Element, Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL
Your Element Contact: Scott Pilkington (07825 991 537)
E: scott.pilkington@element.com

Stack Emissions Testing Report Commissioned by
Fujifilm Diosynth Biotechnologies UK Ltd

Installation Name & Address
Fujifilm Diosynth Biotechnologies UK Ltd
Chilton Site
PO BOX 2
Belasis Avenue
Billingham
Stockton on Tees
TS23 1YN

EPR Permit: BJ8987IQ

Stack Reference
Danks Boiler

Dates of the Monitoring Campaign
11th November 2024

Job Reference Number
EMT10438

Report Written by
Ciaran Skipper Team Leader MCERTS Level 2 MM 20 1611 TE1 TE2 TE3 TE4

Report Approved by
Tracy Dodds Key Account Manager MCERTS Level 2 MM 03 414 TE1 TE2 TE3 TE4

Report Date
22nd November 2024

Version
Version 1

Signature of Report Approver


CONTENTS

Opinions and interpretations expressed herein are outside the scope of Element's ISO 17025 accreditation.

MONITORING OBJECTIVES

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham
Danks Boiler
11th November 2024

Overall Aim of the Monitoring Campaign

Element were commissioned by Fujifilm Diosynth Biotechnologies UK Ltd to carry out stack emissions testing on the Danks Boiler at Billingham.

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

Sulphur Dioxide, Oxides of Nitrogen (as NO_2), Carbon Monoxide

Executive Summary

MONITORING RESULTS

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

11th November 2024

where MU = Measurement Uncertainty associated with the Result

	Concentration				Mass Emission			
Parameter	**Units**	**Result**	**MU +/-**	**Limit**	**Units**	**Result**	**MU +/-**	**Limit**
Sulphur Dioxide [1]	mg/m³	< 0.36	0.022	-	g/hr	< 0.90	0.071	-
Oxides of Nitrogen (as NO_2) [1]	mg/m³	150	7.5	200	g/hr	379	26.8	-
Carbon Monoxide [1]	mg/m³	5.6	1.0	-	g/hr	14.0	2.7	-
Oxygen	% v/v	Dry 8.3	0.31					
Water Vapour	% v/v	13.9	0.70					
Stack Gas Temperature	°C	196						
Stack Gas Velocity	m/s	7.8	0.17					
Volumetric Flow Rate (ACTUAL)	m³/hr	6947	349					
Volumetric Flow Rate (REF) [1]	m³/hr	2516	126					

NOTE: VOLUMETRIC FLOW RATE & VELOCITY DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

[1] Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 3% oxygen.

Executive Summary

MONITORING DATE(S) & TIMES

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

11th November 2024

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Sulphur Dioxide	R1	mg/m³	< 0.36	g/hr	< 0.90	11/11/2024	12:39 - 13:36	30
Oxides of Nitrogen (as NO_2)	R1	mg/m³	150	g/hr	379	11/11/2024	12:39 - 13:36	30
Carbon Monoxide	R1	mg/m³	5.6	g/hr	14.0	11/11/2024	12:39 - 13:36	30
Oxygen	R1	% v/v	8.1			11/11/2024	12:39 - 13:36	30
Velocity Traverse	R1					11/11/2024	11:15 - 11:24	

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

11th November 2024

Standard Operating Conditions

Parameter	Value
Process Status	Boiler
Capacity (of 100%) and Tonnes / Hour	Test While on Lead
Continuous or Batch Process	Continuous
Feedstock (if applicable)	N/A
Abatement System	None
Abatement System Running Status	N/A
Fuel	Natural Gas
Plume Appearance	None

MONITORING & ANALYTICAL METHODS

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

11th November 2024

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**Sampling Status**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**Analysis Status**	**Analysis Lab**	**Overall Status**	**LOD (Average)**
Sulphur Dioxide	EN 14791	MD 009	MCERTS	EET	CAT-AP-01	IC	MCERTS	EET	MCERTS	0.356 mg/m³
Water Vapour	EN 14790	MD 005	MCERTS	EET	MD 005	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Oxides of Nitrogen (as NO_2)	EN 14792	MD 039	MCERTS	EET	Chemiluminescence by Horiba PG-350E				MCERTS	0.41 mg/m³
Carbon Monoxide	EN 15058	MD 039	MCERTS	EET	NDIR by Horiba PG-350E				MCERTS	0.25 mg/m³
Oxygen	EN 14789	MD 039	MCERTS	EET	Dry Paramagnetic Cell by Horiba PG-350E				MCERTS	0.1 %
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	MD 041	MCERTS	EET	Pitot Tube and Thermocouple				MCERTS	1.2 m/s

