



**Title: Monitoring of Particulate Matter (PM)
And Gaseous Emissions**

Permit Number: EPR/BP3790CG
Operator: Unimetals Recycling UK Limited
Installation: A1 Emissions Control System Exhaust
(New Stack)
Monitoring Dates: 16 June 2025

Reference Number: EI/10762

Client Organisation: Unimetals Recycling UK Ltd
Address: Harrimans Lane
Dunkirk
Nottingham
NG7 2SD

Monitoring Organisation: CES Environmental Instruments Ltd
Address: Bretby Business Park
Ashby Road
Burton on Trent
Staffordshire
DE15 0YZ

Date of Report: 21 July 2025

Report Prepared By: Paul Broxham
MCERTS Registration Number: MM 13 1561 (Level 2, TE1, TE2, TE3, TE4)

Signed: 

Report Approved By: Robert Allen
MCERTS Registration Number: MM 02 009 (Level 2, TE1, TE2, TE3, TE4)

Signed: 

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Part 1: Executive Summary

1.1 Monitoring Objectives

Unimetals Recycling UK Limited placed a contract with CES Environmental Instruments Ltd for the compliance check monitoring of emissions to air from the A1 Emissions Control System Exhaust (New Stack).

A1 Emissions Control System Exhaust (New Stack)

Treatment consisting only of shredding and granulation of ferrous and non-ferrous metals for recovery.

The test work was undertaken on 16 June 2025 by CES Environmental Instruments Ltd Engineers and carried out as part of CES Environmental Instruments Ltd job reference EI/10762.

The substances monitored were:-

Particulate Matter

On the day of testing there were no special requirements for the monitoring.

1.2 Monitoring Results

Emission Point Reference: A1 Emissions Control System Exhaust (New Stack)

Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty of Measurement (95% CI)	Blank Result	Units	Reference Conditions	Emission Rate	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
Particulate Matter	20	0.15	0.19	0.05*	mg/m ³	273K, 101.3kPa	0.005 kg/hr	16 June 2025	10:26-13:26	BS EN 13284-1	UKAS & MCERTS	Normal Operation
Volatile Organic Compounds	Not Applicable	30.04	2.45	-	mgC/m ³	273K, 101.3kPa	-	16 June 2025	11:30-1:29	BS EN 12619	UKAS & MCERTS	Normal Operation

* Indicates where a value less than the limit of detection of the weighing procedure (0.09mg) has been reported, the value lies between the detection limit and zero. A value of half the limit of detection (0.045mg) has been used to calculate the concentration.

1.3 Operating Information

Emission Point Reference: A1 Emissions Control System Exhaust (New Stack)

Process Type	Batch Sample Details	Fuel	Product	Load	Abatement
Continuous	-	Light Iron	Scrap Metal	Normal Operation	Cyclone and Bag Filter

Comparison of Operator Continuous Emissions Monitoring Systems (CEMS) and Periodic Monitoring Results								
Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Uncertainty of Measurement (95% CI)	Units	Reference Conditions	Date of Sampling	Start and End Times	CEMS Results
No CEMS Installed								

1.4 Monitoring Deviations

None.

Part 2: Supporting Information

Appendix 1 General Information

CES Environmental Instruments Ltd staff details

Name	Role	MCERT Registration Number	Level 1	Level 2	TE1	TE2	TE3	TE4	At site
Paul Broxham	Team Leader	MM 13 1254		✓	✓	✓	✓	✓	T
				Nov 2029	Feb 2030	Feb 2030	Nov 2029	Nov 2029	
Cameron Helas	Technician	Trainee							✓

T = Nominated Team Leader on Site

CES Environmental Instruments Ltd method details

Pollutant	Method	CES Procedure
Particulate Matter	BS EN 13284-1	WI 4/1
Volatile Organic Compounds	BS WN 12619	WI 4/28

Monitoring Equipment Used

Gravimat & Probe
Sick Maihak FID

CES Environmental Instruments Ltd Reference: C366
CES Environmental Instruments Ltd Reference: C232

