Stack Emissions Monitoring Report

Job Reference: JOB-2162

Commissioned by Air Tech ECS Ltd

Operator Name
Federal-Mogul Coventry Ltd | Tenneco

Operator Address
Holbrook Lane
Holbrooks, Coventry
CV6 4BG
PPC Permit PPC/197

Release Point
Main Stack

Dates of the Monitoring Campaign
08/12/2025

Report Date | Version Number
23/12/2025 | Version 1

Cura Terrae Primary Contact
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2522

Monitoring organisation name & address	Report written by	Report approved by	Report approved by signature
Cura Terrae OH and Emissions Testing Limited North West Office Unit 2, Asher Court, Lyncastle Way Appleton, Warrington, Cheshire, WA4 4ST	Andrew Shipley Senior Team Leader MCERTS Level 2 | Endorsements: TE1 TE2 TE3 TE4 MM 13 1243 | expires on 30/11/2026	Rob Haworth Technical Support Manager MCERTS Level 2 | Endorsements: TE1 TE2 TE3 TE4 MM 07 797 | expires on 30/11/2025	[redacted]

Report Contents and Monitoring Objectives

Report Contents

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Monitoring Objective

The monitoring objective was to conduct stack emissions monitoring to demonstrate compliance against a set of emission limit values (ELVs) as specified in the Site's Environmental Permit.

Special Requirements

There were no special requirements for this monitoring campaign.

Opinions and Interpretations

Any opinions or interpretations contained within this test report are outside the scope of Cura Terrae's MCERTS / ISO 17025 accreditation.

Part 1: Executive Summary - Monitoring Results Summary

Monitoring Results - Summary

	EXPRESSED AS A CONCENTRATION				EXPRESSED AS A MASS EMISSION					
test parameter	**result**	**uncertainty in result +/-**	**limit** (ELV)	**units**	**result**	**uncertainty in result +/-**	**limit** (ELV)	**units**	**reference conditions**	**accreditation status**
Total Particulate Matter	0.21	0.48	20	mg/m^3	0.75	0.75		g/hr	STP, wet	MCERTS
Sulphur Dioxide	0.046	0.0037		mg/m^3	0.16	0.015		g/hr	STP, wet	MCERTS
Chromium, Cobalt & Nickel	0.029	0.0049	5	mg/m^3	0.10	0.018		g/hr	STP, wet	MCERTS
Stack Gas Water Vapour	0.23	0.044		% v/v					actual	MCERTS
Stack Gas Temperature	24.2			°C					actual	MCERTS
Stack Gas Velocity	17.7	0.28		m/s					actual	MCERTS
Stack Gas Flow Rate (ACTUAL)	3932	189		m^3/hr					actual	MCERTS
Stack Gas Flow Rate (REF)	3563	171		m^3/hr					STP, wet	MCERTS

The stack gas water vapour, temperature, velocity and flow rates in the above table are calculated as an average of all of the results recorded during this monitoring campaign

The uncertainty in the result is reported at a 95% Confidence Interval in the same units as the monitoring result. In practice, this means that 95 times out of 100, the true result will lie within the stated range.

Part 1: Executive Summary - Monitoring Results Further Details

Monitoring Results - Further Details

		EXPRESSED AS A CONCENTRATION				EXPRESSED AS A MASS EMISSION							
test parameter	**run**	**result**	**uncertainty in result +/-**	**limit** (ELV)	**units**	**result**	**uncertainty in result +/-**	**limit** (ELV)	**units**	**sampling date | times**	**run time** (mins)	**H_2O** (% v/v)	**reference conditions**
Total Particulate Matter	R1	0.21	0.48	20	mg/m^3	0.75	0.75		g/hr	08/12/2025 | 10:05 - 11:05	60	0.2	STP, wet
Sulphur Dioxide	R1	0.046	0.0037		mg/m^3	0.16	0.015		g/hr	08/12/2025 | 10:05 - 11:05	60	0.2	STP, wet
Chromium, Cobalt & Nickel	R1	0.029	0.0049	5	mg/m^3	0.10	0.018		g/hr	08/12/2025 | 11:11 - 12:11	60	0.2	STP, wet
Velocity & Flow Rate Traverse	R1	17.6	0.28		m/s	3902	187		m^3/hr	08/12/2025 | 09:56 - 09:59			actual
Stack Gas Water Vapour		0.23	0.044		% v/v								actual
Stack Gas Temperature		24.2			°C								actual
Stack Gas Velocity		17.7	0.28		m/s								actual
Stack Gas Flow Rate (ACTUAL)		3932	189		m^3/hr								actual
Stack Gas Flow Rate (REF)		3563	171		m^3/hr								STP, wet

The stack gas water vapour, temperature, velocity and flow rates in the above table are calculated as an average of all of the results recorded during this monitoring campaign

The uncertainty in the result is reported at a 95% Confidence Interval in the same units as the monitoring result. In practice, this means that 95 times out of 100, the true result will lie within the stated range.