ANALYSIS LABORATORIES

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

Element (Stockport Lab - EET)	ISO 17025 Accreditation Number: UKAS 4279

SUMMARY OF SAMPLING DEVIATIONS

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

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.56
Width	m	-
Area	m^2	0.25
Port Depth	cm	6
Orientation of Duct	-	Angled
Number of Ports	-	1
Sample Port Size	-	1" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	Permanent
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.

Sampling Plane Validation Criteria (from EN 15259)

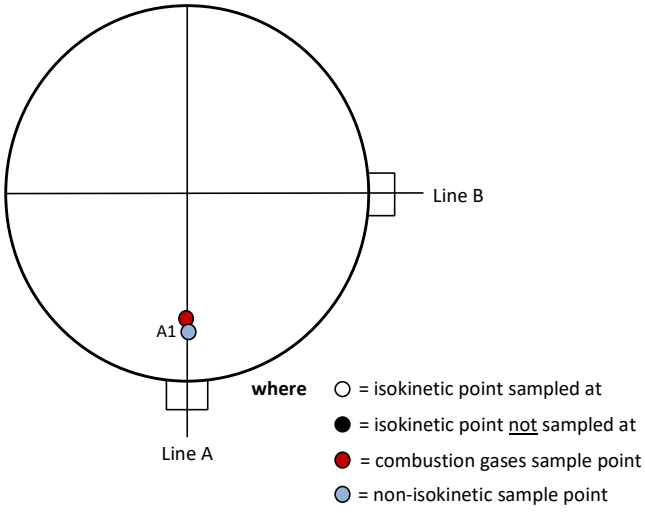
Criteria in EN 15259	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	32.0	> 5 Pa	Yes
Mean Velocity	m/s	7.83	-	-
Lowest Gas Velocity	m/s	7.60	-	-
Highest Gas Velocity	m/s	8.29	-	-
Ratio of Above	: 1	1.09	< 3 : 1	Yes
Maximum Angle of Swirl	°	4.00	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

Executive Summary

PLANT PHOTOS

Photo 1

SAMPLE POINTS



APPENDIX CONTENTS

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Ciaran Skipper	MCERTS Level 2	MM20 1611	TE1 TE2 TE3 TE4
Technician	Joseph Robins	MCERTS Level 1	MM23 1797	TE1

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	-
Control Box DGM (2)	-
Box Thermocouples (1)	-
Box Thermocouples (2)	-
Umbilical (1)	-
Umbilical (2)	-
Oven Box (1)	-
Oven Box (2)	-
Heated Probe (1)	-
Heated Probe (2)	CAT 5.169
Heated Probe (3)	-
S-Pitot (1)	CAT 21P.152
S-Pitot (2)	CAT 21P.153
L-Pitot	-
Site Balance	CAT 17.49
500g / 1Kg Check Weights	CAT 17.49
Last Impinger Arm	CAT 4.1186
Callipers	-
Tubes Kit Thermocouple	CAT 4.00026

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-350E	CAT 39.24
Horiba PG-350E	-
Servomex 5200 MP	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Testo 350 XL	-
JCT JCC P1 Cooler	CAT 4.491
Gasmet DX4000	-
Gasmet Sampling System	-
Sick 3006	-
M&C PSS	-
Mass Flow Controller (1)	CAT 6.73
Mass Flow Controller (2)	CAT 6.74
Mass View (1)	CAT 25.69
Mass View (2)	CAT 25.70
Hioki 5043 (V)	CAT 11.98
Hioki 5043 (V)	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	-
Digital Manometer (2)	-
Digital Temperature Meter	-
Stopwatch	-
Barometer	-
Stack Thermocouple (1)	-
Stack Thermocouple (2)	CAT 4.00127
Stack Thermocouple (3)	-
1m Heated Line (1)	CAT 20.163
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	-
20m Heated Line (1)	CAT 20.252
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	-
Laboratory Balance	
Tape Measure	CAT 16.77