Appendix 2

Diagrams of Emission Point

Sampling Location

Dimensions	Cross Sectional Area	Orientation	Sample Ports Available/Used	Sampling Positions Per Plane	Standard
Dia 1000mm	0.789m ²	Vertical	PM = 2/2 Gases = 2/2	8 1	BS EN 15259
<p>Comments: Sample ports: 2 off 4" BSP sockets.</p> <p>Sample times are calculated from the total sample time equally divided by the no. of sample positions per plane. The minimum sample time per position is 3 minutes.</p> <p>Sample positions calculated using the Tangential method for circular ducts</p> <p>Pitot Traverse Along line A and B at positions consistent with BS EN 15259 these positions are: 6.7%, 25.0%, 75.0%, 93.3%</p> <p>Sample Positions Along line A and B at as many of the positions required within the standard method as can be achieved given the clearance limitations behind each socket. BS EN 15259 requires sampling at 8 points (4 on each of two lines) these positions are: 6.7%, 25.0%, 75.0%, 93.3%</p>					
				Yes	No
Has homogeneity test been carried out?					✓
If Yes - Is stack gas homogenous?				-	-
Any physical or regulatory restrictions regarding usage of equipment? N/A					

Compliance with BS EN 15259 / EA TGN M1	Yes	No
Does the sample plane comply upstream?	✓	
Does the sample plane comply downstream?	✓	
Are the appropriate sample ports fitted?	✓	
Do the stack gas velocity / temperature profiles comply?	✓	
Minimum platform area >5m²	✓	



Appendix 3
Particulate Matter (Sampling Measurement & Results)

Site : Unimetals Recycling UK Limited - Nottingham
Date : 16 June 2025
Plant : A1 Emissions Control System Exhaust
File Ref. : 10762

Mean Particulate Results

Filter	Time	mg/m ³ (Actual Conditions)	m ³ /hr	mg/Nm ³ (Reference Conditions)	Nm ³ /hr	kg/hr
52648	10:26-11:28	0.17	40121	0.19	35579.0	0.007
52709	11:30-12:28	0.13	40263	0.15	35824.0	0.005
52716	12:32-13:26	0.10	40298	0.11	35777.0	0.004
	Mean	0.13	40227	0.15	35726.7	0.005

Control Blank Filter

Filter	Volume (m ³)
52648	0.961
52709	0.962
52716	0.961
	0.961 (Reference Conditions with no correction for Oxygen)

Filter 1002345

Tare Weight 18869.79 mg
Gross Weight 18869.84 mg *

Gain 0.04 mg

Measured Oxygen %

Concentration 0.05 mg/Nm³

Results Correct to

Temperature	Pressure	Oxygen	Gas
°C/K	mbar/kPa	%	Wet/Dry
0/273	1013/101.3		Wet

* Indicates where a value less than the limit of detection of the weighing procedure (0.09mg) has been reported, the value lies somewhere between the detection limit and zero. A value of half the limit of detection (0.045mg) has been used to calculate the concentration.

Velocity Results

	Time	m/s
Test 1	10:26-11:28	14.10
Test 2	11:30-12:28	14.20
Test 3	12:32-13:26	14.20
	Mean	14.17

protocol simultaneous isokinetic extraction measurement

16/06/2025 10:26

16/06/2025 11:28

collector-no. 648
 engineer PB CH
 plant name Metal Shredder New Exhaust
 place Unimetals Nottingham
 remarks Normal Operation
 Diameter = 1000mm
 T1

operating parameter

normal density humid [kg / m³] : 1.27
 water vapour [%Vol] : 3
 ambient pressure [mbar] : 1027
 duct cross-section [m²] : 0.789

extraction parameter

change of meas. point [h:m:s] : 00:07:30
 points / axis : 4
 nozzles diameter [mm] : 5.2
 isokinetic factor : 1
 tare weight [mg] : 16972.59
 gross weight [mg] : 16972.77

evaluation

meas. time [h:m:s] : 00:59:60
 dust weight [mg] : 0.18

extracted partial volume
 actual conditions [m³] : 1.084
 in norm wet [Nm³] : 0.961
 in norm dry [Nm³] : 0.932

volume flow in duct
 actual conditions [m³/h] : 40121
 in norm wet [Nm³/h] : 35579
 in norm dry [Nm³/h] : 34512

dust concentration
 actual conditions [mg/m³] : 0.17
 in norm wet [mg/Nm³] : 0.19
 in norm dry [mg/Nm³] : 0.19

protocol simultaneous isokinetic extraction measurement

16/06/2025 10:26

16/06/2025 11:28

measured values table

axis	depth	T_probe [°C]	v_duct [m/s]	angle [grd]	Q_act. [m³/h]	volume [m³]	meas. time [H:M:S]	p10 [mbar]	p40 [mbar]
1	1	36	14.2	0.3	1.13	0.141	00:07:30	2.00	-31
1	2	38	14.2	0.2	1.08	0.135	00:07:30	2.00	-29
1	3	40	14.1	0.2	1.07	0.134	00:07:30	2.00	-30
1	4	41	14.1	0.1	1.08	0.135	00:07:30	2.00	-30
2	1	41	14.1	0.1	1.07	0.135	00:07:30	2.00	-30
2	2	42	14.1	0.2	1.08	0.135	00:07:30	2.00	-30
2	3	41	14.1	0.1	1.08	0.134	00:07:30	2.00	-30
2	4	40	14.1	0.1	1.07	0.135	00:07:30	2.00	-30
		40	14.1	0.2	1.08	0.135		2.00	-30