Part 1: Executive Summary - Monitoring and Analytical Methods

Monitoring and Analytical Methods

where analysis required	MONITORING					ANALYSIS					
test parameter	**laboratory**	**accreditation number**	**technical procedure**	**reference method**	**monitoring status**	**laboratory**	**accreditation number**	**analytical procedure**	**analytical technique**	**analysis status**	**accreditation status**
Total Particulate Matter	CTA	2522	TP-01	EN 13284-1	MCERTS	CTA	2522	AP-01	Gravimetric	MCERTS	MCERTS
Sulphur Dioxide	CTA	2522	TP-10	EN 14791	MCERTS	RPS	0605	C27	IC	MCERTS	MCERTS
Chromium, Cobalt & Nickel	CTA	2522	TP-05a	EN 14385	MCERTS	RPS	0605	M31	ICP-MS	MCERTS	MCERTS
Water Vapour	CTA	2522	TP-03	EN 14790	MCERTS	CTA	2522	TP-03	Gravimetric	MCERTS	MCERTS

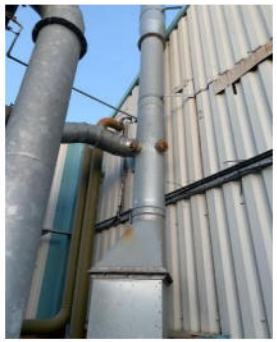
where analysis not required	MONITORING						
test parameter	**laboratory**	**accreditation number**	**technical procedure**	**reference method**	**monitoring status**	**measurement technique & equipment**	**accreditation status**
Velocity & Flow Rate Traverse	CTA	2522	TP-04a	EN 16911-1 | TR 17078	MCERTS	Pitot Tube, Thermocouple & Thermomanometer	MCERTS

Summary of Monitoring Deviations (from Appendix 2)

test parameter	run	details of monitoring deviation
All	1	There were no deviations associated with the monitoring employed.

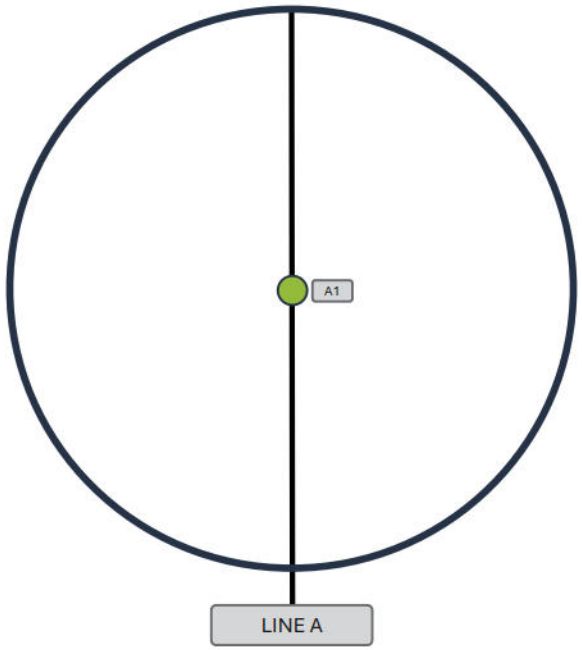
Part 1: Executive Summary - Monitoring Location

Monitoring Location Photos



Identification of Sampling Points on a Duct Diagram

refer to Appendix 2 - Raw Data to see how the points on this diagram relate to the points used for each test



Part 1: Executive Summary - Duct and Sampling Platform Information

Duct Characteristics | Sampling Ports

parameter	units	value
shape	-	Circular
dimensions	-	Diameter = 0.28 m
area	m^2	0.06
orientation	-	Vertical

parameter	value
primary sample port size	4" BSP
primary sample port depth | cm	9
primary sample ports number of sampling lines available	2

summary of all sample ports available
4" BSP

Sampling Location General Information

general information	details
type | location | access	Floor Level | Outside with shelter available in nearby building | On Ground Level

CEMS | Abatement Systems

parameter	details
abatement system/s	AAF Fabripulse M6-168 bag filtration unit
CEMS installed on the stack	N/A

