

Report for the Periodic Monitoring of Emissions to Atmosphere

Sheffield Teaching Hospitals Foundation NHS Trust

Jessop Wing Perkins Generator

Permit No: N/A
Installation: Royal Hallamshire
Monitoring Dates: 3rd October 2024
Site Address: Royal Hallamshire Boiler House, C Road, Sheffield, S10 2RX

Report Number:	ES-1895	Version:	1	Visit:	1 in 2024
Date of Report:	25th September 2024				
Report Author:	Rob Hester				
MCERTS No:	MM 06 766	MCERTS Level:	2 (TE1, TE2, TE3, TE4)		
Approved By:	Andy Dykes	Function:	Operations Manager		
MCERTS No:	MM 04 500	MCERTS Level:	2 (TE1, TE2, TE3, TE4)		

Signed:



T: 07774 068 027

E: andydykes@envirocare.org

Envirocare Technical Consultancy Ltd

Unit 36, Bradford Chamber Business Park, New Lane, Bradford, BD4 8BX

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Contents

Executive Summary	
Monitoring Objectives	3
Monitoring Results	4
Operating Information	5
Monitoring Deviations	5
Supporting Information	
Appendix 1: General Information	5 - 6
Appendix 2: Results and Calculations	7 - 10

Executive Summary

Monitoring Objectives

Envirocare Technical Consultancy were contracted by Sheffield Teaching Hospitals Foundation NHS Trust to carry out emissions monitoring, to determine the compliance of Jessop Wing Generator with the conditions specified in the operators permit (N/A) for emissions to atmosphere. The methodologies utilised and the results obtained form the basis of this report.

The substances requested for monitoring are listed below.

Emission Point Identification

Substances to be Monitored	Jessop Wing Perkins Generator
Carbon Monoxide	✓
Oxides of Nitrogen (as NO ₂)	✓
Oxygen	✓
Volumetric Flow	✓

Special requirements: none

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Executive Summary

Monitoring Results

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

		Concentration				Mass Emission				
Substance		Limit (mg/m³)	Result (mg/m³)	Measurement Uncertainty (MU) +/-	Reference Conditions	Limit (g/hr)	Result (g/hr)	Measurement Uncertainty (MU) +/-	Sampling Date	Sampling Times
Carbon Monoxide	R1	-	643	14.5	273k, 101.3kPa, Dry Gas, 3% O ₂	-	463	363	03/09/2024	12:00-13:01
Oxides of Nitrogen (as NO ₂)	R1	-	2609	31.8		-	1881	1475	03/09/2024	12:00-13:01
Oxygen	R1	-	12.0%	0.10	As Measured, Dry Gas	-	-	-	03/09/2024	12:00-13:01
Volumetric Flow (Actual)	R1	-	3,377 m³/h	153	As Measured	-	-	-	03/09/2024	12:05
Volumetric Flow (REF)	R1	-	721 m³/h	32.6	273k, 101.3kPa, Dry Gas, 3% O ₂	-	-	-	03/09/2024	12:05

Supporting Information

Appendix 1: General Information

Operating Information

Parameter	Process Details
Process Type	Standby Generator/Perkins 1200kW
Continuous or Batch Process	Continuous when in operation
Operating Status	Operational
Feedstock	N/A
Normal Load, Throughput or Continuous Rating	100%
Abatement System	N/A
Abatement System Status	N/A
Process Fuel	Natural Gas
Plume Appearance	N/A

Monitoring Deviations

Parameter	Run	Deviation
All Parameters	All	There are no deviations associated with the monitoring undertaken.

Monitoring Organisation Staff Details

Personnel	Position	MCERTS Level	MCERTS Number
Mr A Dykes	Operations Manager	2 (TE1, TE2, TE3, TE4)	MM 04 500
Mr A Pagliari	Technician	Trainee	N/A

Monitoring Methods

Pollutant Species	Standard	Technical Procedure	Testing MCERTS	Analysis Laboratory	Analytical Procedure	Analytical Technique	Analysis MCERTS
Volumetric Flow	BS EN ISO 16911-1	ETC-SE-24a	Yes	Pitot Tube and Thermocouple			
Carbon Monoxide	BS EN 15058	ETC-SE-10 (a/b)	Yes	NDIR by Horiba PG-250 or PG350E			
Oxides of Nitrogen	BS EN 14792	ETC-SE-10 (a/b)	Yes	Chemiluminescence by Horiba PG-250 or Horiba PG-350			
Oxygen	BS EN 14789	ETC-SE-10 (a/b)	Yes	Dry Zirconia Cell by Horiba PG-250 or Dry Paramagnetic by Horiba PG-350E			