protocol simultaneous isokinetic extraction measurement

16/06/2025 11:30

16/06/2025 12:31

collector-no. 709
 engineer PB CH
 plant name Metal Shredder New Exhaust
 place Unimetals Nottingham
 remarks Normal Operation
 Diameter = 1000mm
 T2

operating parameter

normal density humid [kg / m³] : 1.27
 water vapour [%Vol] : 3
 ambient pressure [mbar] : 1027
 duct cross-section [m²] : 0.789

extraction parameter

change of meas. point [h:m:s] : 00:07:30
 points / axis : 4
 nozzles diameter [mm] : 5.2
 isokinetic factor : 1
 tare weight [mg] : 16851.11
 gross weight [mg] : 16851.25

evaluation

meas. time [h:m:s] : 00:59:60
 dust weight [mg] : 0.14

extracted partial volume
 actual conditions [m³] : 1.081
 in norm wet [Nm³] : 0.962
 in norm dry [Nm³] : 0.933

volume flow in duct
 actual conditions [m³/h] : 40263
 in norm wet [Nm³/h] : 35824
 in norm dry [Nm³/h] : 34750

dust concentration
 actual conditions [mg/m³] : 0.13
 in norm wet [mg/Nm³] : 0.15
 in norm dry [mg/Nm³] : 0.15

protocol simultaneous isokinetic extraction measurement

16/06/2025 11:30

16/06/2025 12:31

measured values table

axis	depth	T_probe [°C]	v_duct [m/s]	angle [grd]	Q_act. [m³/h]	volume [m³]	meas. time [H:M:S]	p10 [mbar]	p40 [mbar]
1	1	39	14.2	0.2	1.08	0.135	00:07:30	2.00	-30
1	2	40	14.2	0.4	1.08	0.135	00:07:30	2.00	-30
1	3	40	14.1	0.2	1.08	0.135	00:07:30	2.00	-30
1	4	40	14.1	0.2	1.08	0.135	00:07:30	2.00	-30
2	1	40	14.2	0.4	1.08	0.135	00:07:30	2.00	-30
2	2	40	14.2	0.3	1.08	0.136	00:07:30	2.00	-30
2	3	39	14.2	0.3	1.08	0.135	00:07:30	2.00	-30
2	4	39	14.2	0.3	1.08	0.135	00:07:30	2.00	-30
		40	14.2	0.3	1.08	0.135		2.00	-30

protocol simultaneous isokinetic extraction measurement

16/06/2025 12:32

16/06/2025 13:36

collector-no. 716
 engineer PB CH
 plant name Metal Shredder New Exhaust
 place Unimetals Nottingham
 remarks Normal Operation
 Diameter = 1000mm
 T3

operating parameter

normal density humid [kg / m³] : 1.27
 water vapour [%Vol] : 3
 ambient pressure [mbar] : 1026
 duct cross-section [m²] : 0.789

extraction parameter

change of meas. point [h:m:s] : 00:07:30
 points / axis : 4
 nozzles diameter [mm] : 5.2
 isokinetic factor : 1
 tare weight [mg] : 16680.88
 gross weight [mg] : 16680.99

evaluation

meas. time [h:m:s] : 00:59:60
 dust weight [mg] : 0.11

extracted partial volume
 actual conditions [m³] : 1.082
 in norm wet [Nm³] : 0.961
 in norm dry [Nm³] : 0.932

volume flow in duct
 actual conditions [m³/h] : 40298
 in norm wet [Nm³/h] : 35777
 in norm dry [Nm³/h] : 34703

dust concentration
 actual conditions [mg/m³] : 0.10
 in norm wet [mg/Nm³] : 0.11
 in norm dry [mg/Nm³] : 0.12

protocol simultaneous isokinetic extraction measurement

16/06/2025 12:32

16/06/2025 13:36

measured values table

axis	depth	T_probe [°C]	v_duct [m/s]	angle [grd]	Q_act. [m³/h]	volume [m³]	meas. time [H:M:S]	p10 [mbar]	p40 [mbar]
1	1	40	14.2	0.3	1.08	0.135	00:07:30	2.00	-30
1	2	39	14.2	0.3	1.08	0.135	00:07:30	2.00	-30
1	3	40	14.2	0.2	1.08	0.135	00:07:30	2.00	-29
1	4	39	14.1	0.3	1.08	0.135	00:07:30	2.00	-30
2	1	39	14.2	0.2	1.08	0.135	00:07:30	2.00	-30
2	2	40	14.2	0.2	1.08	0.136	00:07:30	2.00	-30
2	3	40	14.2	0.3	1.08	0.135	00:07:30	2.00	-29
2	4	41	14.2	0.2	1.09	0.136	00:07:30	2.00	-29
		40	14.2	0.3	1.08	0.135		2.00	-30