Sampling Plane Validation Criteria Summary (EN 15259) from Stack Traverse/s

criteria in EN 15259	units	value	allowed	compliant
lowest differential pressure	Pa	272.0	> 5 Pa	Yes
lowest traverse velocity	m/s	17.6	-	-
highest traverse velocity	m/s	17.6	-	-
mean traverse velocity	m/s	17.6	-	-
ratio traverse velocities	: 1	1.00	< 3 : 1	Yes
angle of swirl compliance	°	< 15	< 15°	Yes
no local negative flow	-	Yes	-	Yes

Part 1: Executive Summary - Sampling Location and Operating Information

Process Details

process detail	details
plume appearance on day of monitoring	No visible plume
type of process	Melting of ferrous alloys using electrical induction furnaces
batch or continuous process	Batch
fuel type	N/A
feedstock	Metal ingots
typical load / throughput of plant	2 electrical induction furnaces of capacity 50 kg and 300 kg
details of any unusual process occurrences	Normal operating capacity

Part 2: Supporting Information - Appendix 1: Monitoring Personnel, Analysis Laboratories and Test Equipment Used

Monitoring Personnel

name	position	MCERTS level | number | expiry	MCERTS technical endorsements
Andrew Shipley	Senior Team Leader	MCERTS Level 2 | MM 13 1243 | 30/11/2026	TE1 TE2 TE3 TE4
Gian Dela Cruz	Trainee	MCERTS Trainee | MM 25 1894 | 02/07/2030	-

Analysis Laboratories

laboratory	ISO 17025 accreditation number	laboratory short name	laboratory phone number
Cura Terrae OH and Emissions Testing Limited | North West	2522	CTA	0800 970 8945
RPS Laboratories | Salford	0605	RPS	0161 872 2443

Test Equipment Used

equipment type	A-EQ ID
Source sampling console	51
Low flow sampling console	
Low flow sampling MFCs	
ThermoFID / iFID mobile	
Horiba PG-250	
Horiba PG-350E	
Gasmet DX4000 FTIR	
Gasmet PSS	
Protea AtmosFIR	
Protea PIB 9ump	
Gasmet syringe calibrator	
M&C PSS5-C	
Digital thermomanometer	116
Top pan balance kit	465

equipment type	A-EQ ID
S-Type pitot	
S-Type pitot tip	174 | 98
Mini S-Type pitot	
L-Type pitot	
Calipers	44
Heated head filter	
Heated tee	
1.5m heated line	
10m heated line	
20m heated line	
Odour barrel	
Vacuum chamber	
Dilution probe	
Tape measure	480

equipment type	A-EQ ID
Barometer	21
Timer	19
10m umbilical	89
30m umbilical	
Heated probe	
Filter oven	77
Ambient thermocouple	164
Stack thermocouple	
Exit thermocouple	
Condenser thermocouple	
Tubes kit thermocouple	
2-way heater controller	
Air sampling pump	
Analytical balance	1 | 492

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Results

reference conditions are: STP, wet

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Total Particulate Matter	mg/m^3	0.21 ± 0.48	g/hr	0.75 ± 0.75

Analytical Laboratory Information

parameter	details
name of analytical lab	CTA
lab analytical procedure	AP-01
lab analytical technique	Gravimetric | Analysis Accreditation: MCERTS
date analysis completed	11/12/2025

General Information

parameter	details
sampling date	08/12/2025
sampling times	10:05 - 11:05
sampling duration | testing team	60 minutes | tested by: AS | GDC | MBA
standard | technical procedure	EN 13284-1 | TP-01
nozzle / probe | filter housing material	Titanium | Titanium
filter IDs	Sample: F-7589 | Blank: F-9606

parameter	details
pre-use filter conditioning temperature	250°C
filter size, material & location	47mm QF | In Stack | heated to 26°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1
volume metering device	XD-502 Digital Source Sampling Console

Quality Assurance

		sample run			blank (taken on 08/12/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m^3	-	-	-	0.14	2.00	Pass
leak test	%	0.13	2.00	Pass	0.80	2.00	Pass
filter intact	-	Yes	-	Pass	-	-	-
filter no signs of water marks	-	Yes	-	Pass	-	-	-
maximum run filter temperature	°C	26	< 230	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	-	18.5	20.0	Pass	-	-	-
isokinetic variation	%	100.1	95 - 115	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, wet

parameter		sample volume [m^3]	LOD [mg]	mass on filter [mg]	mass in rinse [mg]	mass total [mg]	LOD result [mg/m^3]	result [mg/m^3]	result reported [mg/m^3]	mass emission [g/hr]
sample run	F-7589	1.1816	0.15	-0.03	0.28	0.25	0.12	0.21	**0.21**	0.75
blank	F-9606	1.1816	0.16	-0.01	0.05	0.04	0.14	0.034	**0.14**	

