
Zero Drift (During Measurement)	0.20	% full scale	u_{0dr}	0.29
Span Drift (During Measurement)	0.20	% full scale		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.22	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.2	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.35	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.53	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.7	<2% of value	u_{calib}	0.03
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.30			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.59			
Expanded uncertainty to std conditions (mg/m^3)	0.75			
Expanded Uncertainty (% ELV)	**N/A**			
Expanded uncertainty (mg/m^3)	**0.75**			
Expanded uncertainty (% Value)	**22.98**			
Requirement in standard is for uncertainty to be < ±6% at ELV at standard conditions				

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/2

Measured SO_2 concentration (mg/m^3)	12.12	**Calibration Value (mg/m^3)**	411.84
ELV	1000	**Scale used (mg/m^3)**	572.00

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	60	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.09	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.12	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.07
Zero Drift (During Measurement)	0.07	% full scale	u_{0dr}	0.37
Span Drift (During Measurement)	1.47	% full scale		
Losses in the Line (Leak)	0.63	<5% of value	u_{leak}	0.04
Sensitivity to Atmospheric Pressure	N/A	N/A	u_{apres}	N/A
Sensitivity to Sample Gas Flow	0.3	<2.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2.4	<5.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	2.1	<5.0% of the certification range		0.00
Sensitivity to Electric Voltage	1.00	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity @ Reference (Interferents)	-1.82	<4% of the certification range	u_{int}	0.00
Cross Sensitivity @ Zero (Interferents)	-0.48	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.8	<2% of value	u_{calib}	0.13
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.40			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.80			
Expanded uncertainty to std conditions (mg/m^3)	1.02			
Expanded Uncertainty (% ELV)	**0.10**			
Expanded uncertainty (mg/m^3)	**1.02**			
Expanded uncertainty (% Value)	**8.42**			
Requirement in standard is for uncertainty to be < ±20% at ELV at standard conditions				

Uncertainty Budget for Oxygen

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/2

Measured oxygen concentration (% Vol)	6.80	Calibration Value (% Vol)	6.10
ELV	N/A	Scale used (% Vol)	25.00

Performance Characteristic		Specification	Uncertainty	% Vol
Response Time (seconds)	25	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.05	≤±0.2% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.03	≤±0.4% Range	u_{rs}	0.00
Deviation from Linearity (±)	0.02	≤±0.3% Range	u_{fit}	0.01
Zero Drift (During Measurement)	0.16	% vol at zero level	u_{0dr}	0.10
Span Drift (During Measurement)	0.49	% vol at span level		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.19	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	0.11	<0.30% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.21	<0.30% of the certification range		0.00
Sensitivity to Electric Voltage	0.02	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<2% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	0.5	<2% of value	u_{calib}	0.02
Measurement Uncertainty				
Combined Uncertainty (% vol)	0.11			
% of Value	1.55			
Coverage Factor k	2			
Expanded uncertainty (% of value)	**3.10**			
Expanded uncertainty (% Vol)	**0.21**			
Requirement for SRM is that uncertainty should be < ±6% of value, on a dry gas basis (absolute value of approx. 0.5%)				