Appendix 4
Gas (Instrument Measured Values & Results)

Site	Unimetals Nottingham
Date	16/06/2025
Plant	Metal Shredder
File Ref	10762

Date & Time		VOC	
Start	End	wet ppm	wet mg/Nm ³
16/06/2025 11:30	16/06/2025 12:29	24.91	40.04
16/06/2025 12:30	16/06/2025 13:29	12.47	20.04
Mean		18.69	30.04
Max		45.63	73.33
Min		9.69	15.57

Results Correct to

Temperature °C/K	Pressure mbar/kPa	Oxygen %	Gas Wet/Dry	Wet
0/273	1013/101.3	No Correction		

Date/Time	VOC Wet ppm	VOC Wet mg/Nm ³
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16/06/2025 11:30	25.00	40.18
16/06/2025 11:31	39.06	62.78
16/06/2025 11:32	45.63	73.33
16/06/2025 11:33	42.34	68.05
16/06/2025 11:34	34.22	54.99
16/06/2025 11:35	30.78	49.47
16/06/2025 11:36	29.69	47.71
16/06/2025 11:37	28.75	46.21
16/06/2025 11:38	27.34	43.95
16/06/2025 11:39	25.16	40.43
16/06/2025 11:40	24.22	38.92
16/06/2025 11:41	22.97	36.91
16/06/2025 11:42	24.53	39.43
16/06/2025 11:43	27.19	43.69
16/06/2025 11:44	25.47	40.93
16/06/2025 11:45	22.34	35.91
16/06/2025 11:46	25.63	41.18
16/06/2025 11:47	23.44	37.67
16/06/2025 11:48	24.38	39.17
16/06/2025 11:49	27.19	43.69
16/06/2025 11:50	25.63	41.18
16/06/2025 11:51	25.31	40.68
16/06/2025 11:52	26.09	41.94
16/06/2025 11:53	26.09	41.94
16/06/2025 11:54	27.66	44.45
16/06/2025 11:55	25.31	40.68
16/06/2025 11:56	25.78	41.43
16/06/2025 11:57	25.31	40.68
16/06/2025 11:58	24.84	39.93
16/06/2025 11:59	23.44	37.67
16/06/2025 12:00	22.97	36.91
16/06/2025 12:01	25.47	40.93
16/06/2025 12:02	27.97	44.95
16/06/2025 12:03	27.03	43.44
16/06/2025 12:04	25.47	40.93
16/06/2025 12:05	23.13	37.17
16/06/2025 12:06	22.34	35.91
16/06/2025 12:07	31.41	50.47
16/06/2025 12:08	22.97	36.91
16/06/2025 12:09	20.00	32.14
16/06/2025 12:10	18.91	30.39
16/06/2025 12:11	27.66	44.45
16/06/2025 12:12	28.75	46.21
16/06/2025 12:13	22.66	36.41
16/06/2025 12:14	21.25	34.15
16/06/2025 12:15	21.25	34.15
16/06/2025 12:16	27.50	44.20
16/06/2025 12:17	26.09	41.94
16/06/2025 12:18	25.63	41.18
16/06/2025 12:19	24.22	38.92
16/06/2025 12:20	24.06	38.67
16/06/2025 12:21	20.94	33.65
16/06/2025 12:22	18.75	30.13
16/06/2025 12:23	16.88	27.12
16/06/2025 12:24	16.09	25.86
16/06/2025 12:25	15.47	24.86
16/06/2025 12:26	15.00	24.11
16/06/2025 12:27	15.00	24.11
16/06/2025 12:28	14.69	23.60
16/06/2025 12:29	14.38	23.10
Min	14.38	23.10
Max	45.63	73.33
Mean	24.91	40.04