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Raw Data | Calculations

data	units	value
P_{bar}	mmHg	748.6
P_g	Pa	151.0
$\Delta H_@$	mmH_2O	43.5
P_m	mmHg	751.8
P_s	mmHg	749.7
V_m (DGM)	m^3	1.1356
Y_d	-	1.1162
C_{stp}	-	0.3592

data	units	value
T_m	°C	17.3
ΔH_{av}	Pa	418.1
ΔP_{av}	Pa	286.9
m_{wts}	g	2.2
M_w	g/mol	18.0
V_{mol}	m^3/mol	0.0222
T_s	°C	25.0
R_{wv} (H_2O)	% v/v	0.2

data	units	value
$\%CO_{2d}$	% v/v (est)	0.06
$\%O_{2d}$	% v/v (est)	20.80
$\%O_{2w}$	% v/v (est)	N/A
$\%N_{2d}$	% v/v	79.14
$\%O_{2ref}$	% v/v	N/A
O_{2facd}	-	N/A
O_{2facw}	-	N/A
C_p (pitot)	-	0.83

data	units	value
M_d	g/mol	28.84
M_s	g/mol	28.82
R	J/mol	8.314
K_4	-	4.64E+06
A_s	m^2	0.06
D_n	mm	5.02
A_n	mm^2	19.79
θ (sample time)	mins	60

where (est) refers to an estimated value

data	value
f_{WA}	0.995

metered volume calculations	units	value
allow favourable O_2 correction	-	N/A
vol actual stack conditions, $V_{mTa} = (V_{mTstw})(T_s + 273) / (P_s) / (C_{stp})$	m^3	1.3075
vol dry, $V_{mstd} = (V_m)(Y_d)(C_{stp})((P_{bar} + (\Delta H_{av} / 9.80665 / 13.6)) / (T_m + 273))$	m^3	1.1789
vol dry, V_{mSSstd} [from side stream sampling (if applicable)]	m^3	N/A
vol dry, V_{mTstd} [total volume metered]	m^3	1.1789
vol wet, $V_{mTstw} = (V_{mTstd})(100 / (100 - R_{wv}))$	m^3	1.1816
vol dry O_2, $V_{mTstdO_2} = (V_{mTstd}) / (O_{2facd})$	m^3	N/A
vol wet O_2, $V_{mTstwO_2} = (V_{mTstw}) / (O_{2facw})$	m^3	N/A

isokinetic calculations	units	value
isokinetic rate, $\%I_f = ((K_4)(T_s)(V_{mTstd})) / ((P_s)(v_s)(A_n)(\theta)(1 - (R_{wv} / 100)))$	%	100.1

stack gas density | velocity | volume flow rate calculations	units	value
density of stack gas, $\rho = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))$	kg/m^3	1.163
velocity of stack gas, $v_s = (f_{WA})(C_p)\sqrt{((2(\Delta P_{av}) / (\rho))}$	m/s	18.3
stack gas flow actual stack conditions, $Q_a = (60)(60)(A_s)(v_s)$	m^3/hr	4062.3
stack gas flow dry, $Q_{std} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / (T_s + 273)$	m^3/hr	3662.7
stack gas flow wet, $Q_{stw} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)$	m^3/hr	3671.1
stack gas flow dry O_2, $Q_{stdO_2} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / ((T_s + 273)(O_{2facd}))$	m^3/hr	N/A
stack gas flow wet O_2, $Q_{stwO_2} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)(O_{2facw}))$	m^3/hr	N/A