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Sulphur Dioxide	EN 14791	MD 009
Water Vapour	EN 14790	MD 005
Oxides of Nitrogen (as NO_2)	EN 14792	MD 039
Carbon Monoxide	EN 15058	MD 039
Oxygen	EN 14789	MD 039
Velocity & Vol. Flow Rate	EN 16911-1 (MID)	MD 041

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.56
Stack Width, W	m	-
Stack Area, A	m^2	0.25
Average Stack Gas Temperature, T_a	°C	196.0
Average Stack Gas Pressure	Pa	34.0
Average Stack Static Pressure, P_{static}	kPa	0.015
Average Barometric Pressure, P_b	kPa	103.7
Average Pitot Tube Calibration Coefficient, C_p	-	0.82

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m³ p	Conc kg/m³ p_i
CO_2 (Estimated)	-	7.00	6.03	0.0700	44.01	1.9635	0.13745
O_2	-	8.30	7.15	0.0830	32.00	1.4277	0.11847
N_2	-	84.70	72.94	0.8470	28.01	1.2498	1.05865
Moisture (H_2O)	-	-	13.88	0.1388	18.02	0.8037	0.11157

Where: p = M / 22.41

p_i = r x p

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P_{STD}	kg/m³	1.315
Wet Density (STP), P_{STW}	kg/m³	1.244
Dry Density (Actual), P_{Actual}	kg/m³	0.783
Average Wet Density (Actual), $P_{ActualW}$	kg/m³	0.741

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) $= P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF [1]
Temperature	°C	196.0	0.0
Total Pressure	kPa	103.7	101.3
Moisture	%	13.88	0.00
Oxygen (Dry)	%	8.3	3.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m³/hr	6947
Gas Volumetric Flowrate (STP, Wet)	m³/hr	4140
Gas Volumetric Flowrate (STP, Dry)	m³/hr	3565
Gas Volumetric Flowrate REF [1]	m³/hr	2516

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID)

(1 of 1)

Parameter	Units	Value
Date of Survey	-	11/11/2024
Time of Survey	-	11:15 - 11:24
Atmospheric Pressure	kPa	103.7
Average Stack Static Pressure	Pa	15
Result of Pitot Stagnation Test	-	Pass
Are Water Droplets Present?	-	No
Device Used	S-Type Pitot with KIMO MP 200 (500Pa)	

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Angled
Pitot Tube, C_p	-	0.82
Number of Lines Available	-	2
Number of Lines Used	-	2

		Sampling Line A					Sampling Line B				
Traverse Point	**Depth m**	**ΔP Pa**	**Temp °C**	**Wet Density kg/m³**	**Velocity m/s**	**Swirl °**	**ΔP Pa**	**Temp °C**	**Wet Density kg/m³**	**Velocity m/s**	**Swirl °**
STATIC (Units: Pa)		*16.0*					*14.0*				
Mean		**34.0**	**196.0**	**0.741**	**7.84**		**34.0**	**196.0**	**0.741**	**7.83**	
1	0.04	32.0	196.0	0.741	7.60	2.0	32.0	196.0	0.741	7.60	2.0
2	0.14	36.0	196.0	0.741	8.07	3.0	34.0	196.0	0.741	7.84	3.0
3	0.42	36.0	196.0	0.741	8.07	2.0	38.0	196.0	0.741	8.29	4.0
4	0.52	32.0	196.0	0.741	7.60	2.0	32.0	196.0	0.741	7.60	3.0

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE TO EN 16911-1 (MID) - MEASUREMENT UNCERTAINTY

(1 of 1)

