Report Title	Air Emissions Compliance Monitoring Emissions
Company address	Air Scientific Ltd., 32 DeGranville Court, Dublin road, Trim, Co. Meath
Stack Emissions Testing Report Commissioned by	South Dublin County Council
Facility Name	Arthurstown Landfill
Contact Person	Mr. Ben Frost
EPA Licence Number	W0004-04
Licence Holder	South Dublin County Council, AR08
Stack Reference Number	AR08
Dates of the Monitoring Campaign	08/09/2025
Job Reference Number	ARLATL1080925 / 20251724
Report Written By	Amanda Sheridan
Report Approved by	Dr. Brian Sheridan
Stack Testing Team	Dr. John Casey, Stephen O' Carroll
Report Date	06/10/2025
Report Type	Test Report Compliance Monitoring
Version	1
Signature of Approver	Brian Sheridan Technical Manager

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1. Executive Summary

I. Monitoring Objectives

Overall Aim of the monitoring Campaign

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values as specified in the site licence.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter (TPM)
Carbon Monoxide (CO)
Oxides of Nitrogen (NOx) as NO_2
Total Volatile Organic Carbon (TOC)
Hydrogen Chloride (HCL)
Hydrogen Fluoride (HF)
TNMVOCs
Sulphur Dioxide (SO_2)
Stack Gas Temperature
Volume ($m^3.h^{-1}$)
Oxygen (O_2)
Carbon Dioxide (CO_2)

Emission Limit Values

Emission Limit Values / Mass Emissions Limit Values	$mg.m^{-3}$	$kg.h^{-1}$
TPM		-
CO	1400	-
NOx as NO_2	500	-
TOC	1000	-
HCL	50	-
HF	5	-
TNMVOCs	75	-
SO_2	-	-
Stack Gas Temperature	-	-
Volume ($m^3.h^{-1}$)	3,000	-

Reference Conditions

Reference Condition	Value
Oxygen Reference %	5
Temperature K	273.15
Total Pressure kPa	101.3
Moisture Correction	Yes

Executive Summary

Overall Results

	Concentration						Mass Emission		Run 1						
Parameter	**Units**	**Result**	**MU +/-**	**Blanks**	**Limit**	**Compliant**	**Units**	**Result**	**Limit**	**Dates**	**Time on**	**Time off**	**O2 Ref. (%)**	**Accreditation**	**LOD**
TPM EN13284-1:2017	$mg.m^{-3}$	2.48	0.56	<0.92	-	N/A	$kg.h^{-1}$	0.004	-	08/09/2025	11:12:00	11:42:00	5	Yes	0.92
CO EN15058:2017	$mg.m^{-3}$	954.07	59.37	-	1400	N/A	$kg.h^{-1}$	1.547	-	08/09/2025	09:14:00	09:56:00	5	Yes	<1.7
NOx EN14792:2017	$mg.m^{-3}$	196.22	26.73	-	500	N/A	$kg.h^{-1}$	0.318	-	08/09/2025	09:14:00	09:56:00	5	Yes	<1.8
TVOC EN12619:2013	$mg.m^{-3}$	2437.73	1347.72	-	1000	N/A	$kg.h^{-1}$	3.952	-	08/09/2025	09:41:41	10:28:41	5	Yes	<0.8
HCL EN1911:2010	$mg.m^{-3}$	<0.33	0.02	<0.09	50	N/A	$kg.h^{-1}$	<0.0005	-	08/09/2025	11:15:00	11:45:00	5	Yes	0.26
HF EN15713:2006	$mg.m^{-3}$	<0.32	0.02	<0.09	5	N/A	$kg.h^{-1}$	<0.0005	-	08/09/2025	11:15:00	11:45:00	5	Yes	0.25
TNMVOCs EN13649:2014	$mg.m^{-3}$	<0.08	0.01	<0.08	150	N/A	$kg.h^{-1}$	<0.0001	-	08/09/2025	11:03:00	11:41:00	5	Yes	0.07
SO_2 CEN/TS 17021:2017	$mg.m^{-3}$	701.18	107.25	-	-	N/A	$kg.h^{-1}$	1.137	-	08/09/2025	09:14:00	09:56:00	5	Yes	<6.1
Oxygen (%) EN14789:2017	% v/v	8.41	0.3	-	-	N/A	-	-	-	08/09/2025	09:14:00	09:56:00	5	Yes	-
CO_2 ISO12039:2001	% v/v	10.73	0.34	-	-	N/A	-	-	-	08/09/2025	09:14:00	09:56:00	5	Yes	-
H_2O EN14790:2017	% v/v	8.4	0.35	-	-	N/A	-	-	-	08/09/2025	08:32:00	09:02:00	5	Yes	-
Stack Gas Temperature	K	643.15	-	-	-	N/A	-	-	-	08/09/2025	09:12:00	09:16:00	5	Yes	-
Stack Gas Velocity EN16911:2013	$m.s^{-1}$	20.84	0.76	-	-	N/A	-	-	-	08/09/2025	09:12:00	09:16:00	5	N/A	-
Volumetric Flow Rate	$m^3.h^{-1}$	2,064	230	-	3,000	N/A	-	-	-	-	-	-	5	N/A	-
Volumetric Flow Rate (Ref)	$m^3.h^{-1}$	1,621	-	-	3,000	N/A	-	-	-	-	-	-	5	N/A	-

Accreditation details

Air Scientific Limited	INAB319T
External Analytical Laboratory	UKAS0605
Other	-

Executive Summary

Monitoring Dates & Times

Parameter	Run	Location ID	Sampling Dates	Sampling Time On	Sampling Time Off	Duration (mins.)
Total Particulate Matter (TPM)	Run 1	AR08	08/09/2025	11:12:00	11:42:00	00:30:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Carbon Monoxide (CO)	Run 1	AR08	08/09/2025	09:14:00	09:56:00	00:42:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Oxides of Nitrogen (NOx) as NO_2	Run 1	AR08	08/09/2025	09:14:00	09:56:00	00:42:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Total Volatile Organic Carbon (VOC)	Run 1	AR08	08/09/2025	09:41:41	10:28:41	00:47:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Hydrogen Chloride (HCL)	Run 1	AR08	08/09/2025	11:15:00	11:45:00	00:30:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Hydrogen Fluoride (HF)	Run 1	AR08	08/09/2025	11:15:00	11:45:00	00:30:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
TNMVOCs	Run 1	AR08	08/09/2025	11:03:00	11:41:00	00:38:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Sulphur Dioxide (SO_2)	Run 1	AR08	08/09/2025	09:14:00	09:56:00	00:42:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Oxygen (%)	Run 1	AR08	08/09/2025	09:14:00	09:56:00	00:42:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-
Water Vapour (%)		AR08	08/09/2025	08:32:00	09:02:00	00:30:00
Stack Gas Temperature		AR08	08/09/2025	09:12:00	09:16:00	00:04:00
Stack Gas Velocity		AR08	08/09/2025	09:12:00	09:16:00	00:04:00
Carbon Dioxide (%)	Run 1	AR08	08/09/2025	09:14:00	09:56:00	00:42:00
	Run 2	-	-	-	-	-
	Run 3	-	-	-	-	-

Executive Summary

Monitoring, Equipment & Analytical Methods

Parameter	Monitoring				Analysis	
	Standard	Technical Procedure	Accredited Testing	Testing Lab	Analytical Technique	INAB Analysis
Total Particulate Matter (TPM)	EN13284-1:2017	SOP 2000	Yes	RPS	Gravimetric	-
Carbon Monoxide (CO)	EN15058:2017	SOP 2004	Yes	AirSci	NCIR By Horiba PG-250	-
Oxides of Nitrogen (NOx)	EN14792:2017	SOP 2002	Yes	AirSci	Chemiluminescence	-
Total Volatile Organic Carbon (TOC)	EN12619:2013	SOP 2009	Yes	AirSci	Flame Ionisation Detection	-
Hydrogen Chloride (HCL)	EN1911:2010	SOP 2014	Yes	RPS	Ion Chromatography	-
Hydrogen Fluoride (HF)	EN15713:2006	SOP 2024	Yes	RPS	Ion Chromatography	-
TNMVOCs	EN13649:2014	SOP 2019	No	RPS	M104	-
Sulphur Dioxide (SO_2)	CEN/TS 17021:2017	SOP 2046	Yes	AirSci	NDIR Absorption	-
Oxygen (%)	EN14789:2017	SOP 2008	Yes	AirSci	Paramagnetic	-
Carbon Dioxide	ISO12039:2001	SOP 2045	Yes	AirSci	NDIR	-
Water Vapour (%)	EN14790:2017	SOP 2007	Yes	AirSci	Gravimetric	-
Stack Gas Temperature	EN16911:2013	SOP 2005	Yes	AirSci	Thermocouple	-
Stack Gas Velocity	EN16911:2013	SOP 2005	N/A	AirSci	Pitot tubes	-

List of Equipment

ID	Item of Equipment	Manufacturer	Serial No.
ASLTM12EQ511	3010 MiniFID	Signal Instruments	17852
ASLTM12EQ513	Horiba PG2500 Portable Gas Analzer	Horiba	ZVM969TT
ASLTM12EQ526	Knob weights (200,500,1000mg)	KERN & Sohn GmbH	G1117388
ASLTM13EQ505	S TYPE PITOT TUBE	Tecora	1347
ASLTM13EQ509	10 metre industrial heated sample line	Neptech	13B088
ASLTM13EQ510	20 metre heated sample line	Neptech	13C088
ASLTM14EQ511	Buhler Sample Gas Cooler	Buhler Technologies	100094941
ASLTM14EQ512	GemRed Electronic Level 0 to 180 Degrees	GemRed	8088
ASLTM14EQ513	ISO Stack Sampling Machine	TCR Tecora	070205976 & 049039P
ASLTM14EQ519	S TYPE PITOT TUBE	Tecora	33011
ASLTM15EQ508	My weigh ibalance i1200	My Weigh	7.256.358
ASLTM23EQ503	K type thermocouple	TC Direct	109710/1C
ASLTM23EQ507	Chek-mate	SKC	N/A
ASLTM22EQ511	Mass flow meter	Siargo	N/A
ASLTM19EQ518	6" Vernier Caliper	Mitutoyo	N/A
ASLTM22EQ507	SKC Pump	SKC	N/A
ASLTM19EQ509	Kimo Manometer	Kimo	N/A

Sampling Deviations

Parameter	Deviation
Standard ID	EN16911:2013 – flow rates in accordance with MID6911-1
Standard ID	-
Standard ID	-
Standard ID	-

Reference Documents

Risk Assessment (RA)	SOP1011
Site Review (SR)	SOP1015
Site Specific Protocol (SSP)	SOP1015

Executive Summary

Suitability of sampling location

General Information	Value
Permanent/Temporary	Temporary
Inside/ Outside	Outside

Platform Details		
Irish EPA Technical Guidance Note AG1 / BS EN 15259 Platform Requirements	**Value**	**Comment**
Sufficient Working area to manipulate probe and measuring instruments	Yes	-
Platform has 2 handrails (approx. 0.5m & 1.0 m high)	Yes	-
Platform has vertical base boards (approx. 0.25 m high)	Yes	-
Platform has chains / self closing gates at top of ladders	Yes	-
There are no obstructions present which hamper insertion of sampling equipment	No	-
Safe Access Available	Yes	-
Easy Access Available	Yes	-

Sampling Location / Platform Improvement Recommendations
None

BSEN 15259 Homogeneity Test Requirements
1: There is no requirement to perform a BSEN15259 Homogenity Test on this stack

Process details

Parameter	
Process status	Normal
Capacity (per/hour) (if applicable)	700KW
Continuous or Batch Process	Continuous
Feedstock	Process Air
Abatement System	No
Abatement Systems Running Status	Normal
Fuel	LFG
Plume Appearance	No
Other information	None

Licensee			
Reg. number	W0004-04	Contractor	Air Scientific Ltd.
Site Contact	Mr. Ben Frost	Contractor's contact	Amanda Sheridan
Role		Role	-
Signature		Signature	-

Emissions point		-					
Type of process		**Load of process**	**Abatement system**		**List of Solvents used per process**		
Rotogravure Printing	-	as normal	Bag filter	-		-	-
Cement Plant	-		Electrostatic precipitato	-	-	-	-
Electrical generation	-		Cyclone	-	-	-	-
Steam boiler	-		Thermal oxidiser	-	-	-	-
Other	Yes		Active carbon bed	-	-	-	-
			NSCR	-	-	-	-
			SCR	-	-	-	-
			Dry scrubber	-	-	-	-
			Wet scrubber	-	-	-	-
			Lime injection	-	-	-	-
			Biofilter	-	-	-	-
			None	-	-	-	-
			Other:	-	-	-	-

Executive Summary

Stack diagram

2. APPENDICES

II. Appendix I - Monitoring Personnel & Equipment

Stack Emissions Monitoring Personnel

Team Leader	**Name**	Dr. John Casey
	Qualifications	PhD. (Eng.), MSc. (Agr.), B. Agr. Sc.
	System approval	Air Scientific Limited Approved
		-
Team Leader	**Name**	Stephen O' Carroll
	Qualifications	Bachelor of Eng. in Manufacturing & Design Eng.
	System approval	Air Scientific Limited Approved
		-
Team Leader	**Name**	-
	Qualifications	-
	System approval	-
		-

III. Appendix II - Stack Details & flow characteristics

Preliminary stack survey calculations

General Stack Details		
Stack details	**Units**	**Value**
Date of survey		08/09/2025
Time of survey		09:12
Type		Circular
Stack Diameter / Depth, D	m	0.3
Stack Width, W	m	-
Average Stack Gas Temp., Ta	C	370
Average Static Pressure, P static	kPa	0.1
Average Barometric Pressure, Pb	kPa	101.2
Type of Pitot		S
Are Water Droplets Present?		No
Average Pitot Tube Calibration Coeff, Cp		0.83
Negative flow		No
Highly homogeneous flow stream/gas velocity		Yes

Sample Port Size	mm	100
Initial Pitot Leak Check	Pa	490
Final Pitot Leak Check	Pa	480
Orientation of Duct		Vertical
Pitot Tube Cp		0.998
Number of Lines Available		1
Number of Lines Used		1

Sampling Line A						
Point	**Distance to duct (m)**	**Pa**	**Temp °C**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	0.02	-	-	-	-	-
2	0.08	180	370	21.1	-	7
3	0.23	170	370	20.5	-	7
4	0.28	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	175	370	20.84	-	7
Min	-	170	370	20.54	-	7
Max	-	180	370	21.14	-	7

Sampling Line B						
Point	**Distance to duct (m)**	**Pa**	**Temp °C**	**Velocity (m/s)**	**Oxygen (%)**	**Angle of Swirl**
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
Average	-	-	-	-	-	-
Min	-	-	-	-	-	-
Max	-	-	-	-	-	-

Component	Conc. ppm	Conc. Dry % v/v	Conc. Wet % v/v	Molar Mass
Carbon Dioxide CO_2	-	10.73	-	44.01
Oxygen O_2	-	8.41	-	32
Nitrogen N_2	-	80.86	-	28.1
Moisture (H_2O)	-	-	8.4	18.02
Reference Conditions	**Units**	**Numbers**		
Temperature	^oC	273.15		
Total Pressure	kPa	101.3		
Moisture	%	-		
Oxygen (Dry)	%	5		

Stack Gas Composition & Molecular Weights								
Component	**Molar Mass M**	**Density Kg/m^3 p**	**Conc. Dry % v/v**	**Dry Volume Fraction r**	**Dry Conc. kg/m^3 pi**	**Conc. wet % v/v**	**Wet Volume Fraction r**	**Wet Conc. kg/m^3 pi**
Carbon Dioxide CO_2	44.01	1.96	10.73	0.1073	0.21	9.83	0.1	0.19
Oxygen O_2	32	1.43	8.41	0.0841	0.12	7.7	0.08	0.11
Nitrogen N_2	28.1	1.25	80.86	0.8086	1.01	74.07	0.74	0.93
Moisture (H_2O)	18.02	0.8	-	-	-	8.4	0.08	0.07
where p=M/22.41								
pi = r x p								

