Title: Monitoring of Particulate Matter (PM)
& Gaseous Emissions

Permit Number:	TBC
Operator:	CBE Plus Limited
Installation:	Spray Booth
Monitoring Dates:	11 November 2025

Reference Number:	EI/10720
Client Organisation: Address:	CBE Plus Limited Enterprise Drive Holmewood Chesterfield S42 5UZ
Monitoring Organisation: Address:	CES Environmental Instruments Ltd Bretby Business Park Ashby Road Burton on Trent Staffordshire DE15 0YZ
Date of Report:	1 December 2025
Report Prepared By: MCERTS Registration Number:	Martin Rodgers MM 04 531 (Level 2, TE1, TE2, TE3, TE4)
Signed:	.....
Report Approved By: MCERTS Registration Number:	Robert Allen MM 02 009 (Level 2, TE1, TE2, TE3, TE4)
Signed:	.....

Contents

Part 1: Executive Summary

1.1 Monitoring Objectives

CBE Plus Limited placed a contract with CES Environmental Instruments Ltd for the compliance check monitoring of emissions to air from the Stripping Line.

Stripping Line

Plating Process
CBE+ is a global leader in precision Electroless Nickel Plating (ENP), complemented by precision CNC machining and a range of specialist ancillary services.

The test work was undertaken on 11 November 2025 by CES Environmental Instruments Ltd Engineers and carried out as part of CES Environmental Instruments Ltd job reference EI/10720.

The substances monitored were: -

Particulate Matter
Velocity Volume Flow
Total Organic Compounds

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

1.2 Monitoring Results

Emission Point Reference: Spray Booth (Left Hand Side)

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	To Be Confirmed	0.09	0.13	0.03*	mg/m³	273K, 101.3kPa	0.001kg/hr	11 November 2025	09:48-12:57	BS EN 13284-1	UKAS & MCERTS	Normal Operation
Velocity	Not Applicable	5.53	0.40		m/s	Actual	-	11 November 2025	09:48-12:57	BS EN 16911	UKAS & MCERTS	Normal Operation
Mean Volume Flow	Not Applicable	7692.3	-	-	m³/hr	Actual	-	11 November 2025	09:48-12:57	BS EN 16911	UKAS & MCERTS	Normal Operation
Total Organic Compound	To Be Confirmed	114.69	8.95	-	mg/m³	273K, 101.3kPa	-	11 November 2025	10:20-11:19	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.

Emission Point Reference: Spray Booth (Right Hand Side)

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	To Be Confirmed	0.38	0.15	0.04*	mg/m³	273K, 101.3kPa	0.004kg/hr	11 November 2025	09:50-13:02	BS EN 13284-1	UKAS & MCERTS	Normal Operation
Velocity	Not Applicable	7.80	0.34		m/s	Actual	-	11 November 2025	09:50-13:02	BS EN 16911	UKAS & MCERTS	Normal Operation
Mean Volume Flow	Not Applicable	10810.7	-	-	m³/hr	Actual	-	11 November 2025	09:50-13:02	BS EN 16911	UKAS & MCERTS	Normal Operation
Total Organic Compound	To Be Confirmed	64.33	8.34	-	mg/m³	273K, 101.3kPa	-	11 November 2025	11:35-12:34	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: Spray Booth (Left Hand / Right Hand)

Process Type	Batch Sample Details	Fuel	Product	Load	Abatement
Continuous	-	-	Metal Components	Normal Operation	None

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

The sample plane does not comply upstream and downstream as per the requirements of BS EN 15259.

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
				Feb 2030	Feb 2030	Feb 2030	Nov 2029	Nov 2029	
Dylan Foster	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
Velocity Volume Flow	BS EN 16911-1	WI4/56
Total Organic Compound	BS EN 12619	WI4/28

Monitoring Equipment Used

Gravimat & Probe CES Environmental Instruments Ltd Reference: C300 & C193
Sick Maihak FID CES Environmental Instruments Ltd Reference: C301

Appendix 2
Diagrams of Emission Point

Sampling Location

Dimensions	Cross Sectional Area	Orientation	Sample Ports Available/Used	Sampling Positions Per Plane	Standard
Dia = 700mm	0.385m²	Vertical	PM-2/2 Gases-2/1	4 1	BS EN 15259

Comments:
Sample ports: 2 off 4" BSP sockets

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.