Part 2: Supporting Information - Appendix 2: Total Particulate Matter | Run 1

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU | mg/m^3
DGM meter volume, V_m	m^3	1.1356	0.0057	0.50	≤5%	-	-	-
DGM temperature, T_m	K	290.3	2.0	0.69	≤2%	-	-	-
DGM pressure, P_m	kPa	100.2	0.50	0.50	≤2%	-	-	-
DGM humidity, H_m	% v/v	0	1.0	1.00	≤2%	-	-	-
DGM volume STP, V_{mstd}	m^3	-	-	-	-	1.1789	0.18	0.003
leak, L	% [1] | mg/m^3 [2]	0.09 [1]	-	0.09	≤2%	0.00012 [2]	1.00	0.00012
mass of particulate, m	mg	0.25	0.29	1.23	-	0.25	0.85	0.25
uncollected mass, m_{uc}	mg	0	-	0	≤10% total mass	0	1.00	0
			combined MU					0.25
			expanded MU 95% CI (k = 1.96) including method deviations MU					0.48
			expanded MU 95% CI (k = 1.96) as percentage of measured value					227%
			expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission					100%
			expanded MU 95% CI (k = 1.96) as percentage of ELV [allowable 20%]					2.4%

MU factor O_2 correction
N/A

overall MU for O_2 correction
N/A

method deviation factor
1.00

result
Pass

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Sulphur Dioxide | Run 1

Results

reference conditions are: STP, wet

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Sulphur Dioxide	mg/m^3	0.046 ± 0.0037	g/hr	0.16 ± 0.015

Analytical Laboratory Information

parameter	details
name of analytical lab	RPS
lab analytical procedure	C27
lab analytical technique	IC | Analysis Accreditation: MCERTS
date analysis completed	18/12/2025

General Information

parameter	details
sampling date	08/12/2025
sampling times	10:05 - 11:05
sampling duration | testing team	60 minutes | tested by: AS | GDC | MBA
standard | technical procedure	EN 14791 | TP-10
nozzle / probe | filter housing material	Titanium | Titanium
impinger material | capture media	Borosilicate Glass | 0.3% H_2O_2

parameter	details
filter size, material & location	47mm QF | In Stack | heated to 26°C
number sampling lines available	2
number sampling lines used	1
number sampling points ideal per line	1 (total)
number sampling points used per line	1
sampling point IDs	A1
volume metering device	XD-502 Digital Source Sampling Console

Quality Assurance

[2] *The concentration in the last absorber was less than 5 times the analytical LOD.*

		sample run			blank (taken on 08/12/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m^3	-	-	-	0.017	N/A	N/A
leak test	%	0.13	2.00	Pass	0.80	2.00	Pass
absorption efficiency	%	70.3	N/A[2]	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	18.5	20.0	Pass	-	-	-
isokinetic variation	%	100.1	95 - 115	Pass	-	-	-

Breakdown of Results

reference conditions are: STP, wet

parameter	sample volume [m^3]	LOD [mg]	impingers [front | back] [mg/l]	impinger volume [front | back] [ml]	mass total [mg]	LOD result [mg/m^3]	result [mg/m^3]	result reported [mg/m^3]	mass emission [g/hr]
sample run	1.1816	0.018	0.17 | 0.13	226 | 125	0.055	0.015	0.046	**0.046**	0.16
blank	1.1816	0.016	0.06	326	0.02	0.014	0.017	**0.017**	

Part 2: Supporting Information - Appendix 2: Sulphur Dioxide | Run 1

Raw Data | Calculations

data	units	value
P_{bar}	mmHg	748.6
P_g	Pa	151.0
$\Delta H_@$	mmH_2O	43.5
P_m	mmHg	751.8
P_s	mmHg	749.7
V_m (metered)	m^3	1.1356
Y_d	-	1.1162
C_{stp}	-	0.3592

data	units	value
T_m	°C	17.3
ΔH_{av}	Pa	418.1
ΔP_{av}	Pa	286.9
m_{wts}	g	2.2
M_w	g/mol	18.0
V_{mol}	m^3/mol	0.0222
T_s	°C	25.0
R_{wv} (H_2O)	% v/v	0.2

data	units	value
$\%CO_{2d}$	% v/v (est)	0.06
$\%O_{2d}$	% v/v (est)	20.80
$\%O_{2w}$	% v/v (est)	N/A
$\%N_{2d}$	% v/v	79.14
$\%O_{2ref}$	% v/v	N/A
O_{2facd}	-	N/A
O_{2facw}	-	N/A
C_p (pitot)	-	0.83

data	units	value
M_d	g/mol	28.84
M_s	g/mol	28.82
R	J/mol	8.314
K_4	-	4.64E+06
A_s	m^2	0.06
D_n	mm	5.02
A_n	mm^2	19.79
θ (sample time)	mins	60