Calculation of Stack Gas Densities		
Determinant	**Units**	**Result**
Dry Density (STP), P STD	$kg.m^{-3}$	1.345
Wet Density (STP), P STW	$kg.m^{-3}$	1.303
Dry Density (Actual), P Actual	$kg.m^{-3}$	0.571
Average wet Density (Actual), P Actual W	$kg.m^{-3}$	0.553
Where		
P STD = sum of component concentrations, kg/m^3 (excluding water vapour)		
P STW = (P STD + pi of H2O) / (1 + (pi of H2O / 0.8036))		
P actual = P STD x (T STP / (P STP)) x (Pa / Ta)		
P actual W (at each sampling point) = P STW x (Ts / Ps) x (Pa / Ta)		

Sampling Plane Validation Criteria	Value	Units	Requirement	Compliance	Method
Lowest Differential Pressure	170	Pa	>5 Pa	Yes	EN16911:2013
Lowest Gas Velocity	20.54	m/s	-	N/A	-
Highest Gas Velocity	21.14	m/s	-	N/A	-
Ratio of Above	1.03	:1	<3:1	Yes	EN16911:2013
Mean Velocity	20.84	m/s	-	N/A	-
Angle of flow with regard to duct axis	7	degrees	< 15	Yes	EN16911:2013
No local negative flow	No	-	-	Yes	-
Homogeneous flow stream/gas velocity	Yes	-	-	Yes	-

Calculation of stack Gas Velocity, V	
Velocity at Traverse Point, V = Kcp * Sqroot ((2 * DP) / Density)	633.2029362
Where	
Kpt = Pitot tube calibration coefficient	0.83
Compressibility correction factor, assumed at a constant 0.998	0.998

Gas Volumetric Flowrate	Units	Result
Gas Volumetric Flow Rate (Actual)	$m3.h^{-1}$	5304
Gas Volumetric Flow Rate (STP, Wet)	$m3.h^{-1}$	2253
Gas Volumetric Flowrate (STP, Dry)	$m3.h^{-1}$	2064
Gas Volumetric Flowrate REF to Oxygen	$m3.h^{-1}$	1621

Standard uncertainty of velocity (m/s)	0.38	**Expanded uncertainty of velocity (m/s)**	0.76	**Volume flow rate expanded uncertainty (m^3/hr)**	230

IV. Appendix 3 - Individual parameter sampling details and results

Total Particulate Matter Sampling details and results

Run 1			**Time On**	**11:12:00**	
Stack ID	**AR08**		**Time Off**	**11:42:00**	
Filter ID	**AR08**		**Uncertainty Data**		
Start Dry Gas Meter	-	m^3	**Temperature at Pump**	12	Deg C
Finish Dry Gas Meter	-	m^3	**Pressure at Pump**	101.2	kPa
Average Stack Temperature	370	^0C	**Air Volume at Pump**	0.62	m^3
Moisture Content	8.4	%	**Humidity at Pumps**	0.1	%
Stack Flow Rate STP, Dry	2064	$m^3.h^{-1}$	**Filter Weight**	0.65	mg
Volume of Air Sampled	0.59	$m^{3\ (VgN)}$	**Front End Weight**	<0.5	mg
Balance Calibration	**Weight**				
300.0	**-**	g			
500.0	**-**	g			
1000.0	**-**	g			
Inpinger Weights	**Initial**	**Final**	**Difference**		
1	**-**	-	**-**		
2	**-**	-	**-**		
3	**-**	-	**-**		
4	**-**	-	**-**		
Volume of Air Sampled	0.59	Nm^3			
Moisture Content (EN 14790)	0	%			
Leak Check Results	**Result**		**% Leak**		
Before Blank	0.1	l/min	0.4		
After Blank	-	l/min	-		
Before Sample 1	0.12	l/min	0.5		
After Sample 1	-	l/min	-		
Average Flow Rate	25	l/min	0.5		
Standard Maximum	0.5	l/min	2%		
Back Pressure	-	bar	-		
Leak check acceptable	Yes		Yes/No		
Water droplets present	No		Yes/No		
Standard Criteria to be Met	**Result**	**Standard Requirement**			
Angle of Flow	<15	<15 Degrees			
Negative Flow in the Stack	None	None			
Pitot Pressure Difference	>5Pa	>5Pa			
Ratio of Flow Measurement	1.06	<3:1			

Pitot Tube Leak Check	**Result**				
Positive Pressure	Pass				
Negative Pressure	Pass				
Number of Ports	**1**				
Straight length before sample point	> 5	> 5 Hydraulic Diameters			
Straight length after sample point	> 5	> 5 Hydraulic Diameters			
Sample Calculations					
Blank (Filter and Front Wash Combined)	**<0.54**	mg			
Sample 1 (Filter and Front Combined)	**1.15**	mg			
Volume of Air Sampled	**0.59**	Nm^3			
Blank Result	**<0.92**	$mg.m^{-3}$			
Sample Result	**1.95**	$mg.m^{-3}$			
Emission Limit Value	**-**	$mg.m^{-3}$			
Blank as Percentage of ELV	-	%	**Standard Requirement**	**<10% ELV**	
Isokinetic Criterion Compliance					
Isokinetic Variation	**%**	0			
Allowable Isokinetic Range	**%**	95-115			
Iso Kineticity Acceptable	**-**	Yes			

Total Particulates Quality Assurance

Stack ID	AR08						
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Blank**	**Blank**	**Blank**
Sampling Times	-	11:12:00	-	-	-	-	-
Sampling Dates	-	08/09/2025	-	-	-	-	-
Sampling Device	-	Basic	-	-	-	-	-
Volume Sampled (REF.)	m^3	0.59	-	-	-	-	-
Filter ID Number	-	AR08	-	-	-	-	-
Probe rinse ID	-	AR08W	-	-	-	-	-
Total Filter Mass	mg	0.65	-	-	-	-	-
Probe Rinse Solids Mass	mg	<0.5	-	-	-	-	-
Total Mass Collected	mg	1.15	-	-	-	-	-
General information							
Standard	ISEN13284-1						
Technical Procedure	-	SOP 2000	-	-	-	-	-
Probe Material	-	SS	-	-	-	-	-
Filter Housing	-	SS	-	-	-	-	-
Positioning of Filter	-	In-stack	-	-	-	-	-
Filter Size and Material	-	47mm filter, 8mm nozzle	-	-	-	-	-
Number of Sampling lines used	-	1	-	-	-	-	-
Number of Sampling Points used	-	1	-	-	-	-	-

Carbon Monoxide Quality Assurance

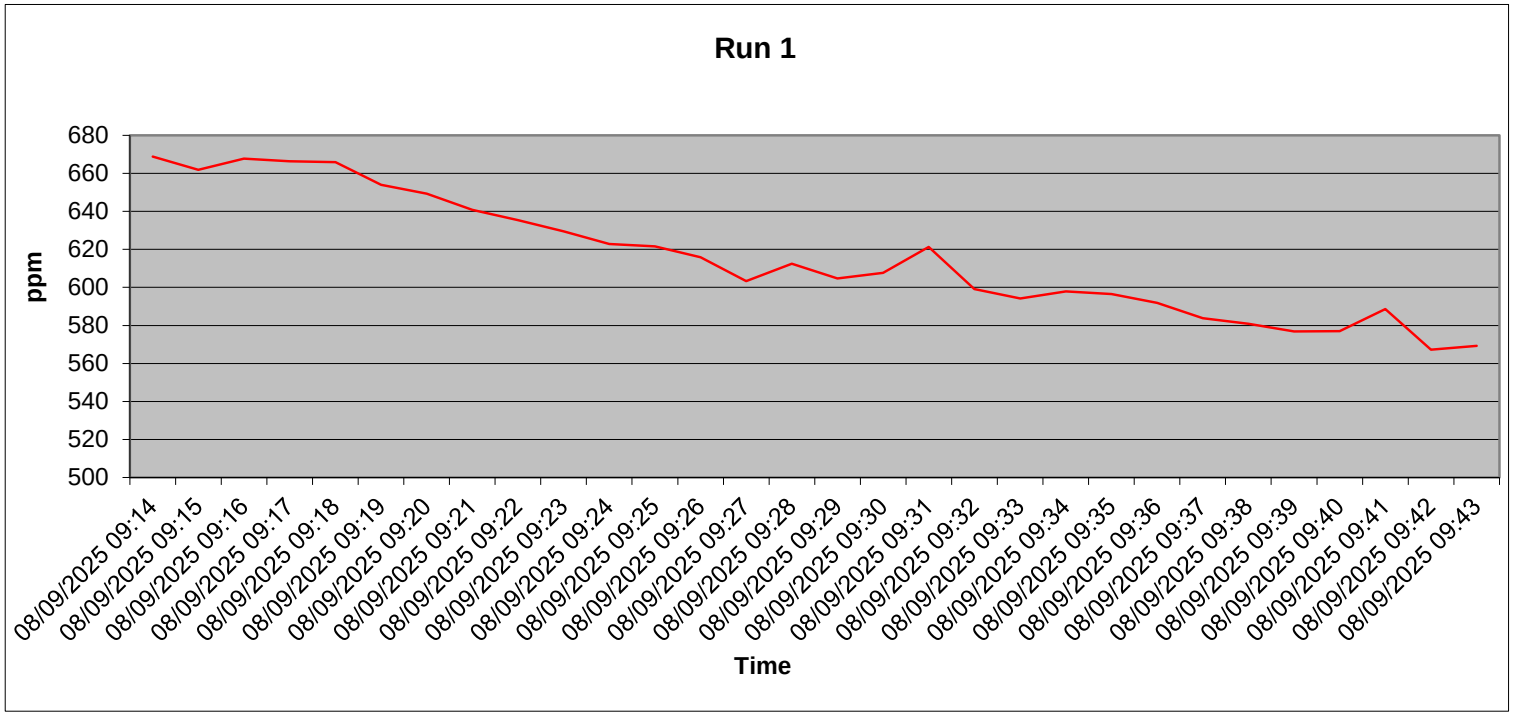
Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:14	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	1000	-	-
Span Gas Value	ppm	698	-	-
Acceptable Gas Range	-	Y	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	2	-	-
Average Temperature	< ^{0}C	2	-	-
Allowable Temperature	-	4	-	-
Temperature Acceptable	-	Y	-	-
Pump flow rate	l/min	0.5	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	ppm	0	-	-
Zero Down Sampling Line (Post)	ppm	4	-	-
Zero Drift	ppm	-4	-	-
Allowable Zero Drift (5%)	ppm	34.9	-	-
Zero Drift Acceptable	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Zero Drift	%	-0.57	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	ppm	698	-	-
Span Down Sampling Line (Post)	ppm	699	-	-
Span Drift	ppm	-1	-	-
Allowable Span Drift (5%)	ppm	34.9	-	-
Span Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Span Drift	%	-0.14	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	ppm	698	-	-
Recorded Conc. down Line	ppm	698	-	-
Leak check acceptable (< 2%)	(Y/N)	Y <2%	-	-
Test Conditions	**Units**	**Run 1**	**Run 2**	**Run 3**
Run Ambient Temperature Range	^{0}C	12	-	-

Carbon Monoxide Results & Sampling Details

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	$mg.m^{-3}$	749.41	-	-	-
Uncertainty	$mg.m^{-3}$	59.37	-	-	-
Mass Emission	$kg.h^{-1}$	1.55	-	-	-

General Sampling Information	
Parameter	**Value**
Standard	EN15058
Technical Procedure	SOP2004
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	180
Span Gas Reference Number	ASLTM24ING515
Span Gas Expiry Date	Feb-29
Span Gas Start Pressure (bar)	80
Gas Cylinder Concentration (ppm)	698
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	AR08
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Carbon Monoxide Trend



Carbon Monoxide Measurement Uncertainty

Measured Quantities	Units	Run 1	Run 2	Run 3
Certified Range of Analyser	ppm	1.36-1000	-	-
Operational Range of Analyser	ppm	1000	-	-
Measured Reading	ppm	599.53	-	-
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
Nonlinearity	%	0.9	-	-
Temperature Dependent Zero drift	%	0.14	-	-
Temperature Dependent Span drift	%	-0.12	-	-
Cross-sensitivity	%	0.08	-	-
Leak	%	0	-	-
Calibration Gas Uncertainty	%	<2	-	-
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Combined uncertainty	$mg.m^{-3}$	9.9	-	-
Expanded uncertainty	$mg.m^{-3}$	19.81	-	-
Uncertainty corrected to std conds.	$mg.m^{-3}$	59.37	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	4.24	-	-
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	59.37	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of value	6.22	-	-
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions				

Oxides of Nitrogen Quality Assurance

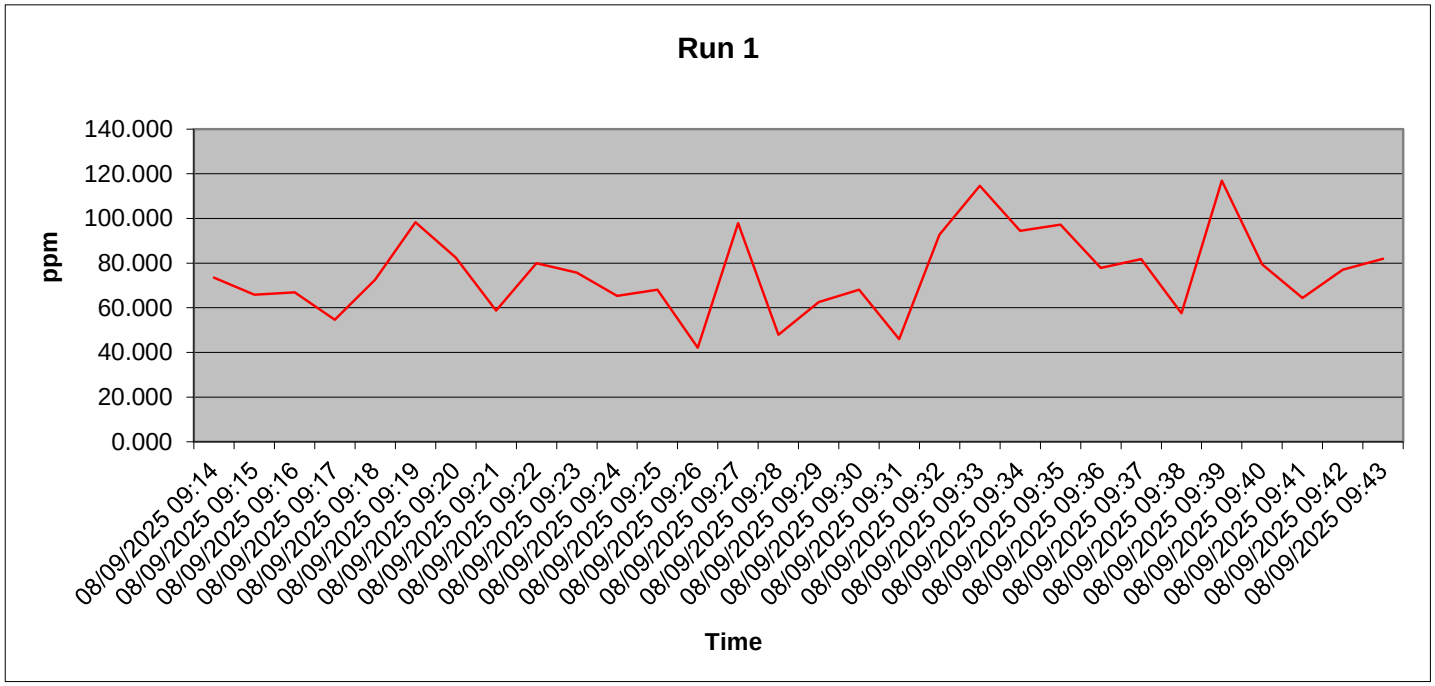
Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:14	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	250	-	-
Span Gas Value	ppm	165	-	-
Acceptable Gas Range	-	Yes	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	2	-	-
Average Temperature	< ^{0}C	2	-	-
Allowable Temperature	-	4	-	-
Temperature Acceptable	-	Y	-	-
Pump flow rate	l/min	0.5	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	ppm	0.1	-	-
Zero Down Sampling Line (Post)	ppm	0	-	-
Zero Drift	ppm	0.1	-	-
Allowable Zero Drift (5%)	ppm	8.25	-	-
Zero Drift Acceptable	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Zero Drift	%	0.06	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	ppm	165	-	-
Span Down Sampling Line (Post)	ppm	164.2	-	-
Span Drift	ppm	0.8	-	-
Allowable Span Drift (5%)	ppm	8.25	-	-
Span Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Span Drift	%	0.48	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	ppm	165	-	-
Recorded Conc. down Line	ppm	165	-	-
Leak check acceptable (< 2%)	(Y/N)	Y <2%	-	-
Test Conditions	**Units**	**Run 1**	**Run 2**	**Run 3**
Run Ambient Temperature Range	^{0}C	12	-	-