Envirocare: 2522

Equipment Checklist

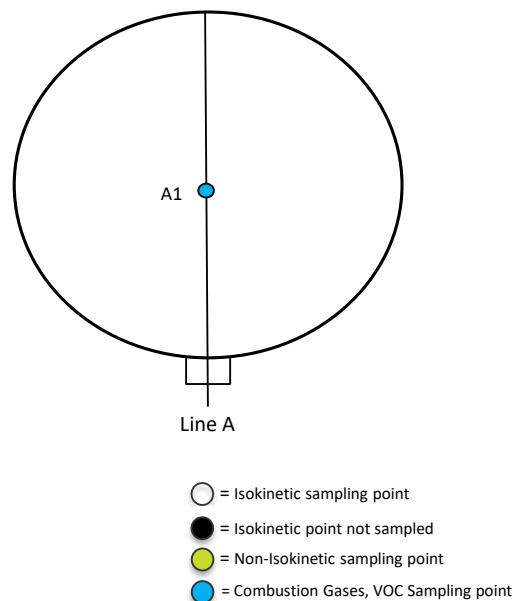
Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Dry Gas Meter (DGM)	-	Horiba PG-250	-	Tape Measure	17.12
Non-Iso DGM	-	Horiba PG-250 SRM	-	Bevel Box	-
Box Thermocouples	-	Horiba PG-350	12.14	Stopwatch	10.01
Box Thermocouple In	-	JCT JCC Cooler	-	Barometer	11.1
Box Thermocouple Out	-	MAK10 Cooler	-	Digital Manometer	24.04
Control Box Timer	-	Horiba PS200 Cooler	3.40B	Digital Temperature Meter	24.04
Umbilical	-	M&C PSS Gas Preparation	7.04	Dual Channel Heat Controller	-
Oven Box	-	Gasmet DX4000 FTIR	-	1m Heated Line	-
Heated Probe (1)	-	Gasmet Sampling System	-	3m Heated Line	-
Heated Probe (2)	-	SK-Thermo FID	-	5m Heated Line	-
Stack Thermocouple (1)	-	Bernath 3006 FID	-	10m Heated Line	5.34
Stack Thermocouple (2)	-	Testo 350XL	-	20m Heated Line	-
S-Type Pitot (1)	-	M&C PSP 4000	-	30m Heated Line	-
S-Type Pitot (2)	-	Easylogger EN-EL-12 Bit	-	Impinger Arm Thermocouple (1)	-
L-Type Pitot	-	Hioki 5043 (V)	-	Impinger Arm Thermocouple (2)	-
Site Balance & Check Weights	-	Analyser Temperature Logger	-	Dioxins Kit Thermocouple	-
Digital Callipers	-	-	-	Sample Temperature Logger	-
-	-	-	-	Laboratory Balance	-

Appendix 2: Jessop Wing Perkins Generator Results and Calculations

Picture of the sampling location



Sampling Points Diagram



Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.35
Width	m	-
Area	m ²	0.1
Port Depth	cm	0.00
Orientation of Stack / Duct	-	Horizontal
Sampling Port Size	-	Hole
Number of Ports	-	1

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

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

BS EN 15259 Platform Requirements		
Load Baring Capacity	Load baring capacity of platform sufficient to fulfil the measurement objective	Yes
Position & Work Space	Sufficient work area to manipulate probe & operate the measurement instruments	Yes
	Depth of work area > internal diameter of stack and wall thickness plus 1.5m	Yes
	Ports on vertical ducts 1.2m to 1.5m above platform floor	Yes
	Platform has chains / self closing gates at top of ladders	Yes
Fall Prevention	Platform has adequate drainage to prevent accumulation of free-standing water	Yes
	Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	Yes
	Gaps between handrails not >0.5m	Yes
Access	Platform has vertical base boards (approx. 0.25m high)	Yes
	Access to sampling ports unhindered by obstructions	No
	Easy & safe access and egress available	No

Sampling Location / Platform Recommendations

All sampling platforms should be designed in accordance with the requirements specified in BS EN 15259.