Sample positions calculated using the Tangential method for circular ducts.

Pitot Traverse
Along lines A & B at positions consistent with BS EN 15259 these positions are: 14.6%, 85.4%

Sample Positions
Along lines A & 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 4 points (2 on each of two lines) these positions are:
14.6%, 85.4%

	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	✓	

*BS 15259 has a general requirement that the sampling plane shall be in a straight section of duct at least 5 hydraulic diameters downstream and 2 hydraulic diameters upstream of any bend or obstruction which could produce turbulent flow.

Appendix 3
Particulate Matter (Sampling Measurement & Results)

Site : **CBE Plus Limited**
Date : **11 November 2025**
Plant : **Spray Booth Left Hand Side**
File Ref. **10720**

Mean Particulate Results

Filter	Time	mg/m³	m³/hr	mg/Nm³	Nm³/hr	kg/hr
		(Actual Conditions)		**(Reference Conditions)**		
100338	09:48-10:50	0.04	8004	**0.05**	**7059.0**	**0.000**
100132	10:52-11:54	0.10	7935	**0.11**	**6998.0**	**0.001**
1001242	11:55-12:57	0.10	7138	**0.11**	**6295.0**	**0.001**
	Mean	0.08	7692.3	**0.09**	**6784.0**	**0.001**

Control Blank Filter

Filter	Volume (m³)
100338	**1.448**
100132	**1.423**
1001242	**1.284**

Mean **1.385** (Reference Conditions with no correction for Oxygen)

Filter **1152051**

Tare Weight **18264.80 mg**
Gross Weight **18264.85 mg** *

Gain **0.04 mg**

Measured Oxygen **%**

Concentration **0.03 mg/Nm³***

Results Correct to

Temperature		Pressure		Oxygen		Gas	
°C/K	0/273	**mbar/kPa**	1013/101.3	**%**		**Wet/Dry**	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	09:48-10:50	5.80
Test 2	10:52-11:54	5.70
Test 3	11:55-12:57	5.10
	Mean	**5.53**

protocol simultaneous isokinetic extraction measurement

11/11/2025 09:48
11/11/2025 10:50

collector-no. 338

engineer	PB DF
plant name	Spray Boot LS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T1

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	2.32
ambient pressure	[mbar]	:	963
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	10
isokinetic factor		:	1
tare weight	[mg]	:	17774.53
gross weight	[mg]	:	17774.6

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.07
extracted partial volume			
actual conditions	[m³]	:	1.642
in norm wet	[Nm³]	:	1.448
in norm dry	[Nm³]	:	1.414
volume flow in duct			
actual conditions	[m³/h]	:	8004
in norm wet	[Nm³/h]	:	7059
in norm dry	[Nm³/h]	:	6895
dust concentration			
actual conditions	[mg/m³]	:	0.04
in norm wet	[mg/Nm³]	:	0.05
in norm dry	[mg/Nm³]	:	0.05

protocol simultaneous isokinetic extraction measurement 11/11/2025 09:48
11/11/2025 10:50

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	22	5.8	0.1	1.64	0.412	00:15:00	1.00	-315
1	2	22	5.7	0.1	1.63	0.406	00:15:00	1.00	-311
2	1	22	5.8	0.9	1.64	0.412	00:15:00	1.00	-315
2	2	22	5.8	0.2	1.65	0.412	00:15:00	1.00	-319
		22	5.8	0.3	1.64	0.410		1.00	-315

protocol simultaneous isokinetic extraction measurement

11/11/2025 10:52
11/11/2025 11:54

collector-no. 132

engineer	PB DF
plant name	Spray Boot LS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T2

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	2.32
ambient pressure	[mbar]	:	964
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	10
isokinetic factor		:	1
tare weight	[mg]	:	18457.17
gross weight	[mg]	:	18457.33