Oxides of Nitrogen Results & Sampling Details

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	$mg.m^{-3}$	154.13	-	-	-
Uncertainty	$mg.m^{-3}$	26.73	-	-	-
Mass Emission	$kg.h^{-1}$	0.32	-	-	-

General Sampling Information	
Parameter	**Value**
Standard	EN14792
Technical Procedure	SOP2002
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	180
Date & Result of last converter check	95.5 18/04/2025
Span Gas Reference Number	ASLTM23ING511
Span Gas Expiry Date	25-Dec
Span Gas Start Pressure (bar)	40
Gas Cylinder Concentration (ppm)	165
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	AR08
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Oxides of Nitrogen Trend



Oxides of Nitrogen Measurement Uncertainty

Measured Quantities	Units	Run 1	Run 2	Run 3
Certified Range of Analyser	ppm	0.87-1000	-	-
Operational Range of Analyser	ppm	250	-	-
Measured Reading	ppm	75.08	-	-
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
Nonlinearity	%	1.4	-	-
Temperature Dependent Zero drift	%	-0.04	-	-
Temperature Dependent Span drift	%	-0.25	-	-
Cross-sensitivity	%	0.5	-	-
Leak	%	0	-	-
Calibration Gas Uncertainty	%	<2	-	-
Mass Flow Controllers (Dilution) Uncertainty	%	<1	-	-
NOx Converter Efficiency	%	95.5	-	-
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Combined uncertainty	$mg.m^{-3}$	4.46	-	-
Expanded uncertainty	$mg.m^{-3}$	8.92	-	-
Uncertainty corrected to std conds.	$mg.m^{-3}$	26.73	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	5.35	-	-
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	26.73	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of value	13.62	-	-
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions				

Total Volatile Organic Carbon Quality Assurance

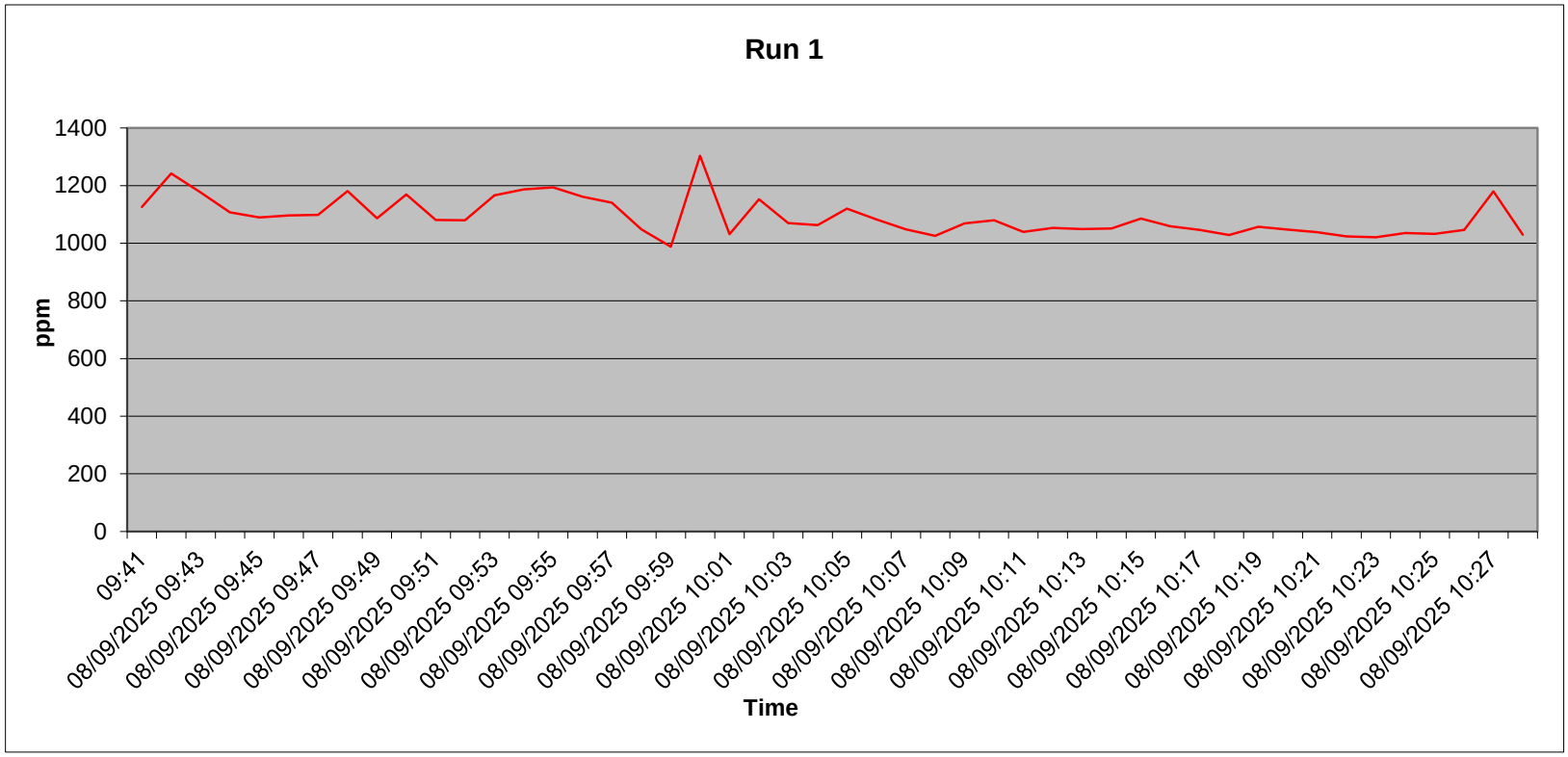
Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:41	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	1000	-	-
Span Gas Value	ppm	693	-	-
Acceptable Gas Range	-	Y	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	193	-	-
Average Temperature	< ^{0}C	193	-	-
Allowable Temperature	-	Yes	-	-
Temperature Acceptable	-	180	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	ppm	0	-	-
Zero Down Sampling Line (Post)	ppm	3	-	-
Zero Drift	ppm	-3	-	-
Allowable Zero Drift (5%)	ppm	34.65	-	-
Zero Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y (<2%)	-	-
Zero Drift	%	-0.43	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	ppm	693	-	-
Span Down Sampling Line (Post)	ppm	694	-	-
Span Drift	ppm	-1	-	-
Allowable Span Drift (5%)	ppm	34.65	-	-
Span Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y (<2%)	-	-
Span Drift (%)	%	-0.14	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	ppm	693	-	-
Recorded Conc. down Line	ppm	693	-	-
Leak check acceptable (< 2%)	(Y/N)	Y (<2%)	-	-

Total Volatile Organic Carbon Results and Sampling Details

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	$mg.m^{-3}$	1914.82	-	-	-
Uncertainty	$mg.m^{-3}$	1347.72	-	-	-
Mass Emission	$kg.h^{-1}$	3.95	-	-	-

General Sampling Information	
Parameter	**Value**
Standard	EN12619
Technical Procedure	SOP2009
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	180
Span Gas Reference Number	ASLTM23ING520
Span Gas Expiry Date	01/12/2026
Span Gas Start Pressure (bar)	80
Gas Cylinder Concentration (ppm)	693
Span Gas Uncertainty (%)	<2
Zero Gas Type	ZA
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	AR08
Reference Conditions	**-**
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Total Volatile Organic Carbon Trend



Total Volatile Organic Carbon Measurement Uncertainty

Measured Quantities	Units	Run 1	Run 2	Run 3
Certified Range of Analyser	ppm	0.5-1680	-	-
Operational Range of Analyser	ppm	1000	-	-
Measured Reading	ppm	1091.46	-	-
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
Nonlinearity	%	0.068	-	-
Temperature Dependent Zero drift	%	0.3	-	-
Temperature Dependent Span drift	%	0.3	-	-
Cross-sensitivity	%	-	-	-
Leak	%	<2	-	-
Calibration Gas Uncertainty	%	<2	-	-
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Measurement uncertainty	$mg.m^{-3}$	224.89	-	-
Combined uncertainty	$mg.m^{-3}$	449.78	-	-
Expanded Uncertainty as % of Limit Value	%	134.77	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of value	23.49	-	-
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	1347.72	-	-
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions				

Hydrogen Chloride Sampling Details & Results

Stack ID	AR08	**Run 1**
Sample ID	AR08 HCL/HF 1+2	**mls**
Impinger 1 ID	AR08 HCL/HF 1+2	210
Impinger 2 ID	-	0
Impinger 3 ID	AR08 HCL/HF 3	130
Time on	11:15	
Time off	11:45	
Leak Check Results		
Prior to test:	<0.01	l/min
Post Test:	<0.01	l/min
Sample Volume Flow Rate:	2.2	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM22EQ511	
Calibration Rate Before Test:	2.2	l/min
Calibration Rate After Test:	2.2	l/min
Average sample Volume:	2.2	l/min
Sample Test Time:	30	min
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.066	m^3
Normalised Gas Volume:	0.066	Nm^3

Hydrogen Chloride Quality Assurance

Stack ID	AR08	**Run 1**	**Run 2**	**Run 3**
Date	08/09/2025	**-**	**-**	**-**
Start time		11:15:00	-	-
Finish Time		11:45:00	-	-
Leak test results	**Units**	**Run 1**	**Run 2**	**Run 3**
Mean Sampling Rate	l/min	2.2	-	-
Pre-sampling leak rate	l/min	<0.01	-	-
Post-sampling leak rate	l/min	<0.01	-	-
Leak rate	l/min	0	-	-
Acceptable leak rate (<2%)	Y/N	Yes	-	-
Filtration				
Filter Material		N/A	-	-
Filter Size	mm	N/A	-	-
Max. Filter Temp	degrees	N/A	-	-
Absorbers Type	Glass/PTFE/ Other	PTFE	-	-
Absorption Solution		Di H2O	-	-
Absorption Efficiency				
Total Imp1 + Imp 2 + Imp 3	µg	17	-	-
Impinger 3	µg	6.5	-	-
Absorption efficiency	%	62	-	-
Acceptable Absorption Eff.	>95% (Y/N)	N	-	-
Blank sample				
Blank sample ID		HCL/HF B	-	-
Blank result	$mg.m^{-3}$	<0.09	-	-
Acceptable Blank	<10% ELV (Y/N)	Y	-	-
Testing laboratory				
Laboratory Name		UKAS0605	-	-
Test certificate Number		25-08135	-	-

Hydrogen Chloride Results & Measurement Uncertainty

Stack ID	AR08	**Run 1**
Date	-	
Start time	11:15	
Finish Time	11:45	
Results		
Laboratory Result	17	µg
Impinger final Volume	340	ml
Factor	-	
Concentration	0.02	mg
Sample Volume	0.066	Nm^3
Emissions Concentration	0.26	$mg.m^{-3}$
Mass Emissions	-	$kg.h^{-1}$

Parameter	Units	Run 1	Run 2	Run 3	Mean
Combined Uncertainty	$mg.m^{-3}$	0.01	-	-	-
Expanded uncertainty as percentage of measured value	% of measured value	7.94	-	-	-
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.02	-	-	-
Expanded uncertainty as percentage of limit value	% Of ELV	0.04	-	-	-

Hydrogen Fluoride Sampling Details & Results

Sampling Details		**Run 1**
Stack ID	AR08	
Time on	11:15	
Time off	11:45	
Leak Check Results		
Prior to test:	0.01	l/min
Post Test:	0.01	l/min
Sample Volume Flow Rate:	2.2	l/min
Standard Requirement:	<2	%
Test Result:	0	%
Test Status	Pass	
Calibration Details		
Pump Number:	-	
Calibration Unit:	ASLTM22EQ511	
Calibration Rate Before Test:	2.2	l/min
Calibration Rate After Test:	2.2	l/min
Average sample Volume:	2.2	l/min
Sample Test Time:	30	min
Pump Gas Temperature:	0	^{O}C
Pump Sample Pressure:	101.3	kPa
Actual Sample Volume:	0.066	m^3
Normalised Gas Volume:	0.066	Nm^3

Hydrogen Fluoride Quality Assurance

Stack ID	AR08	**Run 1**	**Run 2**	**Run 3**
Date	08/09/2025	**-**	**-**	**-**
Start time		**11:15:00**	**-**	**-**
Finish Time		**11:45:00**	**-**	**-**
Leak test results	**Units**	**Run 1**	**Run 2**	**Run 3**
Mean Sampling Rate	l/min	2.2	-	-
Pre-sampling leak rate	l/min	0.01	-	-
Post-sampling leak rate	l/min	0.01	-	-
Leak rate	l/min	0	-	-
Acceptable leak rate (<2%)	Y/N	Yes	-	-
Filtration				
Filter Material		N/A	-	-
Filter Size	mm	N/A	-	-
Max. Filter Temp	degrees	N/A	-	-
Absorbers Type	Glass/PTFE/ Other	Glass	-	-
Absorption Solution		Di-H2O	-	-
Absorption Efficiency				
Total Imp1 + Imp 2 + Imp 3	µg	16.5	-	-
Impinger 3	µg	7	-	-
Absorption efficiency	%	58	-	-
Acceptable Absorption Eff.	>95% (Y/N)	N	-	-
Blank sample				
Blank sample ID		HCL/HF B	-	-
Blank result	$mg.m^{-3}$	<0.09	-	-
Acceptable Blank	<10% ELV (Y/N)	Y	-	-
Testing laboratory				
Laboratory Name		UKAS0605	-	-
Test certificate Number		25-08135	-	-

Hydrogen Fluoride Results & Measurement Uncertainty

Stack ID	AR08	**Run 1**
Date	-	
Start time	11:15:00	
Finish Time	11:45:00	
Results		
Laboratory Result	16.5	µg
Impinger final Volume	330	ml
Factor	-	
Concentration	0.02	mg
Sample Volume	0.07	Nm^3
Emissions Concentration	0.25	$mg.m^{-3}$
Mass Emissions	-	$kg.h^{-1}$

Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**	**Mean**
Combined Uncertainty	$mg.m^{-3}$	0.01	-	-	-
Expanded uncertainty as percentage of measured value	% of measured value	7.94	-	-	-
Expanded uncertainty in units of measurement	$mg.m^{-3}$	0.02	-	-	-
Expanded uncertainty as percentage of limit value	% Of ELV	0.4	-	-	-