ISO 16911 S-Type Pitot Uncertainty

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/2

Uncertainty	Estimated Value %	Measued Value %		sqr est	sqr meas
Equipment Sources					
Master System Velocity Measurements		1		0	1
Master System Air Density Measurement		0.15		0	0.0225
Tape Measure		2		0	4
Dual Incline Manometer		0.05		0	0.0025
Thermocouples		1		0	1
Sensitivity to Atmospheric Pressure	2			4	0
Sensitivity to Ambient Temperature	2			4	0
Site Sources					
Stack Internal Area		2.60014E-06		0	6.76073E-12
Uncertainty in Flow Measurement Device Calibration	1			1	0
Uncertainty in Differential Pressure Device Calibration	1			1	0
Time	0			0	0
S-Type Reference/Stagnation Check		0.00		0	0
Repeatability at single point				0	0
Swirl/Pitch Meter Position	2			4	0
Temperature on site				0	0
Pressure on Site				0	0
Humidity on Site	0			0	0
Laboratory Sources					
Uncertainty due to Caibration	2			4	0
Repeatability (hPa)		0.66		0	0.4356
Repeatability (m/s)		0.14			
Linearity		0.15		0	0.0225
Measurement of Duct Diameter		0.67		0	0.4489
Effect of Swirl Angle (Clockwise)		0.16		0	0.0256
Effect of Swirl Angle (Anti-clockwise)		1.82		0	3.3124
Sum of squares				28.27	
		Total Uncertainty		**5.3**	

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/3

Measured NOx concentration (mg/m^3)	157.79	**Calibration Value (mg/m^3)**	298.28
ELV	1000	**Scale used (mg/m^3)**	512.50

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	33	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.04	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.08	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.06
Zero Drift (During Measurement)	0.00	% full scale	u_{0dr}	0.54
Span Drift (During Measurement)	0.34	% full scale		
Losses in the Line (Leak)	0.21	<2% of value	u_{leak}	0.19
Sensitivity to Atmospheric Pressure	0.1	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	1.53	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	0.04	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.23	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.3	<2% of value	u_{calib}	1.18
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	1.32			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	2.63			
Expanded uncertainty to std conditions (mg/m^3)	3.08			
Expanded Uncertainty (% ELV)	**0.31**			
Expanded uncertainty (mg/m^3)	**3.08**			
Expanded uncertainty (% Value)	**1.95**			
Requirement in standard is for uncertainty to be < ±10% at ELV at standard conditions				

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/3

Measured CO concentration (mg/m^3)	2.85	Calibration Value (mg/m^3)	126.50
ELV	N/A	Scale used (mg/m^3)	250.00

Performance Characteristic		Specification	Uncertainty	
Response Time (seconds)	28	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.16	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.35	≤±2.0% Range	u_{rs}	0.03
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.03
Zero Drift (During Measurement)	0.20	% full scale	u_{0dr}	0.29
Span Drift (During Measurement)	0.20	% full scale		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.22	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.2	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.35	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.53	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.7	<2% of value	u_{calib}	0.03
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.30			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.59			
Expanded uncertainty to std conditions (mg/m^3)	0.69			
Expanded Uncertainty (% ELV)	**N/A**			
Expanded uncertainty (mg/m^3)	**0.69**			
Expanded uncertainty (% Value)	**24.32**			
Requirement in standard is for uncertainty to be < ±6% at ELV at standard conditions				

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/3

Measured SO_2 concentration (mg/m^3)	12.85	**Calibration Value (mg/m^3)**	411.84
ELV	1000	**Scale used (mg/m^3)**	572.00

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	60	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.09	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.12	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.07
Zero Drift (During Measurement)	0.07	% full scale	u_{0dr}	0.38
Span Drift (During Measurement)	1.47	% full scale		
Losses in the Line (Leak)	0.63	<5% of value	u_{leak}	0.05
Sensitivity to Atmospheric Pressure	N/A	N/A	u_{apres}	N/A
Sensitivity to Sample Gas Flow	0.3	<2.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2.4	<5.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	2.1	<5.0% of the certification range		0.00
Sensitivity to Electric Voltage	1.00	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity @ Reference (Interferents)	-1.82	<4% of the certification range	u_{int}	0.00
Cross Sensitivity @ Zero (Interferents)	-0.48	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.8	<2% of value	u_{calib}	0.13
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.41			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.83			
Expanded uncertainty to std conditions (mg/m^3)	0.97			
Expanded Uncertainty (% ELV)	**0.10**			
Expanded uncertainty (mg/m^3)	**0.97**			
Expanded uncertainty (% Value)	**7.53**			
Requirement in standard is for uncertainty to be < ±20% at ELV at standard conditions				