Performance characteristics (Uncertainty Components)	Uncertainty	Value	Units
Standard Uncertainty on the coefficient of the Pitot Tube	u(k)	0.005	-
Standard Uncertainty associated with the mean local dynamic pressures	u(Δpi)	1.104	Pa
- Resolution	u(res)	0.00087	
- Calibration	u(cal)	0.120	
- Drift	u(drift)	0.083	
- Lack of Fit	u(fit)	0.015	
- Overall corrections to dynamic measurements	u(Cf)	0.219	
Standard uncertainty associated with the molar mass of the gas	u(M)	0.00008	-
- $\varphi O_2,w$	-	7.146	
- $\varphi CO_2,w$	-	6.028	
- Oxygen, dry	u(ϕO_2,d)	0.254	
- Carbon Dioxide, dry	u(ϕCO_2,d)	0.214	
- Water Vapour	u(ϕH_2O)	0.708	
- Oxygen, wet	u(ϕO_2,w)	0.227	
- Carbon Dioxide, wet	u(ϕCO_2,w)	0.191	
Standard uncertainty associated with the stack temperature	u(Tc)	2.393	K
Standard uncertainty associated with the absolute pressure in the duct	u(pc)	175.694	Pa
- Atmospheric Pressure	u(patm)	175.692	
- Static Pressure	u(pstat)	0.781	
Standard uncertainty associated with the density in the duct	u(ρ)	0.00398	-
Standard uncertainty associated with the local velocities	u(vi)	0.148	Pa
Standard uncertainty associated with the mean velocity	u(v)	0.087	m/s
Standard uncertainty associated with the mean velocity (95% Confidence)	Uc(v)	0.171	m/s
Standard uncertainty associated with the mean velocity (95% Confidence), relative	Uc,rel(v)	2.18	%
Standard uncertainty associated with the volume flow rate (95% Confidence)	Uc(qV,w)	348.9	m^3/hr
- $u^2(a)/a^2$	-	0.00053	
- $u^2(qV,w)/q^2V,w$	-	0.00066	
- $u^2(qV,w)$	-	31690	
- $u(qV,w)$	-	178.0	
Standard uncertainty associated with the volume flow rate (95% Confidence), relative	Uc,rel(qV,w)	5.02	%

SULPHUR DIOXIDE: RESULTS SUMMARY

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	< 0.36		< 0.36
Uncertainty	±mg/m³	0.022		0.022
Mass Emission	g/hr	< 0.90		< 0.90
Uncertainty	±g/hr	0.071		0.071

NOTE: Where the maximum Blank concentration is higher than the Sample concentration, the Blank concentration has been reported.

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	13.9		13.9
Uncertainty	±% v/v	0.70		0.70

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	< 0.36		< 0.36

General Sampling Information

Parameter	Value	
Standard	EN 14791	
Technical Procedure	MD 009	
Name of Analytical Laboratory	EET	
Analytical Laboratory's Procedure	CAT-AP-01	
ISO 17025 Accredited Analysis?	MCERTS	
Date of Sample Analysis	20/11/2024	
Probe Material	Stainless Steel	
Filter Housing Material	Titanium	
Impinger Material	Polyethylene	
Absorption Solution	0.3% Hydrogen Peroxide	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Quartz Fibre	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

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

SULPHUR DIOXIDE: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	12:39 - 13:36
Sampling Dates	-	11/11/2024
Sampling Device	-	MFC / MV
Duration	mins	30
Volume Sampled (STP, Dry)	m^3	0.0603
Volume Sampled (STP, Wet)	m^3	0.0700
Volume Sampled (REF)	m^3	0.0419
Sample Flow Rate	l/min	1.96
Laboratory Result for Front Impingers	µg/ml	< 0.05
Laboratory Result for Back Impinger	µg/ml	< 0.05
Volume in Front Impingers	ml	199.3
Volume in Back Impinger	ml	98.8
Mass in Front Impingers	µg	< 10.0
Mass in Back Impinger	µg	< 4.9
Total Mass Collected	µg	< 14.9
Calculated Concentration	mg/m^3	< 0.36
Liquid Trap Start Mass	g	1589.2
Liquid Trap End Mass	g	1596.7
Silica Trap Start Mass	g	1479.9
Silica Trap End Mass	g	1480.2
Total Mass Of Water Vapour	g	7.8
Calculated Water Vapour	% v/v	13.88

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

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	11/11/2024
Average Volume Sampled (REF)	m^3	0.0419
Laboratory Result for Impingers	µg/ml	< 0.05
Volume in Impingers	ml	301.0
Total Mass Collected	µg	< 15.1
Calculated Concentration	mg/m^3	< 0.36

SULPHUR DIOXIDE: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	2.0
Pre-Sampling Leak Rate	l/min	0.02
Post-Sampling Leak Rate	l/min	0.02
Allowable Leak Rate	l/min	0.04
Leak Test Acceptable	-	Yes

Absorption Efficiency	Units	Run 1
Absorption Efficiency	%	100.0
Allowable Absorption Efficiency	%	95
Absorption Efficiency Acceptable	-	Yes

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	5.0
Allowable MU	%	20.0
MU Acceptable	%	Yes