16/06/2025 12:30	14.22	22.85
16/06/2025 12:31	14.38	23.10
16/06/2025 12:32	14.06	22.60
16/06/2025 12:33	14.06	22.60
16/06/2025 12:34	14.06	22.60
16/06/2025 12:35	13.91	22.35
16/06/2025 12:36	13.75	22.10
16/06/2025 12:37	13.59	21.85
16/06/2025 12:38	13.91	22.35
16/06/2025 12:39	13.59	21.85
16/06/2025 12:40	13.59	21.85
16/06/2025 12:41	13.28	21.34
16/06/2025 12:42	13.28	21.34
16/06/2025 12:43	13.28	21.34
16/06/2025 12:44	13.13	21.09
16/06/2025 12:45	12.97	20.84
16/06/2025 12:46	12.97	20.84
16/06/2025 12:47	13.13	21.09
16/06/2025 12:48	13.13	21.09
16/06/2025 12:49	13.28	21.34
16/06/2025 12:50	12.97	20.84
16/06/2025 12:51	12.81	20.59
16/06/2025 12:52	12.81	20.59
16/06/2025 12:53	12.97	20.84
16/06/2025 12:54	12.97	20.84
16/06/2025 12:55	12.66	20.34
16/06/2025 12:56	13.13	21.09
16/06/2025 12:57	12.81	20.59
16/06/2025 12:58	13.13	21.09
16/06/2025 12:59	12.34	19.84
16/06/2025 13:00	12.81	20.59
16/06/2025 13:01	12.81	20.59
16/06/2025 13:02	12.97	20.84
16/06/2025 13:03	12.97	20.84
16/06/2025 13:04	12.97	20.84
16/06/2025 13:05	12.97	20.84
16/06/2025 13:06	12.97	20.84
16/06/2025 13:07	13.13	21.09
16/06/2025 13:08	12.03	19.34
16/06/2025 13:09	11.88	19.08
16/06/2025 13:10	11.25	18.08
16/06/2025 13:11	11.56	18.58
16/06/2025 13:12	11.41	18.33
16/06/2025 13:13	11.41	18.33
16/06/2025 13:14	11.41	18.33
16/06/2025 13:15	11.25	18.08
16/06/2025 13:16	11.25	18.08
16/06/2025 13:17	10.94	17.58
16/06/2025 13:18	11.41	18.33
16/06/2025 13:19	11.09	17.83
16/06/2025 13:20	11.09	17.83
16/06/2025 13:21	11.25	18.08
16/06/2025 13:22	11.25	18.08
16/06/2025 13:23	11.09	17.83
16/06/2025 13:24	10.94	17.58
16/06/2025 13:25	11.41	18.33
16/06/2025 13:26	10.78	17.33
16/06/2025 13:27	10.31	16.57
16/06/2025 13:28	9.69	15.57
16/06/2025 13:29	9.84	15.82
Min	9.69	15.57
Max	14.38	23.10
Mean	12.47	20.04

Appendix 5
Instrumental Gas Analyser Site
Calibration Data

CES Environmental Instruments Ltd
GAS ANALYSER CALIBRATION SHEET

Gas Analyser Calibration		Client	Unimetals Nottingham	Date	16/06/2025
Instrument Type	FID	Job Number	10762	Test	Auth
Quality No.	C232	Site	Metal Shredder	Test Period	2 hours

Range - Nitrogen (N2)	%
Range - Carbon Dioxide (CO2)	%
Range - Oxygen (O2)	%
Range - Carbon Monoxide (CO)	ppm
Range - Nitric Oxide (NO)	ppm
Range - Sulphur Dioxide (SO2)	ppm
Range - C ₃ H ₈	100.00 ppm

Zero Gas - Nitrogen (N ₂)	79 %	Certificate Number:	40-79302-001
Span Gas 1 - Carbon Dioxide (CO ₂)	%	Certificate Number:	
Span Gas 1 - Oxygen (O ₂)	%	Certificate Number:	
Span Gas 1 - Carbon Monoxide (CO)	ppm	Certificate Number:	
Span Gas 1 - Nitric Oxide (NO)	ppm	Certificate Number:	
Span Gas 1 - Sulphur Dioxide (SO ₂)	ppm	Certificate Number:	
Span Gas 1 - C ₃ H ₈	80.1 ppm	Certificate Number:	40-00899-003

Span Gas 2 - Carbon Dioxide (CO ₂)	%	Certificate Number:	
Span Gas 2 - Oxygen (O ₂)	%	Certificate Number:	
Span Gas 2 - Carbon Monoxide (CO)	ppm	Certificate Number:	
Span Gas 2 - Nitric Oxide (NO)	ppm	Certificate Number:	
Span Gas 2 - Sulphur Dioxide (SO ₂)	ppm	Certificate Number:	
Span Gas 2 - C ₃ H ₈	ppm	Certificate Number:	