Uncertainty Budget for Oxygen

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/3

Measured oxygen concentration (% Vol)	5.62	Calibration Value (% Vol)	6.10
ELV	N/A	Scale used (% Vol)	25.00

Performance Characteristic		Specification	Uncertainty	% Vol
Response Time (seconds)	25	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	42			
Number of Readings in Measurements	168			
Standard dev Repeat @ Zero	0.05	≤±0.2% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.03	≤±0.4% Range	u_{rs}	0.00
Deviation from Linearity (±)	0.02	≤±0.3% Range	u_{fit}	0.01
Zero Drift (During Measurement)	0.16	% vol at zero level	u_{0dr}	0.09
Span Drift (During Measurement)	0.49	% vol at span level		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.19	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	0.11	<0.30% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.21	<0.30% of the certification range		0.00
Sensitivity to Electric Voltage	0.02	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<2% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	0.5	<2% of value	u_{calib}	0.02
Measurement Uncertainty				
Combined Uncertainty (% vol)	0.09			
% of Value	1.62			
Coverage Factor k	2			
Expanded uncertainty (% of value)	**3.25**			
Expanded uncertainty (% Vol)	**0.18**			
Requirement for SRM is that uncertainty should be < ±6% of value, on a dry gas basis (absolute value of approx. 0.5%)				

ISO 16911 S-Type Pitot Uncertainty

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/3

Uncertainty	Estimated Value %	Measued Value %		sqr est	sqr meas
Equipment Sources					
Master System Velocity Measurements		1		0	1
Master System Air Density Measurement		0.15		0	0.0225
Tape Measure		2		0	4
Dual Incline Manometer		0.05		0	0.0025
Thermocouples		1		0	1
Sensitivity to Atmospheric Pressure	2			4	0
Sensitivity to Ambient Temperature	2			4	0
Site Sources					
Stack Internal Area		2.60014E-06		0	6.76073E-12
Uncertainty in Flow Measurement Device Calibration	1			1	0
Uncertainty in Differential Pressure Device Calibration	1			1	0
Time	0			0	0
S-Type Reference/Stagnation Check		0.00		0	0
Repeatability at single point				0	0
Swirl/Pitch Meter Position	2			4	0
Temperature on site				0	0
Pressure on Site				0	0
Humidity on Site	0			0	0
Laboratory Sources					
Uncertainty due to Caibration	2			4	0
Repeatability (hPa)		0.66		0	0.4356
Repeatability (m/s)		0.14			
Linearity		0.15		0	0.0225
Measurement of Duct Diameter		0.67		0	0.4489
Effect of Swirl Angle (Clockwise)		0.16		0	0.0256
Effect of Swirl Angle (Anti-clockwise)		1.82		0	3.3124
Sum of squares				28.27	
		Total Uncertainty		**5.3**	

Uncertainty Budget for Oxides of nitrogen

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/4

Measured NOx concentration (mg/m^3)	159.47	**Calibration Value (mg/m^3)**	298.28
ELV	1000	**Scale used (mg/m^3)**	512.50

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	33	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	40			
Number of Readings in Measurements	160			
Standard dev Repeat @ Zero	0.04	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.08	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.06
Zero Drift (During Measurement)	0.00	% full scale	u_{0dr}	0.54
Span Drift (During Measurement)	0.34	% full scale		
Losses in the Line (Leak)	0.21	<2% of value	u_{leak}	0.19
Sensitivity to Atmospheric Pressure	0.1	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	1.53	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	0.04	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.23	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.3	<2% of value	u_{calib}	1.20
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	1.33			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	2.66			
Expanded uncertainty to std conditions (mg/m^3)	2.80			
Expanded Uncertainty (% ELV)	**0.28**			
Expanded uncertainty (mg/m^3)	**2.80**			
Expanded uncertainty (% Value)	**1.75**			
Requirement in standard is for uncertainty to be < ±10% at ELV at standard conditions				