Silica Gel (Concurrent Water Vapour)	Units	Run 1
Less than 50% Faded	%	Yes

Test Conditions	Units	Run 1
Ambient Temperature Recorded?	-	Yes

Blank Runs

Leak Test Results	Units	Blank 1
Expected Sampling Rate	l/min	2.0
Pre-Sampling Leak Rate	l/min	0.02
Post-Sampling Leak Rate	l/min	0.03
Allowable Leak Rate	l/min	0.04
Leak Test Acceptable	-	Yes

Validity of Blank vs ELV	Units	Blank 1
Allowable Blank	mg/m^3	N/A
Blank Acceptable	-	N/A

Method Deviations

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

SULPHUR DIOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value		Standard uncertainty		
Measured Quantities	**Symbol**	**Run 1**	**Symbol**	**Units**	**Run 1**
Sampled Volume (STP)	V_m	0.0603	uV_m	m^3	0.0012
Leak	L	1.02	uL	%	-
Laboratory Result	L_r	0.90	uL_r	%	-

	Uncertainty as a Percentage		
Measured Quantities	**Units**	**Run 1**	**Requirement of Standard**
Sampled Volume (STP)	%	2.00	≤2%
Leak	%	1.02	≤2%
Laboratory Result	%	0.90	No Requirement

	Uncertainty in Measurement Units			Sensitivity Coefficient
Measured Quantities	**Symbol**	**Units**	**Run 1**	**Run 1**
Sampled Volume (STP)	V_m	m^3	0.0603	5.96
Leak	L	mg/m^3	0.002	1.00
Laboratory Result	L_r	mg/m^3	0.003	1.00

	Uncertainty in Result	
Measured Quantities	**Units**	**Run 1**
Sampled Volume (STP)	mg/m^3	0.007
Leak	mg/m^3	0.0021
Laboratory Result	mg/m^3	0.0032

	Oxygen Correction Part of MU Budget	
Measured Quantities	**Units**	**Run 1**
O_2 Correction Factor	-	1.44
Stack Gas O_2 Content	% v/v	8.50
MU for O_2 Correction	-	0.06
Overall MU For O_2 Measurement	%	4.00

Parameter	**Units**	**Run 1**
Combined uncertainty	mg/m^3	0.01
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	0.02
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	0.02
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.02
Reported Uncertainty	mg/m^3	0.02
Expanded uncertainty (95% confidence), without Oxygen Correction	%	4.5
Expanded uncertainty (95% confidence), with Oxygen Correction	%	6.0
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	6.0
Reported Uncertainty	%	6.0
Reported Uncertainty as % of ELV	%	N/A

OXIDES OF NITROGEN (as NO_2): RESULTS SUMMARY

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham

Danks Boiler

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	150		150
Uncertainty	±mg/m³	7.5		7.5
Mass Emission	g/hr	379		379
Uncertainty	±g/hr	26.8		26.8

General Sampling Information

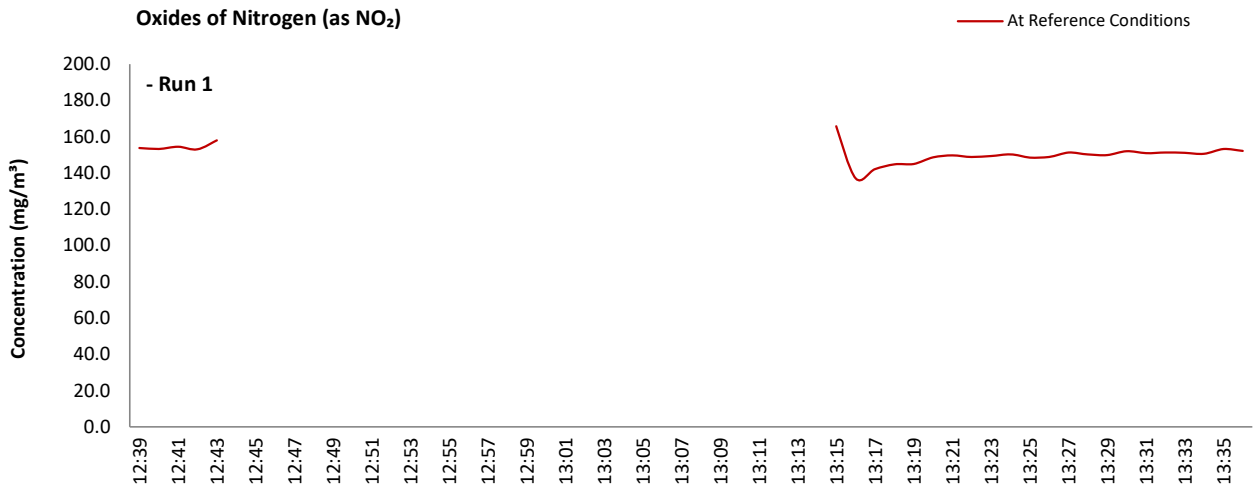
Parameter	Value	
Standard	EN 14792	
Technical Procedure	MD 039	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	08/03/2024 - 95.8%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	12.0540	
Span Gas Expiry Date	20/11/2025	
Span Gas Start Pressure (bar)	20	
Gas Cylinder Concentration (ppm)	414.1	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