Sulphur Dioxide Quality Assurance

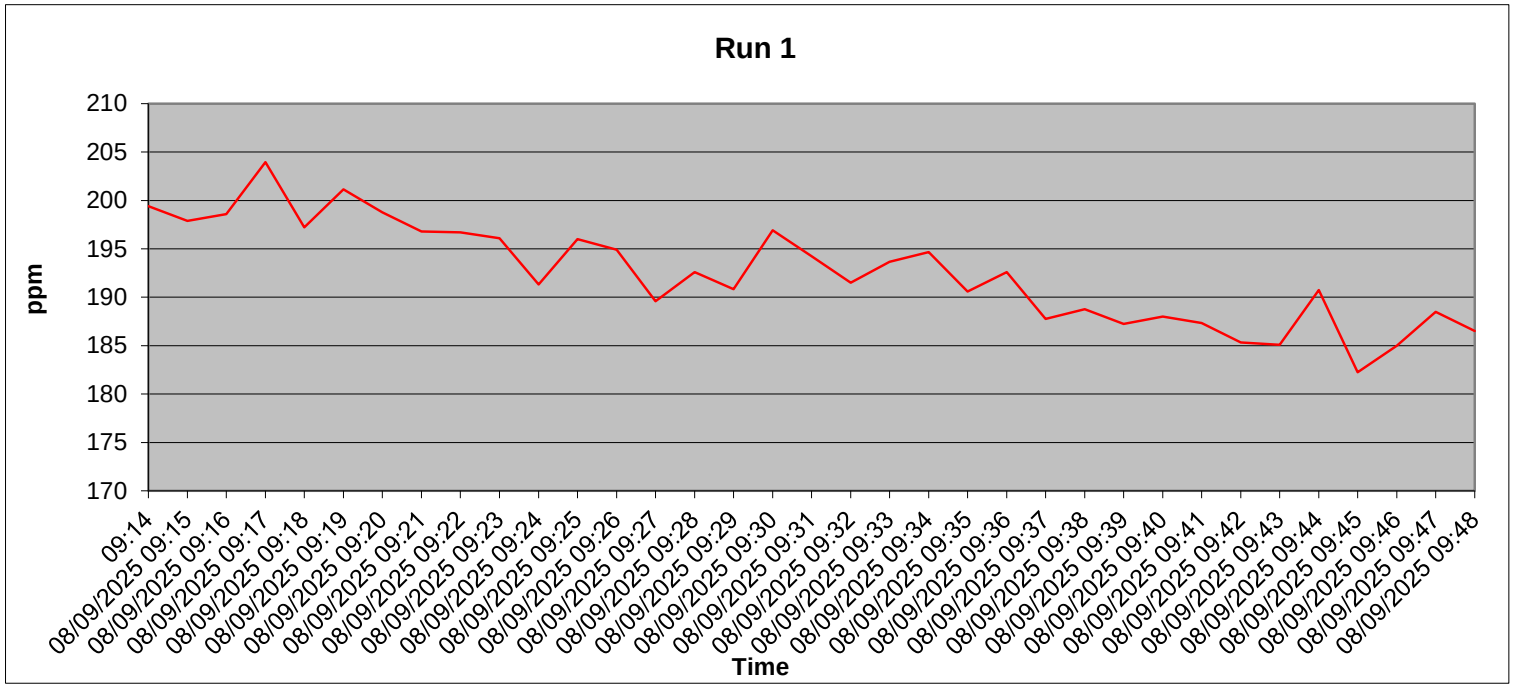
Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:14	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	1000	-	-
Span Gas Value	ppm	701	-	-
Acceptable Gas Range	-	Y	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	2	-	-
Average Temperature	< ^{0}C	2	-	-
Allowable Temperature	-	4	-	-
Temperature Acceptable	-	Y	-	-
Pump flow rate	l/min	0.5	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	ppm	0	-	-
Zero Down Sampling Line (Post)	ppm	8	-	-
Zero Drift	ppm	-8	-	-
Allowable Zero Drift (5%)	ppm	35.05	-	-
Zero Drift Acceptable	Y <2%/Y 2-5%/N>5%	Y (<2%)	-	-
Zero Drift	%	-1.14	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	ppm	701	-	-
Span Down Sampling Line (Post)	ppm	708	-	-
Span Drift	ppm	-7	-	-
Allowable Span Drift (5%)	ppm	35.05	-	-
Span Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y (<2%)	-	-
Span Drift	%	-1	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	ppm	701	-	-
Recorded Conc. down Line	ppm	701	-	-
Leak check acceptable (< 2%)	(Y/N)	Y (<2%)	-	-
Test Conditions	**Units**	**Run 1**	**Run 2**	**Run 3**
Run Ambient Temperature Range	^{0}C	12	-	-

Sulphur Dioxide Results & Sampling Details

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	$mg.m^{-3}$	550.77	-	-	-
Uncertainty	$mg.m^{-3}$	107.25	-	-	-
Mass Emission	$kg.h^{-1}$	1.14	-	-	-

General Sampling Information	
Parameter	**Value**
Standard	CEN/TS 17021
Technical Procedure	SOP 2046
Probe material	SS
Filtration Type/Size	PTFE
Heated Head Filter Used	Yes
Heated Line Temperature	180
Date & Result of last converter check	-
Span Gas Reference Number	ASLTM22ING517
Span Gas Expiry Date	Nov-25
Span Gas Start Pressure (bar)	80
Gas Cylinder Concentration (ppm)	701
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	AR08
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Sulphur Dioxide Trend



Sulphur Dioxide Measurement Uncertainty

Measured Quantities	Units	Run 1	Run 2	Run 3
Certified Range of Analyser	ppm	2.14 to 1000	-	-
Operational Range of Analyser	ppm	1000	-	-
Measured Reading	ppm	192.58	-	-
Measured Quantities	**Units**	**Run 1**	**Run 2**	**Run 3**
Nonlinearity	%	0.8	-	-
Temperature Dependent Zero drift	%	0.8	-	-
Temperature Dependent Span drift	%	2	-	-
Cross-sensitivity	%	1.5	-	-
Leak	%	0	-	-
Calibration Gas Uncertainty	%	<2 %	-	-
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Combined uncertainty	$mg.m^{-3}$	17.89	-	-
Expanded uncertainty	$mg.m^{-3}$	35.79	-	-
Uncertainty corrected to std conds.	$mg.m^{-3}$	107.25	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of ELV	-	-	-
Expanded uncertainty expressed with a level of confidence of 95%	$mg.m^{-3}$	107.25	-	-
Expanded uncertainty expressed with a level of confidence of 95%	% of value	6.5	-	-
Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions				

TNMVOCs

Title:	**Determination of TNMVOCs**			**Run 1**
Method:	EN 13649	-	-	-
Client:	South Dublin County Council	-	11:03	**Time on**
Log Sheet Complete by:	John Casey	-	11:41	**Time off**
Test Date:	08/09/2025	-	-	-
Laboratory Used:	UKAS0605	-	-	-
Certificate Numbers:	25-08135	-	-	-
Stack Reference:	AR08	-	-	-
Leak Check Results				
Prior to test:	<0.0001	l/min	-	-
Post Test:	<0.0001	l/min	-	-
Sample Volume Flow Rate:	0.42	l/min	-	-
Standard Requirement:	<2	%	-	-
Test Result:	0	%	-	-
Test Status	Pass	-	-	-
Calibration Details				
Pump Number:	ASLTM22EQ507	-	-	-
Calibration Unit:	ASLTM23EQ507	-	-	-
Calibration Rate Before Test:	0.42	litres per minute	-	-
Calibration Rate After Test:	0.42	litres per minute	-	-
Average sample Volume:	0.42	litres per minute	-	-
Sample Test Time:	38	minutes	-	-
Pump Gas Temperature:	10	^{O}C	-	-
Pump Sample Pressure:	101.2	kPa	-	-
Actual Sample Volume:	0.01596	m^3	-	-
Normalised Gas Volume:	0.01538	Nm^3	-	-
Tube Details				
Tube Type:	226-09	-	-	-
Tube Identification Number:	6633	-	-	-
Blank Identification Number:	6627	-	-	-
Blank Result	<0.08	mg/m^3	-	-

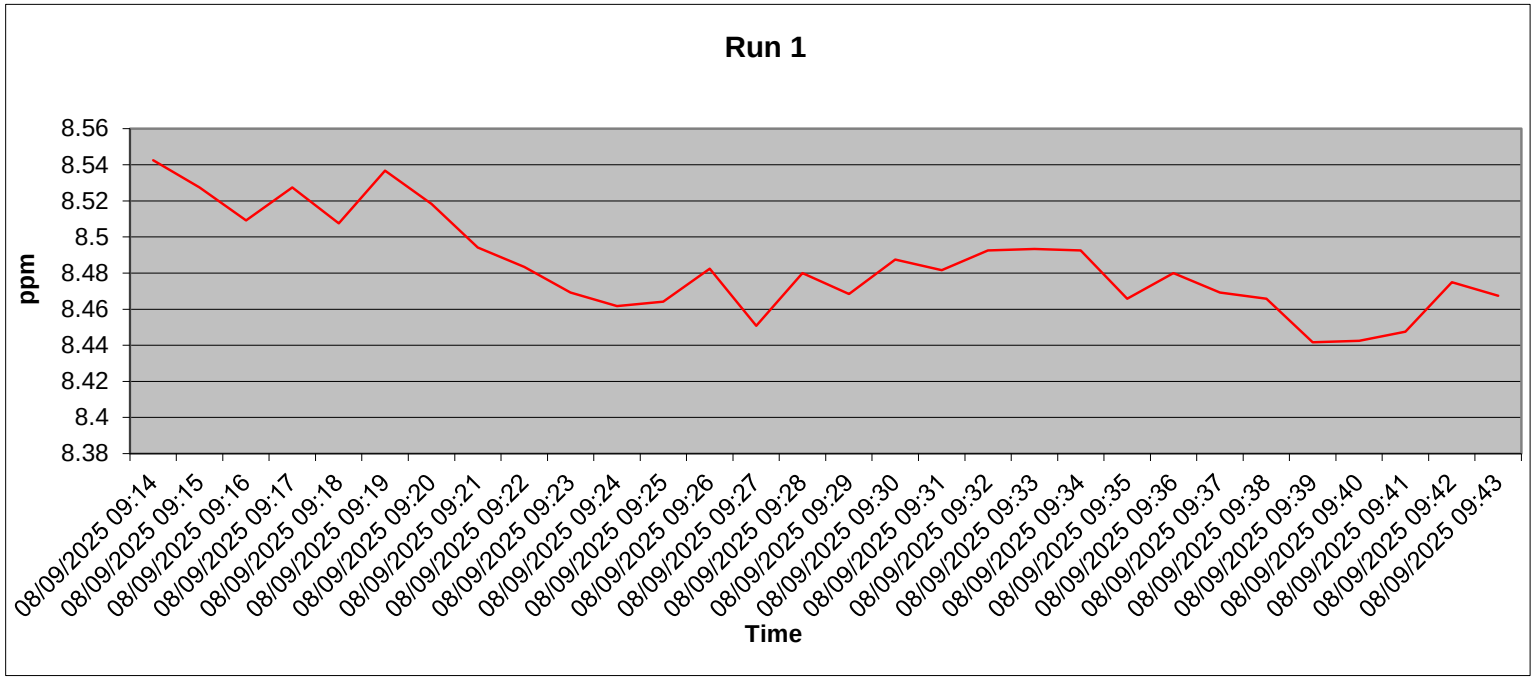
Test Details				
Adsorption Tube Temperature:	10	^{O}C	-	-
Max Temperature Allowable:	40	^{O}C	-	-
Stack Flow Rates				
Diameter:	0.3	m	-	-
Average Velocity:	20.84	m/s	-	-
Average Temperature:	370	^{O}C	-	-
Average Pressure:	101.2	kPa	-	-
Actual Flow Rate:	5304	m^3/Hr	-	-
Normalised Flow Rate:	2064	Nm^3/Hr	-	-
Results				
Compound	***ug/tube***	***mg/Nm ^{3}***	***kg/hr***	
TNMVOCs	<1	< 0.07	< 0.0001	-
Limit of detection	-	-	-	-
Total	<0.07	***mg/Nm ^{3}***	<0.0001	***kg/hr***

Parameter	Units	Run 1
Combined Uncertainty	$mg.m^{-3}$	0.005
Expanded uncertainty	% of measured value	14.03
Expanded uncertainty in units	$mg.m^{-3}$	0.01
Expanded uncertainty as percentage of limit value	% Of ELV	-

Oxygen Quality Assurance

Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:14	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	25	-	-
Span Gas Value	ppm	20.9	-	-
Acceptable Gas Range	-	Y	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	2	-	-
Average Temperature	< ^{0}C	2	-	-
Allowable Temperature	-	4	-	-
Temperature Acceptable	-	Y	-	-
Pump flow rate	l/min	0.5	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	%	0	-	-
Zero Down Sampling Line (Post)	%	0	-	-
Zero Drift	%	0	-	-
Allowable Zero Drift (5%)	%	1.05	-	-
Zero Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	%	20.9	-	-
Span Down Sampling Line (Post)	%	20.8	-	-
Span Drift	%	0.1	-	-
Allowable Span Drift (5%)	%	1.05	-	-
Span Drift Acceptable (Y/N)	Y <2%/Y 2-5%/N>5%	Y <2%	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	%	20.9	-	-
Recorded Conc. down Line	%	20.9	-	-
Leak check acceptable (< 2%)	(Y/N)	Y <2%	-	-
Test Conditions	**Units**	**Run 1**	**Run 2**	**Run 3**
Run Ambient Temperature Range	^{0}C	12	-	-
Combined uncertainty	% vol	0.15	-	-
% of value	%	1.79	-	-
Expanded uncertainty	% of value	3.58	-	-
Expanded uncertainty	% vol	0.3	-	-