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/4

Measured CO concentration (mg/m^3)	3.29	Calibration Value (mg/m^3)	126.50
ELV	N/A	Scale used (mg/m^3)	250.00

Performance Characteristic		Specification	Uncertainty	
Response Time (seconds)	28	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	40			
Number of Readings in Measurements	160			
Standard dev Repeat @ Zero	0.16	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.35	≤±2.0% Range	u_{rs}	0.03
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.03
Zero Drift (During Measurement)	0.20	% full scale	u_{0dr}	0.29
Span Drift (During Measurement)	0.20	% full scale		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.22	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2	<3.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.2	<3.0% of the certification range		0.00
Sensitivity to Electric Voltage	-0.35	<2.0% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.53	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.7	<2% of value	u_{calib}	0.03
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.30			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.59			
Expanded uncertainty to std conditions (mg/m^3)	0.62			
Expanded Uncertainty (% ELV)	**N/A**			
Expanded uncertainty (mg/m^3)	**0.62**			
Expanded uncertainty (% Value)	**18.96**			
Requirement in standard is for uncertainty to be < ±6% at ELV at standard conditions				

Uncertainty Budget for Sulphur dioxide

Client	Saputo Dairy	**Date**	22/10/2024
Emission Point ID	Boiler 3	**Sample Number**	108654/4

Measured SO_2 concentration (mg/m^3)	12.70	**Calibration Value (mg/m^3)**	411.84
ELV	1000	**Scale used (mg/m^3)**	572.00

Performance Characteristic		**Specification**	**Uncertainty**	
Response Time (seconds)	60	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	40			
Number of Readings in Measurements	160			
Standard dev Repeat @ Zero	0.09	≤±1.0% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.12	≤±2.0% Range	u_{rs}	0.01
Deviation from Linearity (±)	0.02	≤±2.0% Range	u_{fit}	0.07
Zero Drift (During Measurement)	0.07	% full scale	u_{0dr}	0.38
Span Drift (During Measurement)	1.47	% full scale		
Losses in the Line (Leak)	0.63	<5% of value	u_{leak}	0.05
Sensitivity to Atmospheric Pressure	N/A	N/A	u_{apres}	N/A
Sensitivity to Sample Gas Flow	0.3	<2.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	2.4	<5.0% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	2.1	<5.0% of the certification range		0.00
Sensitivity to Electric Voltage	1.00	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity @ Reference (Interferents)	-1.82	<4% of the certification range	u_{int}	0.00
Cross Sensitivity @ Zero (Interferents)	-0.48	<4% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	1.8	<2% of value	u_{calib}	0.13
Uncertainty in Factor	0.00		u_f	0.00
Measurement Uncertainty				
Combined Uncertainty (mg/m^3)	0.41			
Coverage Factor k	2			
Expanded uncertainty (mg/m^3)	0.82			
Expanded uncertainty to std conditions (mg/m^3)	0.86			
Expanded Uncertainty (% ELV)	**0.09**			
Expanded uncertainty (mg/m^3)	**0.86**			
Expanded uncertainty (% Value)	**6.79**			
Requirement in standard is for uncertainty to be < ±20% at ELV at standard conditions				

Uncertainty Budget for Oxygen

Client	Saputo Dairy	Date	22/10/2024
Emission Point ID	Boiler 3	Sample Number	108654/4

Measured oxygen concentration (% Vol)	3.87	Calibration Value (% Vol)	6.10
ELV	N/A	Scale used (% Vol)	25.00