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

OXIDES OF NITROGEN (as NO_2): DATA TREND

Graphical Trend of Data



OXIDES OF NITROGEN (as NO_2): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:39 - 13:36
Sampling Dates	-	11/11/2024
Instrument Range	ppm	250
Span Gas Value	ppm	97.5

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	1.7
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	0.10
	Zero Drift	ppm	0.10
	Zero Drift	%	0.10
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	ppm	97.60
	Span at Analyser (Post)	ppm	93.70
	Span Drift	ppm	-3.90
	Zero Adj. Span Drift	%	4.10
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	21 - 23

Method Deviations

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

OXIDES OF NITROGEN (as NO_2): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	200.0		mg/m³ (REF)
Allowable MU	10.0		%
Measured concentration	107.86		mg/m³ (STP, dry)
Ratio NO / NO_2	5		%
Range Used	250.0		ppm
Range Used [A]	513.1		mg/m³
Cal gas conc.	97.5		ppm
Conversion	2.05		ppm to mg/m³
MCERTS Range [B]	205.0		mg/m³
Lower of [A] or [B]	205.0		mg/m³
Cal gas conc.	200.0		mg/m³

Performance characteristics	RUN 1		Units
Response time	31		seconds
Number of readings in measurement	30		-
Repeatability at zero	0.00		% full scale
Repeatability at span level	0.10		% full scale
Deviation from linearity	0.15		% of value
Zero drift	0.10		% full scale
Span drift	0.00		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.10		% of value/kPa
Ambient temperature dependence	0.04		% full scale/10K
Combined interference	0.63		% range
Dependence on voltage	-0.23		% full scale/10V
Converter efficiency	95.8		%
Losses in the line (leak)	1.13		% 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/m³
Standard deviation of repeatability at span level	0.02		mg/m³
Lack of fit	0.18		mg/m³
Drift	0.12		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.06		mg/m³
Ambient temperature dependence	0.01		mg/m³
Combined interference (from MCERTS Certificate)	0.75		mg/m³
Dependence on voltage	-0.03		mg/m³
Converter efficiency	0.13		mg/m³
Losses in the line (leak)	0.70		mg/m³
Uncertainty of calibration gas blending	0.87		mg/m³
Uncertainty of calibration gas	1.25		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	107.86		mg/m³
Combined uncertainty			1.85		mg/m³
Expanded uncertainty	k =	1.96	3.63		mg/m³
Uncertainty corrected to std conds. (O_2)			5.06		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.36		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.81		% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	10.0		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

	RUN 1		Units
Expanded uncertainty (with O_2) - at 95% Confidence	4.99		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	4.47		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	10.7		% at ELV
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 10% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

CARBON MONOXIDE: RESULTS SUMMARY

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham
Danks Boiler

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	5.6		5.6
Uncertainty	±mg/m³	1.0		1.0
Mass Emission	g/hr	14.0		14.0
Uncertainty	±g/hr	2.7		2.7