Flow Criteria Measurements

Duct Diameter (m)	Cross Sectional Area (m²)	Barometric Pressure (mbar)	Ambient Temperature (°C)	Mean Oxygen (%)	Mean Carbon Dioxide (%)	Mean Water Vapour (%)	Stack Gas Molecular mass (g/mol)	Pitot Coefficient
0.35	0.1	1012	20.0	12.0	5.6	5.0	28.7	0.840

Sample Line	Traverse Point	Position (cm)	Differential Pressure Reading (Pa)				Stack Velocity (m/s)	Stack Temp (°C)	Angle of Swirl
			1	2	3	Average			
A	A1	17.5	45.0	45.0	45.0	45.0	9.7	250	-

Parameter	Mean Duct Velocity	Velocity Ratio (Max:Min)	Mean Stack Temperature	Mean Stack Temperature	Stack Gas Volume Flow	Stack Gas Volume Flow (STP Wet)	Stack Gas Volume Flow (REF)
Value	9.7	1.0:1	250	523	3377	1761	721
Units	m/s	-	°C	K	m³/hr	Nm³/hr	Nm³/hr

Instrumental Gas Analyser Calibrations

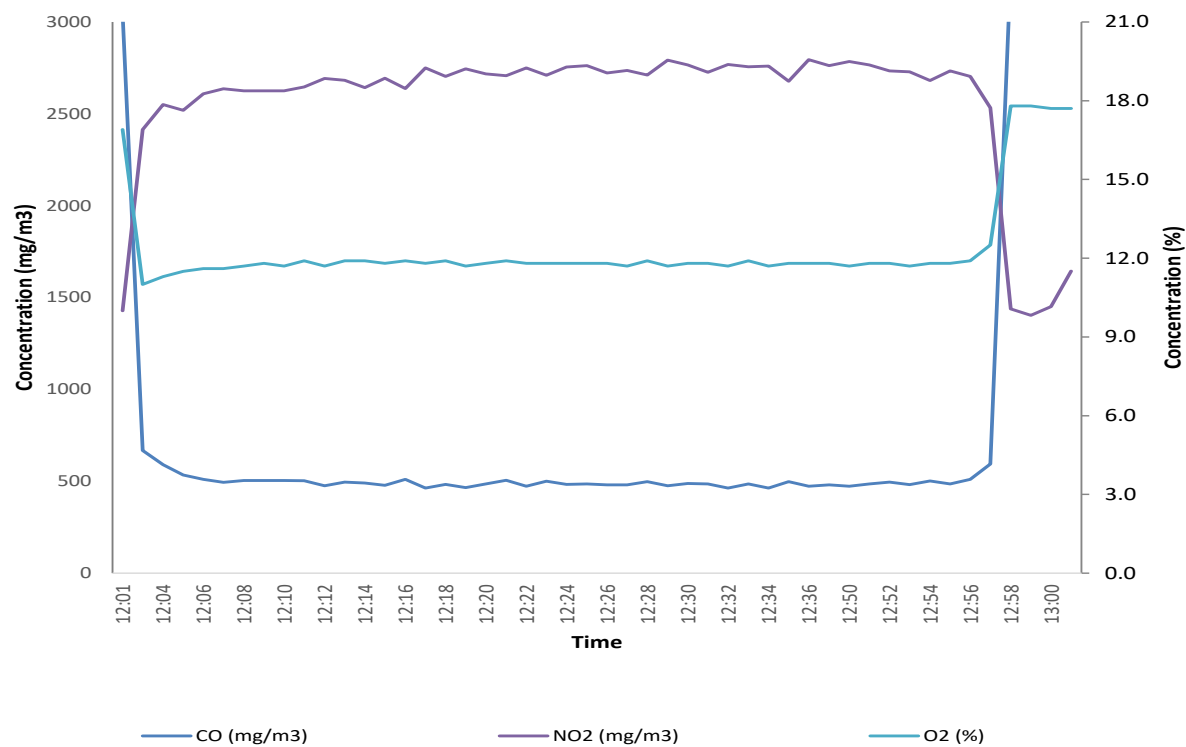
Date	Operators	Combustion Gas Analyser	Flame Ionisation Detector
03/09/2024	AD/AP	12.14	0.00

Calibration Gas	Certified Concentration	Analyser Range	T90 Time	Analyser Span	Pre-sample Cal		Post-sample Cal		Zero Drift (%)	Span Drift (%)	Drift Acceptable
					Zero	Span	Zero	Span			
Carbon Monoxide	1650ppm	2000ppm	30	1650	0.00	1650	0.00	1645	0.00	-0.30	Yes
Nitrogen Monoxide	391ppm	500ppm	30	390	0.00	390	0.00	389	0.00	-0.26	Yes
Oxygen	20.78%	25%	25	20.8	0.00	20.8	0.00	20.8	0.00	-0.10	Yes

Instrumental Gas Analyser Results

Substance	Run	Corrected Concentration			Units	Basis	O ₂ Correction
		Average	Max	Min			
Carbon Monoxide	1	642.77	3120.2	463.18	mg/m ³	-	3%
Oxides of Nitrogen (as NO ₂)	1	2609	2794	1299.9	mg/m ³	NO _x as NO ₂	3%
Oxygen	1	12.0	16.9	10.3	%	-	-