Performance Characteristic		Specification	Uncertainty	% Vol
Response Time (seconds)	25	<200s		
Logger Sampling Interval (seconds)	15			
Measurement Period (minutes)	40			
Number of Readings in Measurements	160			
Standard dev Repeat @ Zero	0.05	≤±0.2% Range	u_{r0}	N/A
Standard dev Repeat @ Span	0.03	≤±0.4% Range	u_{rs}	0.00
Deviation from Linearity (±)	0.02	≤±0.3% Range	u_{fit}	0.01
Zero Drift (During Measurement)	0.16	% vol at zero level	u_{0dr}	0.07
Span Drift (During Measurement)	0.49	% vol at span level		
Losses in the Line (Leak)	0.00	<2% of value	u_{leak}	0.00
Sensitivity to Atmospheric Pressure	0.19	<1.5% of the certification range	u_{apres}	0.00
Sensitivity to Sample Gas Flow	0.1	<1.0% of the certification range	u_{spres}	0.00
Sensitivity to Ambient Temp @ Span	0.11	<0.30% of the certification range	u_{temp}	0.00
Sensitivity to Ambient Temp @ Zero	-0.21	<0.30% of the certification range		0.00
Sensitivity to Electric Voltage	0.02	<0.10% of the certification range	u_{volt}	0.00
Cross Sensitivity (Interferents)	0.00	<2% of the certification range	u_{int}	0.00
Uncertainty of calibration gas	0.5	<2% of value	u_{calib}	0.01
Measurement Uncertainty				
Combined Uncertainty (% vol)	0.07			
% of Value	1.82			
Coverage Factor k	2			
Expanded uncertainty (% of value)	**3.65**			
Expanded uncertainty (% Vol)	**0.14**			
Requirement for SRM is that uncertainty should be < ±6% of value, on a dry gas basis (absolute value of approx. 0.5%)				

ISO 16911 S-Type Pitot Uncertainty

Client	Saputo Dairy UK
Site	Davidstow
Emission Point	Boiler 3
Date	22/10/2024
Sample Number	108654/4

Uncertainty	Estimated Value %	Measued Value %		sqr est	sqr meas
Equipment Sources					
Master System Velocity Measurements		1		0	1
Master System Air Density Measurement		0.15		0	0.0225
Tape Measure		2		0	4
Dual Incline Manometer		0.05		0	0.0025
Thermocouples		1		0	1
Sensitivity to Atmospheric Pressure	2			4	0
Sensitivity to Ambient Temperature	2			4	0
Site Sources					
Stack Internal Area		2.60014E-06		0	6.76073E-12
Uncertainty in Flow Measurement Device Calibration	1			1	0
Uncertainty in Differential Pressure Device Calibration	1			1	0
Time	0			0	0
S-Type Reference/Stagnation Check		0.29		0	0.08661249
Repeatability at single point				0	0
Swirl/Pitch Meter Position	2			4	0
Temperature on site				0	0
Pressure on Site				0	0
Humidity on Site	0			0	0
Laboratory Sources					
Uncertainty due to Caibration	2			4	0
Repeatability (hPa)		0.66		0	0.4356
Repeatability (m/s)		0.14			
Linearity		0.15		0	0.0225
Measurement of Duct Diameter		0.67		0	0.4489
Effect of Swirl Angle (Clockwise)		0.16		0	0.0256
Effect of Swirl Angle (Anti-clockwise)		1.82		0	3.3124
Sum of squares				28.356612	
		Total Uncertainty		**5.3**	

APPENDIX 4

(Instrumental analyser details)

(2 Pages)

Principle of Gas Conditioning

The sampling for oxygen, oxides of nitrogen, sulphur dioxide and carbon monoxide was carried out using a Horiba PG-350 combustion gas analyser fed via a heated sampling system comprising of a sampling probe, 20m sampling line (set at 120°C) and a PD100 permeation dryer gas conditioning system.

The sample gas enters a heated filter (approx. 100°C), separating all particles larger than 2µm. After filtration the sample gas proceeds to the permeation dryer, equipped with a temperature gradient. The installed permeation dryer is operated with dry purge gas, running in inverted direction flow. Due to the difference in partial pressure between sample and purge gas, humidity is driven out of the sample by equalization. The water is extracted from the sample gas through a semi permeable membrane and transported into an outer tube filled with the purge gas. This process does not have a distinguishable effect on the sample gas composition. The conditioned gas is then passed to the gas analyser for quantification.