General Sampling Information

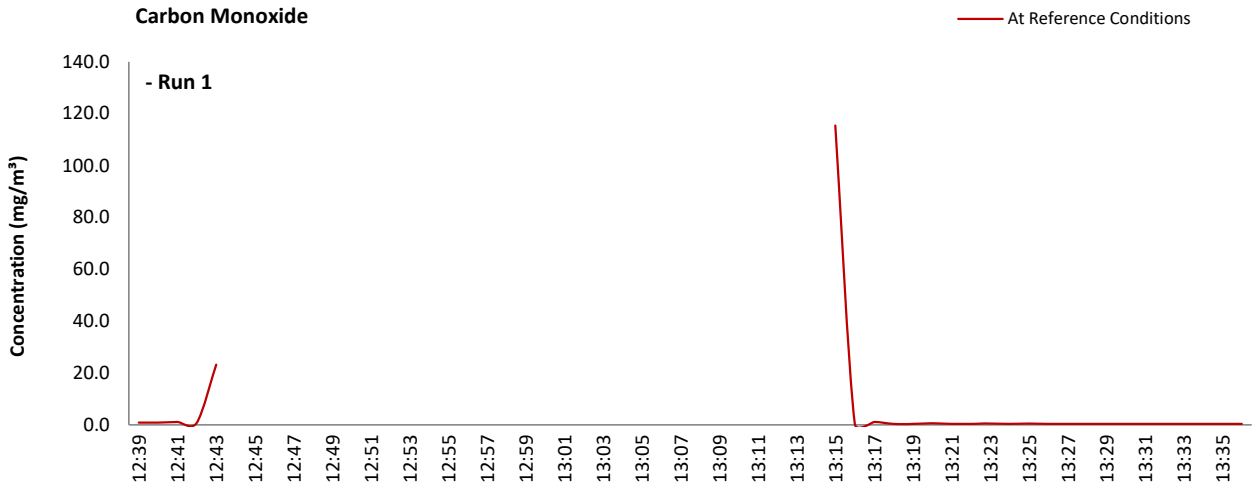
Parameter	Value	
Standard	EN 15058	
Technical Procedure	MD 039	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Carbon Monoxide	
Span Gas Reference Number	12.0540	
Span Gas Expiry Date	20/11/2025	
Span Gas Start Pressure (bar)	20	
Gas Cylinder Concentration (ppm)	405.4	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

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	-	12:39 - 13:36
Sampling Dates	-	11/11/2024
Instrument Range	ppm	200
Span Gas Value	ppm	160.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	1.7
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	0.30
	Zero Drift	ppm	0.30
	Zero Drift	%	0.19
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	ppm	160.30
	Span at Analyser (Post)	ppm	157.30
	Span Drift	ppm	-3.00
	Zero Adj. Span Drift	%	2.06
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	21 - 23

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	-		mg/m³ (REF)
Allowable MU	6.0		%
Measured concentration	4.00		mg/m³ (STP, dry)
Range Used	200.0		ppm
Range Used [A]	249.8		mg/m³
Cal gas conc.	160.0		ppm
Conversion	1.25		ppm to mg/m³
MCERTS Range [B]	75.0		mg/m³
Lower of [A] or [B]	75.0		mg/m³
Cal gas conc.	199.9		mg/m³

Performance characteristics	RUN 1		Units
Response time	28		seconds
Number of readings in measurement	30		-
Repeatability at zero	0.10		% full scale
Repeatability at span level	0.20		% full scale
Deviation from linearity	0.46		% of value
Zero drift	0.19		% full scale
Span drift	0.00		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.22		% of value/kPa
Ambient temperature dependence	-0.20		% full scale/10K
Combined interference	-0.48		% range
Dependence on voltage	-0.35		% full scale/10V
Losses in the line (leak)	0.88		% 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/m³
Standard deviation of repeatability at span level	0.04		mg/m³
Lack of fit	0.20		mg/m³
Drift	0.22		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.05		mg/m³
Ambient temperature dependence	-0.03		mg/m³
Combined interference (from MCERTS Certificate)	-0.21		mg/m³
Dependence on voltage	-0.04		mg/m³
Losses in the line (leak)	0.02		mg/m³
Uncertainty of calibration gas blending	0.03		mg/m³
Uncertainty of calibration gas	0.05		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	4.00		mg/m³
Combined uncertainty			0.37		mg/m³
Expanded uncertainty	k =	1.96	0.73		mg/m³
Uncertainty corrected to std conds. (O_2)			1.02		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	18.28		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	N/A		% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	N/A		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

	RUN 1		Units
Expanded uncertainty (with O_2) - at 95% Confidence	18.64		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	N/A		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	N/A		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 6% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