Oxygen trend



Carbon Dioxide Quality Assurance

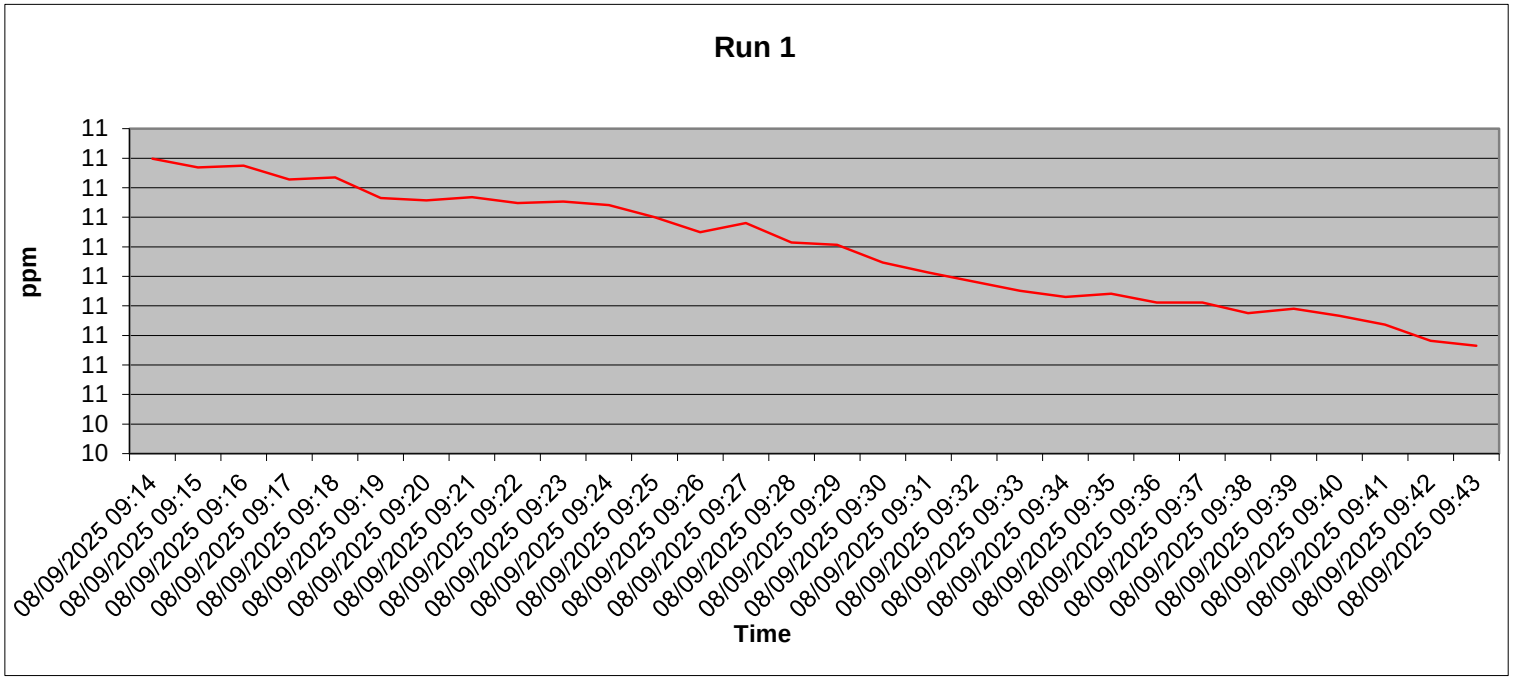
Sampling Details				
Stack ID	AR08			
Parameter	**Units**	**Run 1**	**Run 2**	**Run 3**
Sampling Times	-	09:14	-	-
Sampling Dates	-	08/09/2025	-	-
Instrument Range	ppm	20	-	-
Span Gas Value	ppm	15.01	-	-
Acceptable Gas Range	-	Y	-	-
Quality Assurance	**Units**	**Run 1**	**Run 2**	**Run 3**
Conditioning Unit Temperature	^{0}C	2	-	-
Average Temperature	< ^{0}C	2	-	-
Allowable Temperature	-	4	-	-
Temperature Acceptable	-	Y	-	-
Pump flow rate	l/min	0.5	-	-
Zero Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Zero Down Sampling Line (Pre)	%	0	-	-
Zero Down Sampling Line (Post)	%	0	-	-
Zero Drift	%	0	-	-
Allowable Zero Drift (4%)	%	0.6	-	-
Zero Drift Acceptable	Y <2%/Y 2-4% /N>4%	Y <2%	-	-
Span Drift	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Down Sampling Line (Pre)	%	15.01	-	-
Span Down Sampling Line (Post)	%	15.1	-	-
Span Drift	%	-0.09	-	-
Allowable Span Drift (4%)	%	0.6	-	-
Span Drift Acceptable	Y <2%/Y 2-4% /N>4%	Y <2%	-	-
Leak Check	**Units**	**Run 1**	**Run 2**	**Run 3**
Span Gas Conc.	ppm	15.01	-	-
Recorded Conc. down Line	ppm	15.01	-	-
Leak check acceptable (< 2%)	(Y/N)	Y <2%	-	-
Test Conditions	**Units**	**Run 1**	**Run 2**	**Run 3**
Run Ambient Temperature Range	^{0}C	12	-	-
Combined uncertainty	% vol	0.17	-	-
% of value	%	1.6	-	-
Expanded uncertainty	% of value	3.2	-	-
Expanded uncertainty	% vol	0.34	-	-

Carbon Dioxide Results & Sampling Details

Parameter	Units	Run 1	Run 2	Run 3	Mean
Concentration	%	10.73	-	-	-
Uncertainty	%	0.34	-	-	-

General Sampling Information	
Parameter	**Value**
Standard	ISO12039
Technical Procedure	SOP 2045
Probe material	SS
Filtration Type/Size	Ceramic
Heated Head Filter Used	Yes
Heated Line Temperature	180
Span Gas Reference Number	ASLTM23ING505
Span Gas Expiry Date	28-Jun
Span Gas Start Pressure (bar)	40
Gas Cylinder Concentration (ppm)	15.01
Span Gas Uncertainty (%)	<2
Zero Gas Type	N
Number of Sampling Lines Used	1
Number of Sampling Points Used	1
Sample Point I.D's	AR08
Reference Conditions	
Temperature (K)	273.15
Pressure (kPa)	101.3
Gas (Wet or Dry)	Dry
Oxygen	5

Carbon Dioxide Trend



Moisture Results & Sampling Details

Title:	**Determination of Moisture**				
Method:	EN 14790				
Stack Name	AR08	**Time off**	**Temperature at Pump**	0	Deg C
Test Time	08:32	09:02	**Pressure at Pump**	101.3	kPa
Dry Gas Meter Reading Before	-	m^3	**Humidity at Pumps**	0.1	%
Dry Gas Meter Reading After	-	m^3			
Volume of Air Sampled	-	m^3			
Normalised Air Volume Sampled	0.092	Nm^3			
Leak Rate	0.01				
Balance Calibration	**Weight**				
200.0	200	g			
1000.0	1000	g			
Inpinger Weights	**Initial**	**Final**	**Difference**		
1	490.5	494	3.5		
2	440.2	442.4	2.2		
3	455.6	456.6	1		
4	644.8	644.9	0.1		
Volume of Air Sampled	0.092	Nm^3	**6.8**		
Moisture Content (EN 14790)	8.4	%			
Combined uncertainty		0.18	%		
Expanded uncertainty as percentage of measured value		4.16	% measured value		
Expanded uncertainty in units of measurement		0.35	%		
Expanded uncertainty as percentage of limit value		-	% ELV		

Uncert Sheets

TPM Uncert

Run 1

Uncertainty calculation for EN 13284 Determination of low range mass concentration of dust, Manual Gravimetric Method

Stack Name: AR08

Limit value (ELV)	0	**mg.m-3**	**Reference oxygen**	5	**% by volume**
Measured concentration	1.95	**mg.m-3 (at reference conditions)**			

Measurement Equation

$$c = \frac{m}{V} f_c$$

Measured Quantities	**Symbol**	**Value**	**Standard uncertainty**		**Units**	**Uncertainty as percentage**	**Uncertainty at lv**	**Requirement of std**
Sampled Volume	Vm	0.62	uVm	0.001	**m3**	0.16		<=2%
Sampled gas Temperature	Tm	285	uTm	2	k	0.70		<=1%
Sampled gas Pressure	ρm	101.2	uρm	1	**kPa**	0.99		<=1%
Sampled gas Humidity	Hm	0.1	uHm	1	**% by volume**	1000.00		<=1%
Oxygen content	O2,m	0	uO2,m	0.1	**% by volume**	0.00		<=5%
Mass particulate	m	1.15	um	0.16	**mg**	13.66	#DIV/0!	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	0.48			**%**	0.48		<=2%
Uncollected Mass	UCM	0.5			**mg**	43.47826087		<=10%
(Instack filter - no rinse)								

Intermediate calculations							
Factor for std conds	fs	0.96					
uncertainty components	symbol	**sensitivity coeff**		**u (in units of fs)**			
	ρm	0.009		0.009			
	Hm	0.010		0.010		$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$	
	Tm	0.003		0.007			
	ufs			0.015			1.57
Corrected volume	V	0.59	uV	0.009	**m3**	$V = V_m f_s$	1.58
Factor for O2 correction	fc	0.76					
uncertainty components	symbol	**sensitivity coeff**		**u**			
	O2,m	0.04		0.004		$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$	
Factor for O2 Correction	ufc	0.76		0.004			0.48

Parameter		**Value**	**Units**	**Sensitivity c**	**Uncertainty contribution**		**Uncertainty as %**	
Corrected Volume (standard conditions)	V	0.59	m3	3.29	0.03	mg.m-3	1.58	%
Mass	m	1.15	mg	1.69	0.27	mg.m-3	13.66	%
Factor for O2 Correction	fc	0.76		2.56	0.01	mg.m-3	0.48	%
Leak	L	0.01	mg.m-3	1.00	0.01	mg.m-3	0.28	%
Uncollected mass	UCM	0.29	mg	1.69	0.49	mg.m-3	25.10	%
Combined measurement uncertainty					**0.56**	mg.m-3		

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Facility Location: Arthurstown Landfill
Rev.No: 1

Uncert Sheets

Expanded uncertainty as percentage of measured value	**57.26**	**% measured of value**	**expressed with a level of confidence of 95%**
			(Using a coverage factor k=2)
Expanded uncertainty in units of measurement	**1.12**	**mg.m-3**	
Expanded uncertainty as percentage of limit value	**#DIV/0!**	**% ELV**	

Note: Enter values into green boxes

Developed for the STA by R Robinson, NPL

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

CO Uncert

Uncertainty calculation for Gaseous Measurement CO

Limit value	1400	**mg/m3 (corre**	**Cal gas conc**	872.5	**mg.m-3**
Measured concentration	749.41	**mg/m3**	**Full Scale**	1000	**mg/m3**
Measured concentration	954.07	**mg/m3 (Corrected)**			

Correction for reference conditions

		O2, %	Moisture,	Pressure, KPa	Temperature, K
	ref	5.00	0.00	101.30	**273.00**
	measured	8.41	0.00	101.20	**643.15**
	Uncert	0.35	1.00	0.00	**1.00**
Factors		1.27	1.00	1.00	2.36
Uncertainty in factor		0.04	0.01	0.00	0.00
Correction Factor		**3.00**	uf	**0.04**	

Performance characteristics	**Value**				**specification**
Response time		180	seconds		180.000
Logger sampling interval		60	seconds		
Measurement period		43	minutes		
Number of readings in measurement		43			
Repeatability at zero		0.25	% full scale		<1 % range
Repeatability at span level		0.15	% full scale		<2 % range
Deviation from linearity(lack of fit)		0.7	% of value		<2 % range
Zero drift		-5	mg/m3		<2% range / 24hr
Span drift		-1.25	mg/m3		<2% range/24hr
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	% full scale/10K		<3% range / 10 K
N2O (mg/m3)	20	0.2	mg/m3		
CO2 (% vol)	15	0.2	mg/m3		
CH4 (mg/m3)	40	0.7	mg/m3		
H2O (% vol)	20	0.2	mg/m3		
dependence on voltage		0.1	% full scale/10V		<2% range

Effect of drift	
-6.07	mg/m3
-0.61	% full scale

	ranges min	max	value at calib	
flow	95.00	105	100	kPa
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
N2O range	0	40	0	mg/m3
CO2 range	0	15	0	%vol
CH4 range	0	57	0	mg/m3
H2O range	0	1	0	%vol
Voltage	93	121	110	V

Uncert Sheets

losses in the line (leak)	0.00	% of value		< 0.1%vol /10 volt
Uncertainty of calibration gas	2	% of value		< 2% of value

Performance characteristic		Uncertainty		Value of uncertainty quantity		mg/m3
Standard deviation of repeatability at zero		ur0		for mean		use rep at span
Standard deviation of repeatability at span level		urs		for mean		0.23
Lack of fit		ufit				3.03
Drift		u0dr				-3.51
volume or pressure flow dependence		uspres				0.19
atmopsheric pressure dependence		uapres				0.24
ambient temperature dependence		utemp				0.00
N2O (mg/m3)		uinterf				0.23
CO2 (% vol)		uinterf				0.12
CH4 (mg/m3)		uinterf				0.58
H2O (% vol)		uinterf				0.01
Dependence on voltage		uvolt				0.86
losses in the line (leak)		uleak				0.00
Uncertainty of calibration gas		ucalib				8.65
Uncertianty in factor		uf				27.66

Measurement uncertainty			954.07	mg/m3
Combined uncertainty			9.90	mg/m3
Expanded uncertainty	k =	2	19.81	mg/m3
Uncertainty corrected to std conds			**59.37**	**mg/m3**
Expanded uncertainty	**expressed with a level c**		**4.24**	**% ELV**
Expanded uncertainty	**expressed with a level c**		**59.37**	**mg.m-3**
Expanded uncertainty	**expressed with a level c**		**6.22**	**% value**

Use largest of sum of all positive or all negative influences

0.93	all +ves	Criteria
0	all -ves	sum <4% range
0.93	largest	14.98827519

Value to use for intereference uncertainty
uint 0.93

Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions

Note: Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests

Developed for the STA by R Robinson, NPL

NOx Uncert

Uncertainty calculation for Gaseous Measurement NOx EN14792

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Licence Holder: South Dublin County Council, AR08
Facility Location: Arthurstown Landfill
Rev.No: 1

Uncert Sheets

RUN 1

Limit value	500	**mg/m3 (corre**	**Cal gas conc**	338.745	**mg.m-3 (NO2)**
Measured concentration	75	**ppm**			
Measured concentration	154.13	**mg/m3 (101.3**	**Full Scale**	513.25	**mg/m3 (NO2)**
Measured concentration	196.22	**mg/m3 (Corrected)**			

NO/NO2 ratio	100.00

Gas	NO	
Full Scale	250	**ppm**
Cal gas conc	165	**ppm**
Conversion	2.053	

Correction for reference conditions					
		O2, %	**Moisture,**	**Pressure, KPa**	**Temperature, K**
	ref	5.00	0.00	101.30	**273.00**
	measured	8.41	0.00	101.20	**643.00**
	Uncert	0.35	0.00	0.00	**1.00**
Factors		1.27	1.00	1.00	2.36
Uncertainty in factor		0.04	0.00	0.00	0.00
Correction Factor		**3.00**	uf	**0.04**	

Performance characteristics		**Value**			**specification**
Response time		180	seconds		180.000
Logger sampling interval		60	seconds		
Measurement period		43	minutes		
Number of readings in measurement		43			
Repeatability at zero		0.03	% full scale		<1 % range
Repeatability at span level		0.06	% full scale		<2 % range
Deviation from linearity(lack of fit)		0.2	% of value		<2 % range
Zero drift		0.21	mg/m3		<2% range / 24hr
Span drift		1.64	mg/m3		<2% range/24hr
volume or pressure flow dependence		0	%of full scale/kPa		<2 % / kPa
atmospheric pressure dependence		0	%of value /kPa		<3% / kPa
ambient temperature dependence		0.3	% full scale/10K		<3% range / 10 K
NH3 (mg/m3)	20	0.0	mg/m3		
CO2 (% vol)	15	0.2	mg/m3		
H2O (% vol)	30	0.0	mg/m3		
dependence on voltage		0.1	% full scale/10V		<2% range
losses in the line (leak)		0.00	% of value		< 0.1%vol /10 volt
Converter efficency		95.5	%		>95%
Uncertainty of calibration gas		2	% of value		< 2% of value

		ranges			
		min	max	value at calib	
flow		95.00	105	100	kPa
pressure		101.30	101.3	101.3	kPa
temp		289	289	289	K
NH3 range		0	0	0	mg/m3
CO2 range		0	15	0	%vol
H2O range		0	0	0	%vol
Voltage		93	121	110	V

Effect of drift	
1.15	mg/m3
0.23	% full scale

Performance characteristic		**Uncertainty**		**Value of uncertainty quantity**		**mg/m3**
Standard deviation of repeatability at zero		ur0		for mean		use rep at span
Standard deviation of repeatability at span level		urs		for mean		0.05
Lack of fit		ufit				0.18
Drift		u0dr				0.67
volume or pressure flow dependence		uspres				0.00
atmopsheric pressure dependence		uapres				0.00
ambient temperature dependence		utemp				0.00
NH3		uinterf				0.00
CO2 (% vol)		uinterf				0.12

Use largest of sum of all positive or all negative influences		
0.12	all +ves	Criteria
0	all -ves	sum <4% range