where (est) refers to an estimated value

data	value
f_{WA}	0.995

isokinetic | metered volume calculations	units	value
isokinetic rate, $\%I_r = ((K_4)(T_s)(V_{mstd})) / ((P_s)(v_s)(A_n)(\theta)(1 - (R_{wv} / 100)))$	%	100.1
allow favourable O_2 correction	-	N/A
vol actual stack conditions, $V_{ma} = (V_{mstw})(T_s + 273) / (P_s) / (C_{stp})$	m^3	1.3075
vol dry, $V_{mstd} = (V_m)(Y_d)(C_{stp})((P_{bar} + (\Delta H_{av} / 9.80665 / 13.6)) / (T_m + 273))$	m^3	1.1789
vol wet, $V_{mstw} = (V_{mstd})(100 / (100 - R_{wv}))$	m^3	1.1816
vol dry O_2, $V_{mstdO_2} = (V_{mstd}) / (O_{2facd})$	m^3	N/A
vol wet O_2, $V_{mstwO_2} = (V_{mstw}) / (O_{2facw})$	m^3	N/A

stack gas density | velocity | volume flow rate calculations	units	value
density of stack gas, $\rho = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))$	kg/m^3	1.163
velocity of stack gas, $v_s = (f_{WA})(C_p)\sqrt{((2(\Delta P_{av}) / (\rho))}$	m/s	18.3
stack gas flow actual stack conditions, $Q_a = (60)(60)(A_s)(v_s)$	m^3/hr	4062.3
stack gas flow dry, $Q_{std} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / (T_s + 273$	m^3/hr	3662.7
stack gas flow wet, $Q_{stw} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)$	m^3/hr	3671.1
stack gas flow dry O_2, $Q_{stdO_2} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / ((T_s + 273)(O_{2facd}))$	m^3/hr	N/A
stack gas flow wet O_2, $Q_{stwO_2} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)(O_{2facw}))$	m^3/hr	N/A

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU | mg/m^3
DGM meter volume, V_m	m^3	1.1356	0.0057	0.50	≤2%	-	-	-
DGM temperature, T_m	K	290.3	2.0	0.69	≤1%	-	-	-
DGM pressure, P_m	kPa	100.2	0.50	0.50	≤1%	-	-	-
DGM humidity, H_m	% v/v	0	1.0	1.00	≤1%	-	-	-
DGM volume STP, V_{mstd}	m^3	-	-	-	-	1.1789	0.04	0.00065
leak, L	% [1] | mg/m^3 [2]	0.09 [1]	-	0.09	≤2%	0.000025 [2]	1.00	0.000025
laboratory result, L_r	% [1] | mg/m^3 [2]	3.9 [1]	-	3.9	-	0.0018 [2]	1.00	0.0018
			combined MU					0.0019
			expanded MU 95% CI (k = 1.96) including method deviations MU					0.0037
			expanded MU 95% CI (k = 1.96) as percentage of measured value					8%
			expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission					9.4%

MU factor O_2 correction
N/A

overall MU for O_2 correction
N/A

method deviation factor
1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Chromium, Cobalt & Nickel | Run 1

Results

reference conditions are: STP, wet

parameter	units	result ± MU (95% CI)	units	result ± MU (95% CI)
Chromium, Cobalt & Nickel	mg/m^3	0.029 ± 0.0049	g/hr	0.1 ± 0.018

Analytical Laboratory Information

parameter	details
name of analytical lab	RPS
lab analytical procedure	M31
lab analytical technique	ICP-MS | Analysis Accreditation: MCERTS
date analysis completed	23/12/2025

General Information

parameter	details
sampling date	08/12/2025
sampling times	11:11 - 12:11
sampling duration | testing team	60 minutes | tested by: AS | GDC | MBA
standard | technical procedure	EN 14385 | TP-05a
nozzle / probe | filter housing material	Titanium | Borosilicate Glass
impinger material | capture media	Borosilicate Glass | Filter | HNO_3 | H_2O_2

parameter	details
filter size, material & location	47mm QF | Out Stack | heated to 160°C
number sampling lines available	1
number sampling lines used	1
number sampling points ideal per line	1
number sampling points used per line	1
sampling point IDs	A1
volume metering device	XD-502 Digital Source Sampling Console

Quality Assurance (General)

		sample run			blank (taken on 08/12/2025)		
QA parameter	units	value	allowable	result	value	allowable	result
maximum allowable blank	mg/m^3	-	-	-	0.0025	0.5	Pass
leak test	%	1.00	2.00	Pass	0.80	2.00	Pass
maximum impingers temperature	°C	16.0	30.0	Pass	-	-	-
silica trap <50% faded	-	Yes	-	Pass	-	-	-
are water droplets present	-	No	-	-	-	-	-
water vapour MU	%	19.8	20.0	Pass	-	-	-
isokinetic variation	%	101.1	95 - 115	Pass	-	-	-