Instrumental Gas Analyser Chart - Run 1



Uncertainty

Uncertainty of Carbon Monoxide by Horiba Gas Analyser - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m ³
Reading	514.2	ppm
Span Gas Certified Value	1650	ppm
Range	2000	ppm

Cal Gas
CO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (ppm)	0.00	Rectangular	1.73	0.00	0.000
Span Drift (ppm)	5.0	Rectangular	1.73	2.9	8.3
Linearity (% of value)	0.40	Rectangular	1.73	1.2	1.4
Setting Gas Divider (% of value)	0.35	Normal	1.00	1.8	3.2
Interference (% of value)	-0.48	Rectangular	1.73	-1.4	2.0
Standard deviation of repeatability at zero point (% of range)	0.10	Rectangular	-	2.0	4.0
Standard deviation of repeatability at span point (% of range)	0.20	Rectangular	-	4.0	16.0
Total					35.0
Combined Standard Uncertainty [(sum u²)^{0.5}]					5.9
Expanded Total Uncertainty (ppm) (95% confidence)					11.6
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					2
Expanded Total Uncertainty (mg/m³) (95% confidence)					14.5
Expanded Total Uncertainty as a % of emission limit value (95% confidence)					-

Uncertainty of Oxides of Nitrogen by Horiba Gas Analyser - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	100	mg/m ³
Reading	1271.1	ppm
Span Gas Certified Value	391	ppm
Range	500	ppm

Cal Gas
NO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (ppm)	0.00	Rectangular	1.73	0.00	0.000
Span Drift (ppm)	1.00	Rectangular	1.73	0.58	0.33
Linearity (% of value)	0.62	Rectangular	1.73	4.5	20.7
Setting Gas Divider (% of value)	0.35	Normal	1.00	4.4	19.8
Interference (% of value)	0.63	Rectangular	1.73	4.6	21.4
Standard deviation of repeatability at zero point (% of range)	0.00	Rectangular	-	0.00	0.00
Standard deviation of repeatability at span point (% of range)	0.10	Rectangular	-	0.50	0.25
Total					62.5
Combined Standard Uncertainty [(sum u²)^{0.5}]					7.9
Expanded Total Uncertainty (ppm) (95% confidence)					15.5
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					1.2
Expanded Total Uncertainty (mg/m³) (95% confidence)					31.8
Expanded Total Uncertainty as a % of emission limit value (95% confidence)					31.8

Uncertainty of Oxygen by Horiba Gas Analyser - Run 1

Parameter	Value	Unit
Reading	12.0	%
Span Gas Certified Value	20.8	%
Range	25.0	%

Cal Gas
O ₂

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (%vol)	0.00	Rectangular	1.73	0.00	0.0000
Span Drift (%vol)	0.02	Rectangular	1.73	0.01	0.0001
Linearity (% of value)	0.33	Rectangular	1.73	0.02	0.0005
Setting Gas Divider (% of value)	0.35	Normal	1.00	0.04	0.002
Interference (% of value)	0.00	Rectangular	1.73	0.000	0.000
Standard deviation of repeatability at zero point (% of range)	0.02	Rectangular	-	0.005	0.00003
Standard deviation of repeatability at span point (% of range)	0.02	Rectangular	-	0.005	0.00003
Total					0.002
Combined Standard Uncertainty $[(\sum u^2)^{0.5}]$					0.05
Expanded Total Uncertainty (%) (95% confidence)					0.10
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					0.8

Uncertainty of Volumetric Flow - Run 1

Parameter	Value	Unit
Measured Volumetric Flow Rate Actual	3377	m³/hr

Performance Characteristics & Source Value	Value	Units
Standard Uncertainty - Pitot tube Coefficient	0.005	-
Standard Uncertainty - Mean Local Dynamic Pressure	1.1	Pa
Standard Uncertainty - Molar Mass of Stack Gas	0.00004	-
Standard Uncertainty - Stack Gas Temperature	0.50	K
Standard Uncertainty - Absolute Pressure in Duct	176	Pa
Standard Uncertainty - Density of Stack Gas	0.002	-
Standard Uncertainty - Mean Velocity	0.06	m/s
Expanded Uncertainty Mean Velocity (95% confidence)	0.12	m/s
Expanded Uncertainty Mean Velocity (95% Confidence), Relative	1.2	%
Standard Uncertainty - Volumetric Flow Rate	78.0	-
Standard Uncertainty - Volumetric Flow Rate (95% Confidence)	153	m³/hr
Standard Uncertainty - Volumetric Flow Rate (95% Confidence), Relative	4.5	%

95% confidence interval factor - 1.96

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