Oxides of nitrogen are analysed using a standard technique called Chemiluminescence and during the sampling was set to cover the range 0-250 ppm.

Sulphur dioxide is analysed using a standard technique called Non-dispersive infra-red spectroscopy (N.D.I.R.) and was set to cover the range 0-200 ppm.

Carbon monoxide is analysed using a standard technique called Non-dispersive infra-red spectroscopy (N.D.I.R.) and was set to cover the range 0-2000ppm.

Performance Characteristic	Minimum performance characteristic			
	NOx	CO	O_2	SO_2
Response Time (Required)	≤200 s	≤200 s	≤200 s	≤200 s
Results	<50	<50	<40	<60
Detection Limit	≤± 2% Range	≤± 2% Range	≤± 0.2% relative of Range	≤± 2%
Results	<0.1	<0.2	<0.05	<0.15
Lack of Fit (Linearity)	≤± 2% Range	≤± 2% Range	≤± 0.3% volume	≤± 2%
Results	<2 (R^2 >0.9998)	<2 (R^2 >0.9999)	<2 (R^2 >0.9998)	<2 (R^2 >0.9997)
Zero Drift	≤± 2% Range/24 hours	≤± 2% Range/24 hours	≤± 0.2% Volume/24 hours	≤± 2%/24 hours
Results	0.04%	0.12%	0.02%	0.44%
Span Drift	≤± 2% Range/24 hours	≤± 2% Range/24 hours	≤± 0.2% Volume/24 hours	≤± 2%/24 hours
Results	0.08%	0.25%	0.01%	0.75%
Sensitivity to Atmos Pressure	≤± 3% Range/2 kPa	≤± 3% Range/2 kPa	≤± 3% of Range for 2 kPa	≤± 3%/2 kPa
Results	≤± 3% Range/2 kPa	≤± 3% Range/2 kPa	≤± 3% of Range for 2 kPa	≤± 3%/2 kPa
Sensitivity to Sample Volume/pressure	-	-	-	≤± 1%
Results	-	-	-	≤± 1%
Sensitivity to ambient temperature	≤± 3% Range/10 K	≤± 3% Range/10 K	≤± 0.3% Volume/10 K	≤± 3% Range/10 K
Results	≤± 3% Range/10 K	≤± 3% Range/10 K	≤± 0.3% Volume/10 K	≤± 3% Range/10 K
Sensitivity to Electric Voltage	≤± 2% Range/10 V	≤± 2% Range/10 V	≤± 0.1% Volume/10 V	≤± 2% Range/10 V
Results	≤± 2% Range/10 V	≤± 2% Range/10 V	≤± 0.1% Volume/10 V	≤± 2% Range/10 V
Interferents	Total ≤± 4% Range	Total ≤± 4% Range	Total ≤± 0.2% Volume	Total ≤± 4%
Results	-0.52%	-0.87%	0%	-1.82%
Converter Efficiency	≥95.0%			
Results	95.24%			
Losses & Leakage in Sampling Line and Conditioning System	≤± 2% of measured value	≤± 2% of measured value	≤± 2.0% relative of the measured value	≤± 5%
Results	<2%	<2%	<2%	<5%
Std Deviation of repeatability in Lab at zero	≤± 1% Range	≤± 1% Range	≤± 0.20% relative of the range	≤± 1%
Results	0.03%	0.32%	0.07%	0.24%
Std Deviation of repeatability in Lab at span level	≤± 2% Range	≤± 2% Range	≤± 0.40% relative of the range	≤± 2%
Results	0.11%	0.22%	0.06%	0.46%

APPENDIX 5

(Annual calibration details & analysis data retained at permanent laboratory)