Part 2: Supporting Information - Appendix 2: Chromium, Cobalt & Nickel | Run 1

Breakdown of Results

reference conditions are: STP, wet

sample run

parameter	sample volume [m^3]	LOD [mg]	filter / rinse [mg]	impingers [front | back] [mg]	mass total [mg]	LOD result [mg/m^3]	sample result [mg/m^3]	result reported [mg/m^3]	mass emission [g/hr]
Chromium, Cobalt & Nickel	1.1057	0.0019	0.03	0.00092 | 0.00083	0.032	0.0018	0.029	**0.029**	0.1

blank

parameter	sample volume [m^3]	LOD [mg]	filter / rinse [mg]	impingers [mg]	mass total [mg]	LOD result [mg/m^3]	blank result [mg/m^3]	result reported [mg/m^3]
Chromium, Cobalt & Nickel	1.1057	0.0019	0.002	0.00081	0.0028	0.0017	0.0025	**0.0025**

Quality Assurance (Extended)

absorption efficiency

parameter	absorption efficiency | %	allowable | %	QA result	further details
Chromium, Cobalt & Nickel	97.4	90	Pass	-

detection limit

parameter	detection limit | $\mu g/m^3$	allowable | $\mu g/m^3$	QA result
Chromium, Cobalt & Nickel	1.76	5	Pass

Part 2: Supporting Information - Appendix 2: Chromium, Cobalt & Nickel | Run 1

Raw Data | Calculations

data	units	value
P_{bar}	mmHg	748.6
P_g	Pa	151.0
$\Delta H_@$	mmH_2O	43.5
P_m	mmHg	751.8
P_s	mmHg	749.7
V_m (metered)	m^3	1.0856
Y_d	-	1.1162
C_{stp}	-	0.3592

data	units	value
T_m	°C	23.4
ΔH_{av}	Pa	365.8
ΔP_{av}	Pa	247.0
m_{wts}	g	2.0
M_w	g/mol	18.0
V_{mol}	m^3/mol	0.0222
T_s	°C	30.7
R_{wv} (H_2O)	% v/v	0.2

data	units	value
$\%CO_{2d}$	% v/v (est)	0.06
$\%O_{2d}$	% v/v (est)	20.80
$\%O_{2w}$	% v/v (est)	N/A
$\%N_{2d}$	% v/v	79.14
$\%O_{2ref}$	% v/v	N/A
O_{2facd}	-	N/A
O_{2facw}	-	N/A
C_p (pitot)	-	0.84

data	units	value
M_d	g/mol	28.84
M_s	g/mol	28.82
R	J/mol	8.314
K_4	-	4.64E+06
A_s	m^2	0.06
D_n	mm	5.02
A_n	mm^2	19.79
θ (sample time)	mins	60

where (est) refers to an estimated value

data	value
f_{WA}	0.995

isokinetic | metered volume calculations	units	value
isokinetic rate, $\%I_f = ((K_4)(T_s)(V_{mstd})) / ((P_s)(v_s)(A_n)(\theta)(1 - (R_{wv} / 100)))$	%	101.1
allow favourable O_2 correction	-	N/A
vol actual stack conditions, $V_{ma} = (V_{mstw})(T_s + 273) / (P_s) / (C_{stp})$	m^3	1.2469
vol dry, $V_{mstd} = (V_m)(Y_d)(C_{stp})((P_{bar} + (\Delta H_{av} / 9.80665 / 13.6)) / (T_m + 273))$	m^3	1.1032
vol wet, $V_{mstw} = (V_{mstd})(100 / (100 - R_{wv}))$	m^3	1.1057
vol dry O_2, $V_{mstdO_2} = (V_{mstd}) / (O_{2facd})$	m^3	N/A
vol wet O_2, $V_{mstwO_2} = (V_{mstw}) / (O_{2facw})$	m^3	N/A

stack gas density | velocity | volume flow rate calculations	units	value
density of stack gas, $\rho = ((Ms / 1000)(Ps)(0.133322)(1000)) / ((R)(Ts + 273))$	kg/m^3	1.141
velocity of stack gas, $v_s = (f_{WA})(C_p)\sqrt{((2(\Delta P_{av}) / (\rho))}$	m/s	17.3
stack gas flow actual stack conditions, $Q_a = (60)(60)(A_s)(v_s)$	m^3/hr	3832.4
stack gas flow dry, $Q_{std} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / (T_s + 273$	m^3/hr	3390.9
stack gas flow wet, $Q_{stw} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)$	m^3/hr	3398.6
stack gas flow dry O_2, $Q_{stdO_2} = (Q_a)(P_s)(C_{stp})(1 - (R_{wv} / 100)) / ((T_s + 273)(O_{2facd}))$	m^3/hr	N/A
stack gas flow wet O_2, $Q_{stwO_2} = (Q_a)(P_s)(C_{stp}) / (T_s + 273)(O_{2facw}))$	m^3/hr	N/A