Uncert Sheets

H2O (% vol)			uinterf				0.00	0.12 largest	3.082606286
Dependence on voltage			uvolt				0.44	Value to use for intereference uncertainty	
losses in the line (leak)			uleak				0.00	uint 0.12	
Uncertainty of calibration gas			ucalib				1.78		
converter efficiency			uceff				4.00		
Uncertainty in factor			uf				5.48		

Measurement uncertainty			196.22	mg/m3
Combined uncertainty			4.46	mg/m3
Expanded uncertainty	k =	2	8.92	mg/m3
Uncertainty corrected to std conds			**26.73**	**mg/m3**
Expanded uncertainty	**expressed with a level c**		**5.35**	**% ELV**
Expanded uncertainty	**expressed with a level c**		**26.73**	**mg.m-3**
Expanded uncertainty	**expressed with a level c**		**13.62**	**% value**

Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions

Note: Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests

Developed for the STA by R Robinson, NPL

corrected drift to be based on mg/m3 reading and the correction alert to be based on % full scale

TOC Uncert

QGU-008-2013 Uncertainty calculation for Gaseous Measurement SO2 EA M21

V2 Jul-08

Limit value	1000	**mg/m3 (corre**	**Cal gas conc**	1108.8	**mg.m-3**
Measured concentration	1914.82	**mg/m3**	**Full Scale**	1600	**mg/m3**
Measured concentration	5737.49	**mg/m3 (Corrected)**			

Correction for reference conditions					
		O2, %	**Moisture,**	**Pressure, KPa**	**Temperature, K**
	ref	5.00	0.00	101.30	**273.00**
	measured	8.41	0.00	101.20	**643.00**
	Uncert	0.35	1.00	0.00	**1.00**
Factors		1.27	1.00	1.00	2.36
Uncertainty in factor		0.04	0.01	0.00	0.00
Correction Factor		**3.00**	uf	**0.04**	

Performance characteristics	**Value**			**specification**

Effect of drift

Uncert Sheets

Response time		180	seconds		180.000
Logger sampling interval		60	seconds		
Measurement period		48	minutes		
Number of readings in measurement		48			
Repeatability at zero		0.25	% full scale		<1 % range
Repeatability at span level		0.15	% full scale		<2 % range
Deviation from linearity		0.7	% of value		<2 % range
Zero drift		-4.8	mg/m3		<2% range / 24hr
Span drift		-1.6	mg/m3		<2% range/24hr
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	% full scale/10K		<3% range / 10 K
N2O (mg/m3)	40	9.0	mg/m3		
CO2 (% vol)	15	9.0	mg/m3		
CH4 (mg/m3)	57	9.0	mg/m3		
H2O (% vol)	30	9.0	mg/m3		
dependence on voltage		0.1	% full scale/10V		<2% range
losses in the line (leak)		2	% of value		< 0.1%vol /10 volt
Uncertainty of calibration gas		1.07	% of value		< 2% of value

-13.08 mg/m3
-0.23 % value

	ranges min	max	value at calib	
flow	0.3	0.5	0.4	l/hr
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
N2O range	0	0	0	mg/m3
CO2 range	0	40	0	%vol
CH4 range	0	57	0	mg/m3
H2O range	0	1	0	%vol
Voltage	93	121	110	V

Performance characteristic			**Uncertainty**		**Value of uncertainty quantity**		
Standard deviation of repeatability at zero			ur0		for mean		use rep at span
Standard deviation of repeatability at span level			urs		for mean		0.02
Lack of fit			ufit				6.47
Drift			u0dr				-7.55
volume or pressure flow dependence			uspres				0.01
atmopsheric pressure dependence			uapres				0.39
ambient temperature dependence			utemp				0.00
N2O (mg/m3)			uinterf				0.00
CO2 (% vol)			uinterf				13.86
CH4 (mg/m3)			uinterf				5.20
H2O (% vol)			uinterf				0.17
Dependence on voltage			uvolt				1.38
losses in the line (leak)			uleak				66.25
Uncertainty of calibration gas			ucalib				35.44
Uncertianty in factor			uf				211.73

Use largest of sum of all positive or all negative influences

19.23	all +ves	Criteria
0	all -ves	sum <4% range
19.23	largest	38.29645691

Value to use for intereference uncertainty
uint 19.23

Measurement uncertainty			5737.49	mg/m3
Combined uncertainty			224.89	mg/m3
Expanded uncertainty	k =	2	449.78	mg/m3
Uncertainty corrected to std conds			1347.72	mg/m3
Expanded uncertainty	**expressed with a level c**		**134.77**	**% ELV**

Uncert Sheets

Expanded uncertainty	**expressed with a level c**	**1347.72 mg.m-3**
Expanded uncertainty	**expressed with a level c**	**23.49 % value**

HCL Uncert

QGU-009-2013 Uncertainty calculation for HCL

v2

Limit value (ELV)	50	**mg.m-3**	**Reference oxygen**	5	**% by volume**
Measured concentration	0.26	**mg.m-3 (at reference conditions)**			

Measurement Equation

$$c = \frac{m}{V} f_c$$

Measured Quantities	Symbol	Value	Standard uncertainty		Units	Uncertainty as percentage	Uncertainty at lv	Requirement of std
Sampled Volume Gas	Vm	0.066	uVm	0.001	**m3**	1.52		<=2%
Sampled gas Temperature	Tm	273	uTm	2	k	2.00		<2.5 k
Sampled gas Pressure	ρm	101.3	uρm	1	**kPa**	0.99		<=1%
Sampled gas Humidity	Hm	0	uHm	1	**% by volume**	1.00		<=1%
Oxygen content	O2,m	8.41	uO2,m	0.1	**% by volume**	1.19		<=5%
Concentration in impinger	C	0.1	uC	0.003	**mg/l**	3.00		<5%
Impinger solution volume	VS	340	uVS	0.001	**l**	0.00		<1%
Mass SO2	m	34	um	1.02	**mg**	3.00	0.02	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	2			**%**	2.00		<=2%

Intermediate calculations							
Factor for std conds	fs	1.00					
uncertainty components	symbol	**sensitivity coeff**		**u (in units of fs)**			
	ρm	0.010		0.010			
	Hm	0.010		0.010			
	Tm	0.004		0.007			
	ufs			0.016			1.58
Corrected volume	V	0.07	uV	0.001	**m3**	$V = V_m f_s$	2.19
Factor for O2 correction	fc	1.27					
uncertainty components	symbol	**sensitivity coeff**		**u**			
	O2,m	0.10		0.010			
Factor for O2 Correction	ufc	1.27		0.010			0.79

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

$$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$$

Parameter		Value	Units	Sensitivity c	Uncertainty contribution		Uncertainty as %
Corrected Volume (standard conditions)	V	0.07	m3	3.90	0.01	mg.m-3	2.19 %
Mass	m	34.00	mg	0.01	0.01	mg.m-3	3.00 %
Factor for O2 Correction	fc	1.27		0.20	0.00	mg.m-3	0.79 %

Uncert Sheets

Leak	L	0.00 mg.m-3	1.00	0.00 mg.m-3	1.15 %	
Combined uncertainty				**0.01** mg.m-3		

Expanded uncertainty as percentage of measured value	**7.94**	**% measured of value**	**expressed with a level of confidence of 95%** **(Using a coverage factor k=2)**
Expanded uncertainty in units of measurement	**0.02**	**mg.m-3**	
Expanded uncertainty as percentqge of limit value	**0.04**	**% ELV**	

QGU-009-2013 Uncertainty calculation for HF

v2

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

Measurement Equation

$$c = \frac{m}{V} f_c$$

Limit value (ELV)	5	**mg.m-3**	**Reference oxygen**	5	**% by volume**
Measured concentration	0.25	**mg.m-3 (at reference conditions)**			

Measured Quantities	**Symbol**	**Value**	**Standard uncertainty**		**Units**	**Uncertainty as percentage**	**Uncertainty at lv**	**Requirement of std**
Sampled Volume Gas	Vm	0.066	uVm	0.001	**m3**	1.52		<=2%
Sampled gas Temperature	Tm	273	uTm	2	k	2.00		<2.5 k
Sampled gas Pressure	ρm	101.3	uρm	1	**kPa**	0.99		<=1%
Sampled gas Humidity	Hm	0	uHm	1	**% by volume**	1.00		<=1%
Oxygen content	O2,m	8.41	uO2,m	0.1	**% by volume**	1.19		<=5%
Concentration in impinger	C	0.1	uC	0.003	**mg/l**	3.00		<5%
Impinger solution volume	VS	330	uVS	0.001	**l**	0.00		<1%
Mass SO2	m	33	um	0.99	**mg**	3.00	0.15	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter								
Leak	L	2			**%**	2.00		<=2%

Intermediate calculations						
Factor for std conds	fs	1.00				
uncertainty components	symbol	**sensitivity coeff**		**u (in units of fs)**		
	ρm	0.010		0.010		
	Hm	0.010		0.010		
	Tm	0.004		0.007		
	ufs			0.016		1.58
Corrected volume	V	0.07	uV	0.001	**m3**	2.19
Factor for O2 correction	fc	1.27				
uncertainty components	symbol	**sensitivity coeff**		**u**		
	O2,m	0.10		0.010		
Factor for O2 Correction	ufc	1.27		0.010		0.79

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

$$V = V_m f_s$$

$$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$$

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Uncert Sheets

Parameter		Value	Units	Sensitivity c	Uncertainty contribution		Uncertainty as %	
Corrected Volume (standard conditions)	V	0.07	m3	3.79	0.01	mg.m-3	2.19	%
Mass	m	33.00	mg	0.01	0.01	mg.m-3	3.00	%
Factor for O2 Correction	fc	1.27		0.20	0.00	mg.m-3	0.79	%
Leak	L	0.00	mg.m-3	1.00	0.00	mg.m-3	1.15	%
Combined uncertainty					**0.01**	mg.m-3		

Expanded uncertainty as percentage of measured value	**7.94**	**% measured of value**	**expressed with a level of confidence of 95%**
			(Using a coverage factor k=2)
Expanded uncertainty in units of measurement	**0.02**	**mg.m-3**	
Expanded uncertainty as percentqge of limit value	**0.40**	**% ELV**	

Uncertainty calculation for Gaseous Measurement SO2 EA M21

$$f_s = \frac{(100 - H_m)}{100}\frac{273}{T_m}\frac{\rho_m}{101.3}$$

Limit value	-	mg/m3 (corre	Cal gas conc	2004.86	mg.m-3
Measured concentration	550.77	mg/m3	Full Scale	2860	mg/m3
Measured concentration	1650.69	mg/m3 (Corrected)			

Correction for reference conditions					
		O2, %	Moisture,	Pressure, KPa	Temperature, K
	ref	5.00	0.00	101.30	**273.00**
	measured	8.41	0.00	101.20	**643.15**
	Uncert	0.35	1.00	0.00	**1.00**
Factors		1.27	1.00	1.00	2.36
Uncertainty in factor		0.04	0.01	0.00	0.00
Correction Factor		**3.00**	uf	**0.04**	

Performance characteristics	Value				specification
Response time		180	seconds		180.000
Logger sampling interval		60	seconds		
Measurement period		43	minutes		
Number of readings in measurement		43			
Repeatability at zero		0.25	% full scale		<1 % range
Repeatability at span level		0.15	% full scale		<2 % range
Deviation from linearity(lack of fit)		0.7	% of value		<2 % range
Zero drift		-22.80	mg/m3		<2% range / 24hr
Span drift		-19.95	mg/m3		<2% range/24hr
volume or pressure flow dependence		0.02	% of full scale/3 kPa		<2 % / 3 kPa
atmospheric pressure dependence		0.8	% of full scale/2 kPa		<3% / 2 kPa
ambient temperature dependence		0.01	% full scale/10K		<3% range / 10 K
N2O (mg/m3)	20	0.2	mg/m3		
CO2 (% vol)	15	0.2	mg/m3		
CH4 (mg/m3)	40	0.7	mg/m3		
H2O (% vol)	20	0.2	mg/m3		

Effect of drift	
-28.28	mg/m3
-0.99	% full scale

	ranges min	max	value at calib	
flow	95.00	105	100	kPa
pressure	100.76	100.92	100.88	kPa
temp	287	288.5	287.5	K
N2O range	0	40	0	mg/m3
CO2 range	0	15	0	%vol
CH4 range	0	57	0	mg/m3
H2O range	0	1	0	%vol

Uncert Sheets

dependence on voltage	0.1	% full scale/10V		<2% range	Voltage	93	121	110	V
losses in the line (leak)	0.00	% of value		< 0.1%vol /10 volt					
Uncertainty of calibration gas	2	% of value		< 2% of value					

Performance characteristic		Uncertainty		Value of uncertainty quantity		mg/m3
Standard deviation of repeatability at zero		ur0		for mean		use rep at span
Standard deviation of repeatability at span level		urs		for mean		0.65
Lack of fit		ufit				2.23
Drift		u0dr				-16.33
volume or pressure flow dependence		uspres				0.55
atmopsheric pressure dependence		uapres				0.70
ambient temperature dependence		utemp				0.00
N2O (mg/m3)		uinterf				0.23
CO2 (% vol)		uinterf				0.12
CH4 (mg/m3)		uinterf				0.58
H2O (% vol)		uinterf				0.01
Dependence on voltage		uvolt				2.47
losses in the line (leak)		uleak				0.00
Uncertainty of calibration gas		ucalib				6.36
Uncertianty in factor		uf				20.33

Use largest of sum of all positive or all negative influences

0.93	all +ves	Criteria	
0	all -ves	sum <4% range	
0.93	largest	11.01538976	

Value to use for intereference uncertainty
uint 0.93

Measurement uncertainty		1650.69	mg/m3
Combined uncertainty		17.89	mg/m3
Expanded uncertainty	k = 2	35.79	mg/m3
Uncertainty corrected to std conds		**107.25**	**mg/m3**
Expanded uncertainty	**expressed with a level c**	**#VALUE!**	**% ELV**
Expanded uncertainty	**expressed with a level c**	**107.25**	**mg.m-3**
Expanded uncertainty	**expressed with a level c**	**6.50**	**% value**

Requirement in standard is for uncertainty to be < 10% at ELV at standard conditions

Note: Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests

TNMVOCs Uncert

Run 1

Uncertainty calculation for TOC

Measurement Equation

$$c = \frac{m}{\quad} \cdot f$$

Limit value (ELV)	75	**mg.m-3**	**Reference oxygen**	5	**% by volume**

Uncert Sheets

Measured concentration	0.07	**mg.m-3 (at reference conditions)**

$$c = \frac{m}{V} f_c$$

Measured Quantities	**Symbol**	**Value**	**Standard uncertainty**		**Units**	**Uncertainty as percentage**	**Uncertainty at lv**
Sampled Volume	Vm	0.015380844	uVm	0.001	**m3**	6.50	
Sampled gas Temperature	Tm	283	uTm	2	k	0.71	
Sampled gas Pressure	ρm	100.6	uρm	1	**kPa**	0.99	
Sampled gas Humidity	Hm	0	uHm	1	**% by volume**	1.00	
Oxygen content	O2,m	8.41	uO2,m	0.1	**% by volume**	1.19	
Note - Sampled gas humidity, temperature and pressure are values at the gas meter							
Leak	L	0			**%**	0.00	
Uncollected Mass	UCM	0			**mg**	#REF!	
(Instack filter - no rinse)							

Intermediate calculations							
Factor for std conds	fs	0.96					
uncertainty components	symbol	**sensitivity coeff**		**u (in units of fs)**			
	ρm	0.010		0.010			
	Hm	0.010		0.010			
	Tm	0.003		0.007			
	ufs			0.015			1.58
Corrected volume	V	0.01	uV	0.001	**m3**	$V = V_m f_s$	6.97
Factor for O2 correction	fc	1.27					
uncertainty components	symbol	**sensitivity coeff**		**u**			
	O2,m	0.10		0.010			
Factor for O2 Correction	ufc	1.27		0.010			0.79