Date	16/06/2025	Time	11:00:00	Amb Press (mbar)	1028	Amb Temp. (°C)	21
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Calibration Check - Pre-Sampling	CO ₂	O ₂	CO	NO	SO ₂	C3H8
Test Gas Entered - Instrument						
Zero Reading						0.00
Span Gas 1 Reading						80.10
Zero Reading						0.10
Ambient Air						
Analyser T ₉₀ Response (sec)						14.00
<2x Repeatability @ zero	0.00	0.00	0.00	0.00	0.00	0.10

Leak Check - Pre-Sampling	Leak Check O ₂	C3H8
Test Gas Entered - Probe		
Zero Reading		0.20
Span Gas 1 Reading		80.20
Span Gas 2 Reading		
Ambient Air		
Zero Drift (%)		0.20
Span Drift (%)		0.10

Leak Check - Pre-Sampling	Leak Check Flow
Flow Check	
Conditioning Unit Flow (L/min)	
Leak Rate (L/min)	
Leak rate (%)	

Date	16/06/2025	Time	13:45:00	Amb Press (mbar)	1028	Amb Temp. (°C)	26
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Calibration Check - Mid / Post Sampling	CO ₂	O ₂	CO	NO	SO ₂	C3H8
Test Gas Entered - Instrument						
Zero Reading						0.20
Span Gas 1 Reading						80.30
Span Gas 2 Reading						
Ambient Air						
Zero Drift (%)						0.20
Span Drift (%)						0.20

Checks completed by: P.Broxham Page 1 of 1

Appendix 4
Calibration Certificates

Certificate of Calibration

Date of Issue: 4th July 2025

Certificate No. CES2651
page 1 of 2

CES Environmental Instruments Ltd
Bretby Business Park, Ashby Road
Burton-on-Trent, Staffordshire, DE15 0YZ
Tel: 01283 216334 Fax: 01283 550939


Certified By

Instrument Details

Instrument Type	Gravimat SHC-502
Instrument Make	Erwin Sick
Instrument Serial No.	12058569
Quality No.	C366
Calibration Date	04 07 25
Calibrated By Name	M.Rodgers

Ambient Conditions

Air Temperature (°C)	25
Barometric Pressure (mbar)	1015
Relative Humidity (%)	60

Instruments used to undertake calibration

E Type Pitot	UKAS Certificate No. K58740V	(Qu. No. C136)
Manometer Type FC012	UKAS Certificate No. 29299	(Qu. No. C082)
Manometer Type FC012	UKAS Certificate No. 29300	(Qu. No. C081)
Barometer Type 104	UKAS Certificate No. K55933P	(Qu. No. C138)
Gallus Dry Gas Meter	UKAS Certificate No. N039726	(Qu. No. C333)
RIS Supercal XT	UKAS Certificate No. 10345	(Qu. No. C014)

Flow and Extraction

The reference pitot was placed in a wind tunnel located at Bretby Business Park. The Gravimat SHC-502 Sampling Probe under test was mounted within the same wind tunnel in close proximity to the reference pitot. The wind tunnel was operated to generate a differential pressure across each pitot, a direct comparison was made. The differential pressures measured were in the region of the calibration points of the reference pitot. Correction factors were applied to the reference pitot and compared to the differential pressure shown for the pitot under test. The extraction system of the unit was operated for a period of one minute.

Volume Flow

A calibrated dry gas meter was connected to the sampling nozzle of the Gravimat SCH-502. A volume of air is pulled through the sampling system. The measured value shown on the calibrated dry gas meter is then compared to the indicated value on the Gravimat SCH-5 display.

Barometric Pressure

The barometric pressure was measured using a calibrated barometer. The indicated pressure was compared to the Gravimat SHC-502 display.

Temperature

The probe thermocouple was placed in a thermocouple oven and heated. The temperature was measured using a calibrated thermocouple and temperature indicator. The resultant temperature was compared to the Gravimat SCH-502 display.

Current

A mA current source was injected into the Gravimat SCH-502 using a mA current generator. The injected current was compared to the Gravimat SCH-502 display.