Measurement Uncertainty (MU) Calculations

parameter	units	value	standard MU	MU as %age	required standard	value	sens coeff.	MU | mg/m^3
DGM meter volume, V_m	m^3	1.0856	0.0054	0.50	≤2%	-	-	-
DGM temperature, T_m	K	296.4	2.0	0.67	≤1%	-	-	-
DGM pressure, P_m	kPa	100.2	0.50	0.50	≤1%	-	-	-
DGM humidity, H_m	% v/v	0	1.0	1.00	≤1%	-	-	-
DGM volume STP, V_{mstd}	m^3	-	-	-	-	1.1032	0.03	0.0004
leak, L	% [1] | mg/m^3 [2]	0.74 [1]	-	0.74	≤2%	0.00012 [2]	1.00	0.00012
laboratory result, L_r	% [1] | mg/m^3 [2]	8.6 [1]	-	8.6	-	0.0024 [2]	1.00	0.0024
			combined MU					0.0025
			expanded MU 95% CI (k = 1.96) including method deviations MU					0.0049
			expanded MU 95% CI (k = 1.96) as percentage of measured value					17%
			expanded MU 95% CI (k = 1.96) as percentage of measured value for mass emission					17.7%
			expanded MU 95% CI (k = 1.96) as percentage of ELV [allowable 20%]					0.097%

result
Pass

MU factor O_2 correction
N/A

overall MU for O_2 correction
N/A

method deviation factor
1.00

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.

Part 2: Supporting Information - Appendix 2: Velocity & Flow Rate Traverse | Run 1

Supporting Information

parameter	units	value
barometric pressure	kPa	99.8
average wet density	kg/m^3	1.195
average stack static pressure	Pa	151.0
pitot tube coefficient, C_p	-	0.829

ND = Not Detected
NM = Not Measured

Line A

static pressure = 151 Pa

Pt	Depth | m	ΔP | Pa	Temp | °C	Vel | m/s	Swirl | °
1	0.14	272.0	17.0	17.6	< 15

General Information

parameter	details
traverse date	08/12/2025
traverse times | performed by	09:56 - 09:59 | performed by: AS | GDC | MBA
standard | technical procedure	EN 16911-1 | TR 17078 | TP-04a
device used	S-type Pitot with Apex XD-502 (0 to 249Pa)

Limit of Detection (LOD) is 1 m/s for this device combination

Quality Assurance

parameter	details
result of pitot stagnation test	Pass
result of pitot leak check (pre)	Pass
result of pitot leak check (post)	Pass
water droplets present	No

Part 2: Supporting Information - Appendix 2: Velocity & Flow Rate Traverse | Run 1

Measurement Uncertainty (MU) Calculations

ND = Not Detected

parameter	units	value
standard uncertainty on the coefficient of the pitot tube	-	0.0015
standard uncertainty associated with the mean local dynamic pressures	Pa	4.1
standard uncertainty associated with the molar mass of the gas	-	0.000025
standard uncertainty associated with the temperature	K	1.5
standard uncertainty associated with the absolute pressure in the duct	Pa	176
standard uncertainty associated with the density of the gas effluent	kg/m^3	0.0065
standard uncertainty associated with the local velocities	m/s	0.15
standard uncertainty associated with the mean velocity	m/s	0.14

ND = Not Detected

parameter	units	value
standard uncertainty associated with the mean velocity (95% CI)	m/s	0.28
standard uncertainty associated with the mean velocity (95% CI), relative	%	1.6
standard uncertainty associated with the volume flow rate @ actual (95% CI)	m^3/hr	187
standard uncertainty associated with the volume flow rate @ actual (95% CI), relative	%	4.8
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI)	m^3/hr	174
standard uncertainty associated with the volume flow rate @ ref 1 (95% CI), relative	%	4.8

method and sampling deviations
Sampling was performed in full compliance with the Standard, technical procedure and regulatory requirements.