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

$$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$$

Parameter		**Value**	**Units**	**Sensitivity c**	**Uncertainty contribution**		**Uncertainty as %**
Corrected Volume (standard conditions)	V	0.01	m3	4.41	0.00	mg.m-3	6.97 %
Factor for O2 Correction	fc	1.27		0.05	0.00	mg.m-3	0.79 %
Leak	L	0.00	mg.m-3	1.00	0.00	mg.m-3	0.00 %
Combined measurement uncertainty					**0.00**	mg.m-3	

Expanded uncertainty as percentage of measured value	**14.03**	**% measured of value**	**expressed with a level of confidence of 95%** **(Using a coverage factor k=2)**
Expanded uncertainty in units of measurement	**0.009**	**mg.m-3**	
Expanded uncertainty as percentage of limit value	**0.00**	**% ELV**	

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

O_2 Uncert

Run 1

Uncert Sheets

Uncertainty calculation for Gaseous Measurement Oxygen EN14789

Limit value	n/a	**%vol**	**Calibration gas**	**20.9**	**%vol**
Measured concentration	8.41	**%vol**	**Full Scale**	**25**	**%vol**

Performance characteristics	**Value**				**specification**
Response time		180	seconds		< 200 s
Logger sampling interval		60	seconds		
Measurement period		43	minutes		
Number of readings in measurement		43	Assuming 1 minute collected over 1 hour		
Repeatability at zero		0.015	% by volume	stdev	<0.2 % range
Repeatability at span level		0.014	% by volume	stdev	<0.4 % range
Deviation from linearity		0.13	% vol	+/-	<0.3 % volume
Zero drift (during measurement period)		0.00	% vol at zero level	+/-	<2% of volume / 24hr
Span drift (during measurement period)		0.10	% vol at span level	+/-	<2% volume/24hr
volume or pressure flow dependence		0	% of fs / 10l/h	+- 5 l/h	<1% range
atmospheric pressure dependence		0.3	% of fs/kPa	+- 2kPa	< 1.5 % range
ambient temperature dependence		-0.07	% by volume /10K	+- 15K	<0.3% volume 10 K
CO2 (% vol)	15	0.07	% by volume per	15	
NO (mg/m3)	300	0.02	% by volume per	300	
NO2 (mg/m3)	30	0	% by volume per	30	
Combined interference		0.56	% range		<2% range
Dependence on voltage		0.1	% by volume /10V	+- 5%	< 0.1%vol /10 volt
Losses in the line (leak)		0.00	% of value		< 2% of value
Uncertainty of calibration gas		2	% of value		

Effect of drift	
0.04	% vol
0.16	% full scale

	range of variation from conditions at calibration			
	min	max	value at calib	
flow	5	15	10	l/h
pressure	99.00	101	100	kPa
temp	280	285	285	K
CO2 range	8	15	0	% vol
NO range	100	150	0	mg/m3
NO2 range	5	7.5	0	mg/m3
Voltage	105	115	110	V

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**			**% vol**
Standard deviation of repeatability at zero			ur0		for mean		Only use rep at span
Standard deviation of repeatability at span level			urs		for mean		0.00
Lack of fit			ufit				0.08
Drift			u0dr				0.02
volume or pressure flow dependence			uspres				0.00
atmospheric pressure dependence			uapres				0.04
ambient temperature dependence			utemp				-0.02
CO2							0.05
NO							0.01
NO2							0.00
Combined interference (from mcerts)							0.08
dependence on voltage			uvolt				0.03
losses in the line (leak)			uleak				0.00
Uncertainty of calibration gas			ucalib				0.10

Use largest of sum of all positive or all negative influences

0.06	all +ves
0	all -ves
0.06	largest

Value to use for intereference uncertainty

uint 0.06

Uncert Sheets

Measurement uncertainty			8.41	%vol
Combined uncertainty			0.15	%vol
% of value			1.79	%
Coverage factor k =	2			
Expanded uncertainty	**expressed with a level c**		**3.58**	**% of value**
Expanded uncertainty	**expressed with a level c**		**0.30**	**% vol**

Requirement for SRM is that Uncertaitny should be < 6% of value, on a dry gas basis

Note: Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests
Purple boxes are from manufacturer specification, or CEN standard as MCERTS data not available

Developed for the STA by R Robinson, NPL

corrected drift alert to be based on % full scale

CO_2 Uncert

Run 1

Uncertainty calculation for Gaseous Measurement Carbon Dioxide

Limit value	n/a	**%vol**	**Calibration gas**	**15.01**	**%vol**
Measured concentration	10.73	**%vol**	**Full Scale**	**25**	**%vol**

Performance characteristics	**Value**			**specification**
Response time	180	seconds		< 200 s
Logger sampling interval	60	seconds		
Measurement period	43	minutes		
Number of readings in measurement	43	Assuming 1 minute collected over 1 hour		
Repeatability at zero	0.015	% by volume	stdev	<0.2 % range
Repeatability at span level	0.014	% by volume	stdev	<0.4 % range
Deviation from linearity	0.13	% vol	+/-	<0.3 % volume
Zero drift (during measurement period)	0.00	% vol at zero level	+/-	<2% of volume / 24hr
Span drift (during measurement period)	-0.09	% vol at span level	+/-	<2% volume/24hr
volume or pressure flow dependence	0	% of fs / 10l/h	+- 5 l/h	<1% range
atmospheric pressure dependence	0.3	% of fs/kPa	+- 2kPa	< 1.5 % range
ambient temperature dependence	-0.07	% by volume /10K	+- 15K	<0.3% volume 10 K

Effect of drift	
-0.06	% vol
-0.26	% full scale

	range of variation from conditions at calibration			
	min	max	value at calib	
flow	5	15	10	l/h
pressure	99.00	101	100	kPa
temp	280	285	285	K

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Uncert Sheets

CO2 (% vol)	15	0.07	% by volume per	15	
NO (mg/m3)	300	0.02	% by volume per	300	
NO2 (mg/m3)	30	0	% by volume per	30	
Combined interference		0.56	% range		<2% range
Dependence on voltage		0.1	% by volume /10V	+- 5%	< 0.1%vol /10 volt
Losses in the line (leak)		0.00	% of value		< 2% of value
Uncertainty of calibration gas		2	% of value		

CO2 range	8	15	0	% vol	
NO range	100	150	0	mg/m3	
NO2 range	5	7.5	0	mg/m3	
Voltage	105	115	110	V	

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**			**% vol**	
Standard deviation of repeatability at zero			ur0		for mean		Only use rep at span	
Standard deviation of repeatability at span level			urs		for mean		0.00	
Lack of fit			ufit				0.08	
Drift			u0dr				-0.04	
volume or pressure flow dependence			uspres				0.00	
atmospheric pressure dependence			uapres				0.04	
ambient temperature dependence			utemp				-0.02	
CO2							0.05	**Use largest of sum of all positive or all negative influences**
NO							0.01	0.06 all +ves
NO2							0.00	0 all -ves
Combined interference (from mcerts)							0.08	0.06 largest
dependence on voltage			uvolt				0.03	Value to use for intereference uncertainty
losses in the line (leak)			uleak				0.00	uint 0.06
Uncertainty of calibration gas			ucalib				0.12	

Measurement uncertainty			10.73	%vol
Combined uncertainty			0.17	%vol
% of value			1.60	%
Coverage factor k =	2			
Expanded uncertainty	**expressed with a level c**		**3.20**	**% of value**
Expanded uncertainty	**expressed with a level c**		**0.34**	**% vol**

Requirement for SRM is that Uncertaitny should be < 6% of value, on a dry gas basis

Note:
Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests
Purple boxes are from manufacturer specification, or CEN standard as MCERTS data not available

Developed for the STA by R Robinson, NPL

Uncert Sheets

Moisture Uncert

Run 1

Uncertainty calculation for Gaseous Measurement Carbon Dioxide

$$c = \frac{m}{V} f_c$$

Limit value	n/a	**%vol**	**Calibration gas**	**15.01**	**%vol**
Measured concentration	10.73	**%vol**	**Full Scale**	**25**	**%vol**

Performance characteristics	**Value**				**specification**
Response time		180	seconds		< 200 s
Logger sampling interval		60	seconds		
Measurement period		43	minutes		
Number of readings in measurement		43	Assuming 1 minute collected over 1 hour		
Repeatability at zero		0.015	% by volume	stdev	<0.2 % range
Repeatability at span level		0.014	% by volume	stdev	<0.4 % range
Deviation from linearity		0.13	% vol	+/-	<0.3 % volume
Zero drift (during measurement period)		0.00	% vol at zero level	+/-	<2% of volume / 24hr
Span drift (during measurement period)		-0.09	% vol at span level	+/-	<2% volume/24hr
volume or pressure flow dependence		0	% of fs / 10l/h	+- 5 l/h	<1% range
atmospheric pressure dependence		0.3	% of fs/kPa	+- 2kPa	< 1.5 % range
ambient temperature dependence		-0.07	% by volume /10K	+- 15K	<0.3% volume 10 K
CO_2 (% vol)	15	0.07	% by volume per	15	
NO (mg/m3)	300	0.02	% by volume per	300	
NO_2 (mg/m3)	30	0	% by volume per	30	
Combined interference		0.56	% range		<2% range
Dependence on voltage		0.1	% by volume /10V	+- 5%	< 0.1%vol /10 volt
Losses in the line (leak)		0.00	% of value		< 2% of value
Uncertainty of calibration gas		2	% of value		

Effect of drift	
-0.06	% vol
-0.26	% full scale

	range of variation from conditions at calibration			
	min	max	value at calib	
flow	5	15	10	l/h
pressure	99.00	101	100	kPa
	280	285	285	K
	8	15	0	% vol
NO range	100	150	0	mg/m3
NO_2 range	5	7.5	0	mg/m3
Voltage	105	115	110	V

$$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$$

$$c = \frac{m}{V} f_s$$

$$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$$

Performance characteristic			**Uncertainty**		**Value of uncertainty quantity**		**% vol**
Standard deviation of repeatability at zero			u_{r0}		for mean		Only use rep at span
Standard deviation of repeatability at span level			u_{rs}		for mean		0.00
Lack of fit			u_{fit}				0.08
Drift			u_{0dr}				-0.04
volume or pressure flow dependence			u_{spres}				0.00
atmospheric pressure dependence			u_{apres}				0.04
ambient temperature dependence			u_{temp}				-0.02
CO_2							0.05

Use largest of sum of all positive or all negative influences

Uncert Sheets

NO							0.01	0.06	all +ves
NO_2							0.00	0	all -ves
Combined interference (from mcerts)							0.08	0.06	largest
dependence on voltage			u_{volt}				0.03	Value to use for intereference uncertainty	
losses in the line (leak)			u_{leak}				0.00	u_{int}	0.06
Uncertainty of calibration gas			u_{calib}				0.12		

Measurement uncertainty			10.73	%vol
Combined uncertainty			0.17	%vol
% of value			1.60	%
Coverage factor k =	2			
Expanded uncertainty	**expressed with a level c**		**3.20**	**% of value**
Expanded uncertainty	**expressed with a level c**		**0.34**	**% vol**

Requirement for SRM is that Uncertaitny should be < 6% of value, on a dry gas basis

Note:
Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests
Purple boxes are from manufacturer specification, or CEN standard as MCERTS data not available

Developed for the STA by R Robinson, NPL

Run 2

Uncertainty calculation for Gaseous Measurement Carbon dioxide

Limit value	n/a	**%vol**	**Calibration gas**	**0**	**%vol**
Measured concentration	0.00	**%vol**	**Full Scale**	**25**	**%vol**

Performance characteristics	**Value**				**specification**
Response time		180	seconds		< 200 s
Logger sampling interval		60	seconds		
Measurement period		0	minutes		
Number of readings in measurement		0	Assuming 1 minute collected over 1 hour		
Repeatability at zero		0.015	% by volume	stdev	<0.2 % range
Repeatability at span level		0.014	% by volume	stdev	<0.4 % range
Deviation from linearity		0.13	% vol	+/-	<0.3 % volume
Zero drift (during measurement period)		0.00	% vol at zero level	+/-	<2% of volume / 24hr

Effect of drift	
#DIV/0!	% vol
#DIV/0!	% full scale
#DIV/0!	

range of variation from conditions at calibration

Uncert Sheets

Span drift (during measurement period)		0.00	% vol at span level	+/-	<2% volume/24hr
volume or pressure flow dependence		0	% of fs / 10l/h	+- 5 l/h	<1% range
atmospheric pressure dependence		0.3	% of fs/kPa	+- 2kPa	< 1.5 % range
ambient temperature dependence		-0.07	% by volume /10K	+- 15K	<0.3% volume 10 K
CO_2 (% vol)	15	0.07	% by volume per	15	
NO (mg/m3)	300	0.02	% by volume per	300	
NO_2 (mg/m3)	30	0	% by volume per	30	
Combined interference		0.56	% range		<2% range
Dependence on voltage		0.1	% by volume /10V	+- 5%	< 0.1%vol /10 volt
Losses in the line (leak)		0	% of value		< 2% of value
Uncertainty of calibration gas		2	% of value		

	min	max	value at calib	
flow	5	15	10	l/h
pressure	99.00	101	100	kPa
temp	280	285	285	K
CO_2 range	8	15	0	% vol
NO range	100	150	0	mg/m3
NO_2 range	5	7.5	0	mg/m3
Voltage	105	115	110	V

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**		**% vol**
Standard deviation of repeatability at zero			u_{r0}	for mean		Only use rep at span
Standard deviation of repeatability at span level			u_{rs}	for mean		#DIV/0!
Lack of fit			u_{fit}			0.08
Drift			u_{0dr}			#DIV/0!
volume or pressure flow dependence			u_{spres}			0.00
atmospheric pressure dependence			u_{apres}			0.04
ambient temperature dependence			u_{temp}			-0.02
CO_2						0.05
NO						0.01
NO_2						0.00
Combined interference (from mcerts)						0.08
dependence on voltage			u_{volt}			0.03
losses in the line (leak)			u_{leak}			0.00
Uncertainty of calibration gas			u_{calib}			0.00

Use largest of sum of all positive or all negative influences

0.06	all +ves
0	all -ves
0.06	largest

Value to use for intereference uncertainty

u_{int} 0.06

Measurement uncertainty			0.00	%vol
Combined uncertainty			#DIV/0!	%vol
% of value			0.00	%
Coverage factor k =	2			
Expanded uncertainty	**expressed with a level c**		**0.00**	**% of value**
Expanded uncertainty	**expressed with a level c**		**0.00**	**% vol**

Requirement for SRM is that Uncertaitny should be < 6% of value, on a dry gas basis

Note:
Enter values into green boxes
Dark blue boxes indicate information that can be obtained from MCERTS tests
Purple boxes are from manufacturer specification, or CEN standard as MCERTS data not available

Uncert Sheets

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Run 3

Uncertainty calculation for Gaseous Measurement Carbon dioxide

Limit value	n/a	**%vol**	**Calibration gas**	**0**	**%vol**
Measured concentration	0.00	**%vol**	**Full Scale**	**25**	**%vol**