OXYGEN: RESULTS SUMMARY

Fujifilm Diosynth Biotechnologies UK Ltd, Billingham
Danks Boiler

Sample Runs

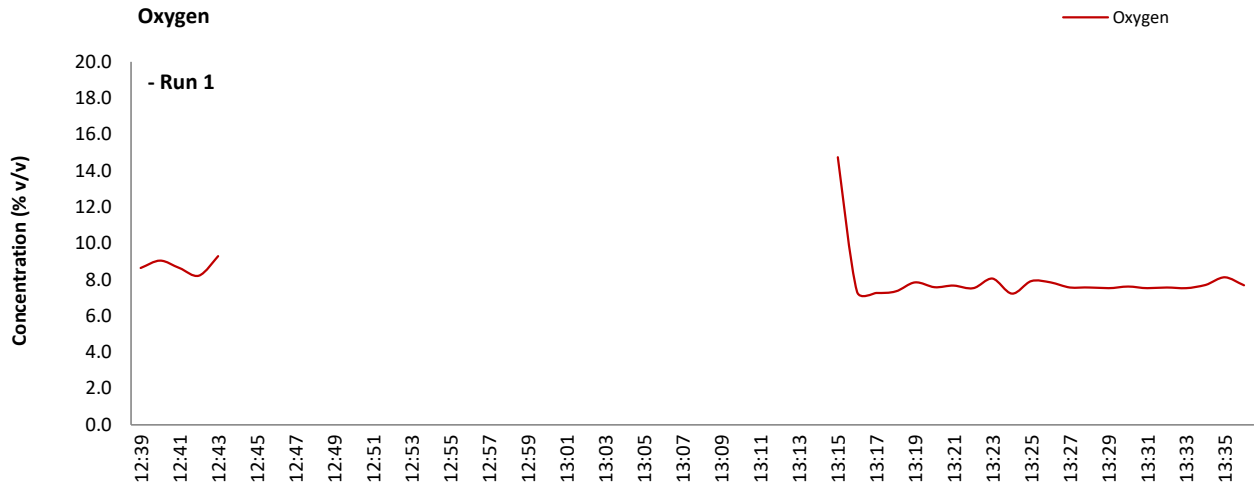
Parameter	Units	Run 1		Mean
Concentration	% v/v	8.1		8.1
Uncertainty	±% v/v	0.30		0.30

General Sampling Information

Parameter	Value	
Standard	EN 14789	
Technical Procedure	MD 039	
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 11.0641	
Span Gas Expiry Date	01/02/2029	
Span Gas Start Pressure (bar)	40	
Gas Cylinder Concentration (% v/v)	21.7	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	12:39 - 13:36
Sampling Dates	-	11/11/2024
Instrument Range	% v/v	25.0
Span Gas Value	% v/v	5.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	1.7
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	% v/v	0.00
	Zero at Analyser (Post)	% v/v	-0.03
	Zero Drift	% v/v	-0.03
	Zero Drift	%	0.60
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	% v/v	4.97
	Span at Analyser (Post)	% v/v	4.90
	Span Drift	% v/v	-0.07
	Zero Adj. Span Drift	%	0.80
	Drift Correction Applied	2-5%	No
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	21 - 23

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
Allowable MU	6.0		%
Measured concentration	8.10		%vol
Range Used	25.0		%vol
Cal gas conc.	21.7		%vol

Performance characteristics	RUN 1		Units
Response time	41		seconds
Number of readings in measurement	30		-
Repeatability at zero	0.02		% full scale
Repeatability at span level	0.02		% full scale
Deviation from linearity	0.07		% of value
Zero drift	-0.60		% full scale
Span drift	-0.80		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.19		% of value/kPa
Ambient temperature dependence	-0.21		% full scale/10K
Combined interference	0.00		% range
Dependence on voltage	0.02		% full scale/10V
Losses in the line (leak)	0.40		% 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		%vol
Standard deviation of repeatability at span level	0.00		%vol
Lack of fit	0.01		%vol
Drift	-0.11		%vol
Volume or pressure flow dependence	0.00		%vol
Atmospheric pressure dependence	0.01		%vol
Ambient temperature dependence	-0.03		%vol
Combined interference (from MCERTS Certificate)	0.00		%vol
Dependence on voltage	0.00		%vol
Losses in the line (leak)	0.02		%vol
Uncertainty of calibration gas	0.09		%vol

			RUN 1		Units
Measurement uncertainty		**Result**	8.10		%vol
Combined uncertainty			0.15		%vol
Expanded uncertainty	k =	1.96	0.30		%vol

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.68		% of Value
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be 0.3% vol absolute or 6% relative whichever is the lower, on a dry gas basis. Source, EN 14789.

VERSION HISTORY

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client