Certificate of Calibration

Date of Issue: 4th July 2025

Certificate No. CES2651
page 2 of 2

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Bretby Business Park, Ashby Road
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Tel: 01283 216334 Fax: 01283 550939


Certified By

Instrument Details

Instrument Type Gravimat SHC-502
Instrument Make Erwin Sick
Instrument Serial No 12058569
Quality No C366
Calibration Date 04 07 25

Ambient Conditions

Air Temperature (°C) 25
Barometric Pressure (mbar) 1015
Relative Humidity (%) 60
Air Density @ 0°C (kg/m³) 1.277
Corrected Air Density (kg/m³) 1.172

Calibration Details

Flow and Extraction

	Pitot Correction	Applied Pressure Corrected (Pa)	SHC502 (Calculated) (Pa)	Pressure Factor	Calculated Velocity (m/s)	SHC502 Velocity (m/s)	Velocity Factor
5.5	1.004	5.5	5.6	0.98	3.069	3.100	0.99
40.2	1.006	40.4	41.4	0.98	8.307	8.400	0.99
86.9	1.005	87.3	91.6	0.95	12.207	12.500	0.98
145.2	1.002	145.5	150.0	0.97	15.756	16.000	0.98
235.9	0.997	235.2	248.7	0.95	20.032	20.600	0.97

Mean (excluding 4.0Pa)	0.97		0.98
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Volume Flow

Nominal Flow Rate l/min	Actual Flow Rate l/min	Actual Flow Rate m³/hr	Orifice Constant
10.000	9.095	0.182	12.136
15.000	14.430	0.289	13.922
20.000	19.750	0.395	13.144
25.000	25.633	1.538	13.344
30.000	29.905	0.598	13.324
ment Orifice Constant(@1.5m³/hr) =			13.344

Barometric Pressure

Pressure Input	
Required Value (mbar)	Indicated Value (mbar)
1015.0	1015.0
998.0	998.0
961.0	961.0

Temperature

Temperature Input	
Required Value (°C)	Indicated Value (°C)
25.0	25.0
50.0	50.1
100.0	100.4
150.0	150.2
250.0	249.8
300.0	299.7

Current

Current Value	
Required Value (mA)	Indicated Value (mA)
0	0.0
5	5.0
10	10.0
15	15.0
20	20.0

Time

Time Period mins	Required Value mins	Within Limit
3:00	2:59 → 3:01	Yes
5:00	4:59 → 5:01	Yes
10:00	9:59 → 10:01	Yes

Appendix 4

Uncertainty Calculations

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

Limit value (ELV)	20 mg.m ⁻³	Reference oxygen	% by volume
Measured concentration	0.19 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	V _m	0.961	uV _m	0.001 m ³	0.10		<=2%
Sampled gas Temperature	T _m	273	uT _m	2 k	0.73		<=1%
Sampled gas Pressure	ρ _m	101.3	uρ _m	0.1 kPa	0.10		<=1%
Sampled gas Humidity	H _m	0	uH _m	1 % by volume	1.00		<=1%
Oxygen content	O _{2,m}		uO _{2,m}	0.1 % by volume	#DIV/0!		<=5%
Mass particulate	m	0.18	um	0.09 mg	50.00	0.47	<5% of limit value
Note - Sampled gas humidity, temperature and pressure are values at the gas meter							
Leak	L	2		%	2.00		<=2%
Uncollected Mass (Instack filter - no rinse)	UCM	0.01		mg	5.555555556		<=10%

Intermediate calculations				
Factor for std conds	fs	1.00		
uncertainty components	symbol	sensitivity coeff	u (in units of fs)	
	ρ _m	0.010	0.001	$f_s = \frac{(100 - H_m) 273 \rho_m}{100 T_m 101.3}$
	H _m	0.010	0.010	
	T _m	0.004	0.007	
	ufs		0.012	
Corrected volume	V	0.96	uV	0.012 m ³
				1.24
				1.25
Factor for O2 correction	fc	1.00		
uncertainty components	symbol	sensitivity coeff	u	
	O _{2,m}	0.05	0.005	$f_c = \frac{21 - O_{2,ref}}{21 - O_{2,m}}$
Factor for O2 Correction	ufc	1.00	0.005	

Parameter	Value	Units	Sensitivity coeff	Uncertainty contribution	Uncertainty as %
Corrected Volume (standard cc)	V	0.96 m ³	0.19	0.00 mg.m ⁻³	1.25 %
Mass	m	0.18 mg	1.04	0.09 mg.m ⁻³	50.00 %
Factor for O2 Correction	fc	1.00	0.19	0.00 mg.m ⁻³	0.48 %
Leak	L	0.00 mg.m ⁻³	1.00	0.00 mg.m ⁻³	1.15 %
Uncollected mass	UCM	0.01 mg	1.04	0.01 mg.m ⁻³	3.21 %
Combined measurement uncertainty				0.09 mg.m⁻³	
Expanded uncertainty as percentage of measured value		100.27 % measured of value		expressed with a level of confidence of 95% (Using a coverage factor k=2)	
Expanded uncertainty in units of measurement		0.19 mg.m ⁻³			
Expanded uncertainty as percentage of limit value		0.94 % ELV			