Performance characteristics		**Value**			**specification**
Response time		180	seconds		< 200 s
Logger sampling interval		60	seconds		
Measurement period		0	minutes		
Number of readings in measurement		0	Assuming 1 minute collected over 1 hour		
Repeatability at zero		0.015	% by volume	stdev	<0.2 % range
Repeatability at span level		0.014	% by volume	stdev	<0.4 % range
Deviation from linearity		0.13	% vol	+/-	<0.3 % volume
Zero drift (during measurement period)		0.00	% vol at zero level	+/-	<2% of volume / 24hr
Span drift (during measurement period)		0.00	% vol at span level	+/-	<2% volume/24hr
volume or pressure flow dependence		0	% of fs / 10l/h	+- 5 l/h	<1% range
atmospheric pressure dependence		0.3	% of fs/kPa	+- 2kPa	< 1.5 % range
ambient temperature dependence		-0.07	% by volume /10K	+- 15K	<0.3% volume 10 K
CO_2 (% vol)	15	0.07	% by volume per	15	
NO (mg/m3)	300	0.02	% by volume per	300	
NO_2 (mg/m3)	30	0	% by volume per	30	
Combined interference		0.56	% range		<2% range
Dependence on voltage		0.1	% by volume /10V	+- 5%	< 0.1%vol /10 volt
Losses in the line (leak)		0	% of value		< 2% of value
Uncertainty of calibration gas		2	% of value		

Effect of drift	
#DIV/0!	% vol
#DIV/0!	% full scale
#DIV/0!	

	range of variation from conditions at calibration			
	min	max	value at calib	
flow	5	15	10	l/h
pressure	99.00	101	100	kPa
temp	280	285	285	K
CO_2 range	8	15	0	% vol
NO range	100	150	0	mg/m3
NO_2 range	5	7.5	0	mg/m3
Voltage	105	115	110	V

Performance characteristic			**Uncertainty**	**Value of uncertainty quantity**			**% vol**
Standard deviation of repeatability at zero			u_{r0}		for mean		Only use rep at span
Standard deviation of repeatability at span level			u_{rs}		for mean		#DIV/0!
Lack of fit			u_{fit}				0.08
Drift			u_{0dr}				#DIV/0!
volume or pressure flow dependence			u_{spres}				0.00
atmospheric pressure dependence			u_{apres}				0.04
ambient temperature dependence			u_{temp}				-0.02

Uncert Sheets

CO_2							0.05	**Use largest of sum of all positive or all negative influences**
NO							0.01	0.06 all +ves
NO_2							0.00	0 all -ves
Combined interference (from mcerts)							0.08	0.06 largest
dependence on voltage			u_{volt}				0.03	Value to use for intereference uncertainty
losses in the line (leak)			u_{leak}				0.00	u_{int} 0.06
Uncertainty of calibration gas			u_{calib}				0.00	

Measurement uncertainty			0.00	%vol
Combined uncertainty			#DIV/0!	%vol
% of value			0.00	%
Coverage factor k =	2			
Expanded uncertainty	**expressed with a level c**		**0.00**	**% of value**
Expanded uncertainty	**expressed with a level c**		**0.00**	**% vol**

Requirement for SRM is that Uncertaitny should be < 6% of value, on a dry gas basis

Note: Enter values into green boxes
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Developed for the STA by R Robinson, NPL

Certificate of Analysis

Report No.: **25-08135-1**

Issue No.: **1**
Date of Issue **06/10/2025**

Customer Details:	Air Scientific Ltd, Unit 32, De Granville Court, Dublin Road, Trim, Co. Meath, , Ireland
Customer Contact:	Amanda Sheridan
Customer Order No.:	ARLATL1080925
Customer Reference:	Not Supplied
Quotation Reference:	Q25-07740
Description:	3 gas samples, 10 liquid samples, 3 solid samples
Date Received:	25/09/2025
Date Started:	25/09/2025
Date Completed:	06/10/2025
Test Methods:	Details available on request (refer to SOP code against relevant result/s)
Notes:	None

Approved By: **Joanne Dewhurst, Operational Manager**

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.
This certificate shall not be reproduced except in full without the prior written approval of the laboratory.
Observations and interpretations are outside of the scope of UKAS accreditation.
Results reported herein relate only to the items supplied to the laboratory for testing.
Results on an Interim Report are not dry-weight corrected.
Where the laboratory is not responsible for the sampling, results apply to the sample(s) as they were received.
The laboratory shall not be responsible for any information that is supplied by the customer that may affect the validity of results.

UKAS TESTING 0605

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

A TETRA TECH COMPANY

Results Summary

Report No.: 25-08135-1

Customer Reference: Not Supplied

Customer Order No: ARLATL1080925

Customer Sample No	AR07 - 003589	AR07 W	AR08 - 003003	AR08 W	Blank - 003571	Blank W	AR07 HCL/HF 1+2	AR07 HCL/HF 3	HCL/HF B	AR08 HCL/HF 1+2	AR08 HCL/HF 3	F1 HCL/HF 1+2
RPS Sample No	324199	324200	324201	324202	324203	324204	324205	324206	324207	324208	324209	324210
Sample Matrix	FILTER	SOLUTION	FILTER	SOLUTION	FILTER	SOLUTION	SOLUTION	SOLUTION	SOLUTION	SOLUTION	SOLUTION	SOLUTION
Sampling Date	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025	08/09/2025

Determinand	CAS No	Codes	SOP	RL	Units												
volume of sample supplied		U	N/A	n/a	ml							131	106	121	121	95	131
hydrogen chloride	7647-01-0	UM	C27	0.05	ug/mL							< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
particulates		UM	D9	0.04	mg	1.76		0.65		< 0.04							
particulates		UM	D9	0.5	mg		< 0.5		< 0.5		< 0.5						
NMVOCs (low level) FRONT		N	M104	0.5	ug												
NMVOCs (low level) BACK		N	M104	0.5	ug												
hydrogen fluoride	7664-39-3	UM	C27	0.05	ug/mL							< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

Results Summary

Report No.: 25-08135-1

Customer Reference: Not Supplied

Customer Order No: ARLATL1080925

Customer Sample No	F1 HCL/HF 3	6624	6633	6627
RPS Sample No	324211	324212	324213	324214
Sample Matrix	SOLUTION	TUBE	TUBE	TUBE
Sampling Date	08/09/2025	08/09/2025	08/09/2025	08/09/2025

Determinand	CAS No	Codes	SOP	RL	Units				
volume of sample supplied		U	N/A	n/a	ml	131			
hydrogen chloride	7647-01-0	UM	C27	0.05	ug/mL	< 0.05			
particulates		UM	D9	0.04	mg				
particulates		UM	D9	0.5	mg				
NMVOCs (low level) FRONT		N	M104	0.5	ug		< 0.5	< 0.5	< 0.5
NMVOCs (low level) BACK		N	M104	0.5	ug		< 0.5	< 0.5	< 0.5
hydrogen fluoride	7664-39-3	UM	C27	0.05	ug/mL	< 0.05			

A TETRA TECH COMPANY

Deviating Samples

Report No.: 25-08135-1

Customer Reference: Not Supplied

Customer Order No: ARLATL1080925

Our policy on Deviating Samples has been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).
RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling. Samples submitted may be declared to be deviating.
Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be compromised.
Where no sampling date was supplied, samples have been declared to be deviating. If the date can be supplied, results may be reissued if assessed not deviating.
Where the sample container used was unsuitable or broken, the sample is flagged as deviating and re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating	Reason for Deviation
324199	AR07 - 003589		08/09/2025	Container	No	
324200	AR07 W		08/09/2025	Container	No	
324201	AR08 - 003003		08/09/2025	Container	No	
324202	AR08 W		08/09/2025	Container	No	
324203	Blank - 003571		08/09/2025	Container	No	
324204	Blank W		08/09/2025	Container	No	
324205	AR07 HCL/HF 1+2		08/09/2025	Container	No	
324206	AR07 HCL/HF 3		08/09/2025	Container	No	
324207	HCL/HF B		08/09/2025	Container	No	
324208	AR08 HCL/HF 1+2		08/09/2025	Container	No	
324209	AR08 HCL/HF 3		08/09/2025	Container	No	
324210	F1 HCL/HF 1+2		08/09/2025	Container	No	
324211	F1 HCL/HF 3		08/09/2025	Container	No	
324212	6624		08/09/2025	Container	No	
324213	6633		08/09/2025	Container	No	
324214	6627		08/09/2025	Container	No	

Report No.: 25-08135-1

Key Code	Description
N	Not Accredited Test
U	UKAS Accredited Test - UKAS accreditation is only implied if the report carries the UKAS logo
UF	UKAS Flexible Scope Test
M	MCERTS Accredited Test - MCERTS accreditation is only implied if the report carries the MCERTS logo
O	Marine Management Organisation (MMO) Validated
SN	Subcontracted to approved laboratory not accredited for the test
SU	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
SIN	Subcontracted to internal RPS Group laboratory not accredited for the test
SIU	Subcontracted to internal RPS Group laboratory UKAS Accredited for the test
SIM	Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test
I/S (in results)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	Not Detected
L (in results)	Result is outside normal limits

Please note that all samples will be destroyed 4 WEEKS after the report has been issued.

Note: Sample retention may be subject to agreement with the customer for particular projects

Certificate Notes	Description
Note 1	This test report shall not be reproduced except in full, without written approval of the Laboratory.
Note 2	Unless otherwise stated, results are not corrected for analytical recoveries.
Note 3	Samples were taken by the customer and, unless otherwise stated, sampling locations were not supplied.
Note 4	Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
Note 5	Unless otherwise stated, method D9 conditioning temperatures are 180°C for pre-weigh and 160°C for re-weigh.
Note 6	The PDF version of the certificate is the definitive copy and the Excel version is uncontrolled and provided for information only.

Note: Where the following information is included in this certificate, it has usually been supplied by the customer: Customer Sample ID, Sample Location, Sampling Date and Sample Air Volumes. The laboratory shall not be responsible for any information that is supplied by the customer that may affect the validity of results.

Report No.: 25-08135-1

Determinand	CAS No	Media	SOP	% Recovery	% Uncertainty
acetaldehyde	75-07-0	tube	A40	98	16.2
benzaldehyde	100-52-7	tube	A40	100	19.4
butyraldehyde	123-72-8	tube	A40	92	11.5
formaldehyde	50-00-0	tube	A40	97	12.8
hexanal	66-25-1	tube	A40	89	11
propionaldehyde	123-38-6	tube	A40	96	12.6
valeraldehyde	110-62-3	tube	A40	93	12.3
ammonia	7664-41-7	sulphuric scid solution	A6	n/a	8.9
chlorine	7782-50-5	sodium hydroxide solution	C27	n/a	15.2
hydrogen bromide	10035-10-6	sulphuric acid solution	C27	n/a	10.9
hydrogen chloride	7647-01-0	deionised water	C27	n/a	7.9
hydrogen chloride	7647-01-0	sulphuric acid solution	C27	n/a	13.3
hydrogen fluoride	7664-3-3	sodium hydroxide solution	C27	n/a	7.9
sulphur dioxide	7446-09-5	hydrogen peroxide solution	C27	n/a	7.7
nitrogen oxide	10102-43-9	potassium permanganate solution	C27	n/a	11.7
particulates	n/a	filter	D9	n/a	12.2
particulates	n/a	wash solution	D9	n/a	14.8
formaldehyde	50-00-0	deionised water	M103	n/a	23.7
2,4- & 2,6-toluene diisocyanate (TDI)	n/a	filter	M119	n/a	8.6
hexamethylene diisocyanate (HDI)	822-06-0	filter	M119	n/a	5.6
methylene diphenyl diisocyanate (MDI)	101-68-8	filter	M119	n/a	11.8
hydrogen sulphide	7783-06-4	zinc acetate solution	M120	n/a	4.2
antimony	7440-36-0	filter	M31	n/a	10.3
arsenic	7440-38-2	filter	M31	n/a	17.1
cadmium	7440-43.9	filter	M31	n/a	12.1
chromium	7440-47-3	filter	M31	n/a	17.1
cobalt	7440-48-4	filter	M31	n/a	13.1
copper	7440-50-8	filter	M31	n/a	14
lead	7439-92-1	filter	M31	n/a	9.8
manganese	7439-96-5	filter	M31	n/a	17.5
nickel	7440-02-0	filter	M31	n/a	14.4
thallium	7440-28-0	filter	M31	n/a	15.3
tin	7440-31-5	filter	M31	n/a	18.5
vanadium	7440-62-2	filter	M31	n/a	12.1
zinc	7440-66-6	filter	M31	n/a	15.2
antimony	7440-36-0	nitric acid wash	M31	n/a	10.3
arsenic	7440-38-2	nitric acid wash	M31	n/a	17.1
cadmium	7440-43-9	nitric acid wash	M31	n/a	12.1
chromium	7440-47-3	nitric acid wash	M31	n/a	17.1
cobalt	7440-48-4	nitric acid wash	M31	n/a	13.1
copper	7440-50-8	nitric acid wash	M31	n/a	14
lead	7439-92-1	nitric acid wash	M31	n/a	9.8
manganese	7439-96-5	nitric acid wash	M31	n/a	17.5
nickel	7440-02-0	nitric acid wash	M31	n/a	14.4
selenium	7782-49-2	nitric acid wash	M31	n/a	15.1
thallium	7440-28-0	nitric acid wash	M31	n/a	15.3
tin	7440-31-5	nitric acid wash	M31	n/a	18.5
vanadium	7440-62-2	nitric acid wash	M31	n/a	12.1
zinc	7440-66-6	nitric acid wash	M31	n/a	15.2
antimony	7440-36-0	nitric/peroxide solution	M31	n/a	5.9
arsenic	7440-38-2	nitric/peroxide solution	M31	n/a	6.8
cadmium	7440-43-9	nitric/peroxide solution	M31	n/a	6.3
chromium	7440-47-3	nitric/peroxide solution	M31	n/a	7.2
cobalt	7440-48-4	nitric/peroxide solution	M31	n/a	5.2
copper	7440-50-8	nitric/peroxide solution	M31	n/a	6.8
lead	7439-92-1	nitric/peroxide solution	M31	n/a	8.6
manganese	7439-96-5	nitric/peroxide solution	M31	n/a	9.6
nickel	7440-02-0	nitric/peroxide solution	M31	n/a	5.5
selenium	7782-49-2	nitric/peroxide solution	M31	n/a	8.7
thallium	7440-28-0	nitric/peroxide solution	M31	n/a	7.7
tin	7440-31-5	nitric/peroxide solution	M31	n/a	5.8
vanadium	7440-62-2	nitric/peroxide solution	M31	n/a	6.7
zinc	7440-66-6	nitric/peroxide solution	M31	n/a	11.9
1,2,4-trimethylbenzene	95-63-6	tube	O8	88	8.1
1,3,5-trimethylbenzene	108-67-8	tube	O8	92	7.7
2-ethyltoluene	611-14-3	tube	O8	91	8.4
3- & 4-ethyltoluene	n/a	tube	O8	91	8.4
benzene	71-43-2	tube	O8	90	13.9
butyl acetate	123-86-4	tube	O8	90	10.3
decane	124-18-5	tube	O8	97	6.7
dichloromethane	75-09-2	tube	O8	88	24
ethyl acetate	141-78-6	tube	O8	n/a	n/a
ethyl benzene	100-41-4	tube	O8	92	9.8
heptane	142-82-5	tube	O8	94	10.5
hexane	110-54-3	tube	O8	n/a	n/a
limonene	138-86-3	tube	O8	93	13
m- & p-xylene	n/a	tube	O8	90	9.3
methyl isobutyl ketone (MIBK)	108-10-1	tube	O8	86	10
methyl tert-butyl ether (MTBE)	1634-04-4	tube	O8	92	15
o-xylene	95-47-6	tube	O8	86	9.9
propylbenzene	103-65-1	tube	O8	92	7.5
tetrachloroethylene	127-18-4	tube	O8	91	9.3
tetrahydrofuran (THF)	109-99-9	tube	O8	87	14.7
toluene	108-88-3	tube	O8	89	10.7
trichloroethylene	79-01-6	tube	O8	91	10.6
m- & p-cresol	n/a	tube	P1	n/a	11
m- & p-xylenol	n/a	tube	P1	n/a	11.9
o-cresol	95-48-7	tube	P1	n/a	10.8
o-xylenol	526-75-0	tube	P1	n/a	12
phenol	108-95-2	tube	P1	n/a	10.4