Verified

Uncertainty calculation for Gaseous Measurement Volatile Organic Compounds

BS EN 12619

Limit value	mg.m ⁻³ (corrected)	Gas	C3H8
Uncertainty Requirement	15 %	Full Scale	100 ppm
Measured concentration	18.69 ppm	Cal gas conc	80.1 ppm
Measured concentration	29.91 mgC.m ⁻³ (273K, 101.3kPa)	Conversion	1.6
Measured concentration	33.23 mgC.m ⁻³ (corrected)	Full Scale	160 mg.m ⁻³
		Cal gas conc	128.16 mg.m ⁻³

Correction for reference conditions				
	O2, %	Moisture, %	Pressure, KPa	Temperature, K
ref	0.00	0.00	101.30	273.00
measured	0.00	10.00	101.30	273.00
Uncert	0.05		0.00	1.00
Factors	1.00	1.11	1.00	1.00
Uncertainty in factor	0.00	0.00	0.00	0.00
Correction Factor	1.11	uf	0.00436881334867	

Performance characteristics	Value		specification
Response time	14.00	seconds	180.000
Number of readings in measurement	120		
Repeatability at zero	0.15	% full scale	0.200
Repeatability at span level	0.8	% full scale	2.000
Deviation from linearity	0.4	% of value	2.000
Zero drift	0.20	% full scale	2.000
Span drift	0.20	% full scale	2.000
volume or pressure flow dependence	0.02	% of full scale/kPa	0.033
atmospheric pressure dependence	0.5	% of value/kPa	0.750
ambient temperature dependence	0.01	% full scale/10K	0.300
N2O (40 mg/m3)	0.3	mg/m3	
CH4 (57 mg/m3)	0.3	mg/m3	
NH3 (20 mg/m3)	0.3	mg/m3	
CO2 (15%)	0.3	% by vol	
H2O (30%)	0.5	% by vol	4.000
dependence on voltage	0.1	% full scale/10V	2%/fs/10V
losses in the line (leak)	2	% of value	2% of value
Uncertainty of calibration gas	2	% of value	

Effect of drift	
	0.38 mg/m3
	0.24 % value

	ranges		
	min	max	value at calib
flow	18	30	24 l/hr
pressure	102.80	102.80	102.80 kPa
temp	294.00	299.00	294.00 K
NH3 range	0	20	0 mg/m3
N2O range	0	40	0 mg/m3
CH4 range	0	57	0 mg/m3
CO2 range	8	10	0 %vol
H2O range	10.00	10.00	0 %vol
Instrument Voltage Rating	110 V		
Voltage	104.5	115.5	110 V

Measurement performance related to stationary conditions				
Performance characteristic	Uncertainty	Value of uncertainty quantity		
		for mean		use rep at span
Standard deviation of repeatability at zero	U _{r0}			
Standard deviation of repeatability at span level	U _{rs}			0.07
Lack of fit	U _{fit}			0.37
Drift	U _{odr}			0.22
volume or pressure flow dependence	U _{spres}			0.01
atmospheric pressure dependence	U _{apres}			0.00
ambient temperature dependence	U _{temp}			0.00
NH3 (20 mg/m3)	U _{interf}			0.17
CO2 (15%)	U _{interf}			0.18
H2O (30%)	U _{interf}			0.17
N2O (40 mg/m3)	U _{interf}			0.17
CH4 (57 mg/m3)	U _{interf}			0.17
Dependence on voltage	U _{volt}			0.03
losses in the line (leak)	U _{leak}			0.35
Uncertainty of calibration gas	U _{calib}			0.35
Uncertainty in factor	uf			0.00

Use largest negative or positive interferent effect		
NH3	0	0.17
CO2	0	0.18
H2O	0	0.17
N2O	0	0.17
CH4	0	0.17
	0	0.87
Interference uncertainty		0.87

Measurement uncertainty	Result	29.91	mg/m ³
Combined uncertainty		1.10	mg/m ³
Expanded uncertainty	k = 2	2.20	mg/m ³
Uncertainty corrected to std conds		2.45	mg.m-3 (corrected)
Expanded uncertainty	expressed with a level of confidence of 95%	#VALUE!	% ELV
Expanded uncertainty	expressed with a level of confidence of 95%	2.45	mg.m ⁻³ at ELV
	U ₉₅ ≤ U _{req}	#VALUE!	

Verified