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.16
extracted partial volume			
actual conditions	[m³]	:	1.614
in norm wet	[Nm³]	:	1.423
in norm dry	[Nm³]	:	1.390
volume flow in duct			
actual conditions	[m³/h]	:	7935
in norm wet	[Nm³/h]	:	6998
in norm dry	[Nm³/h]	:	6835
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 11/11/2025 10:52
11/11/2025 11:54

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	22	5.8	1.0	1.62	0.406	00:15:00	1.00	-312
1	2	22	5.7	1.1	1.62	0.406	00:15:00	1.00	-311
2	1	22	5.7	0.8	1.60	0.402	00:15:00	1.00	-306
2	2	22	5.7	0.7	1.60	0.400	00:15:00	1.00	-307
		22	5.7	0.9	1.61	0.403		1.00	-309

protocol simultaneous isokinetic extraction measurement

11/11/2025 11:55
11/11/2025 12:57

collector-no. 1242

engineer	PB DF
plant name	Spray Boot LS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T3

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	2.32
ambient pressure	[mbar]	:	965
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	10
isokinetic factor		:	1
tare weight	[mg]	:	18291.1
gross weight	[mg]	:	18291.24

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.14
extracted partial volume			
actual conditions	[m³]	:	1.456
in norm wet	[Nm³]	:	1.284
in norm dry	[Nm³]	:	1.254
volume flow in duct			
actual conditions	[m³/h]	:	7138
in norm wet	[Nm³/h]	:	6295
in norm dry	[Nm³/h]	:	6149
dust concentration			
actual conditions	[mg/m³]	:	0.10
in norm wet	[mg/Nm³]	:	0.11
in norm dry	[mg/Nm³]	:	0.11

protocol simultaneous isokinetic extraction measurement 11/11/2025 11:55
11/11/2025 12:57

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	22	5.1	-5.1	1.45	0.362	00:15:00	1.00	-264
1	2	22	5.2	-5.3	1.46	0.366	00:15:00	1.00	-268
2	1	22	5.2	-5.6	1.45	0.364	00:15:00	1.00	-266
2	2	22	5.1	-5.5	1.46	0.364	00:15:00	1.00	-268
		22	5.1	-5.4	1.46	0.364		1.00	-267

Site : **CBE Plus Limited**
Date : **11 November 2025**
Plant : **Spray Booth Right Hand Side**
File Ref. **10720**

Mean Particulate Results

Filter	Time	mg/m³	m³/hr	mg/Nm³	Nm³/hr	kg/hr
		(Actual Conditions)		**(Reference Conditions)**		
802010	09:50-10:52	0.25	10811	**0.29**	**9534.0**	**0.003**
80341	10:54-11:56	0.24	10776	**0.27**	**9503.0**	**0.003**
802039	12:00-13:02	0.50	10845	**0.57**	**9479.0**	**0.005**
	Mean	0.33	10810.7	**0.38**	**9505.3**	**0.004**

Control Blank Filter

Filter	Volume (m³)
802010	**1.249**
80341	**1.238**
802039	**1.238**

Mean **1.242** (Reference Conditions with no correction for Oxygen)

Filter **115336**

Tare Weight **18053.94 mg**
Gross Weight **18053.99 mg** *

Gain **0.04 mg**

Measured Oxygen **%**

Concentration **0.04 mg/Nm³***

Results Correct to

Temperature		Pressure		Oxygen		Gas	
°C/K	0/273	**mbar/kPa**	1013/101.3	**%**		**Wet/Dry**	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	09:50-10:52	7.80
Test 2	10:54-11:56	7.80
Test 3	12:00-13:02	7.80
	Mean	**7.80**

protocol simultaneous isokinetic extraction measurement

11/11/2025 09:50
11/11/2025 10:52

collector-no. 2010

engineer	PB DF
plant name	Spray Boot RS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T1

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	1.58
ambient pressure	[mbar]	:	964
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	8
isokinetic factor		:	1
tare weight	[mg]	:	18509.71
gross weight	[mg]	:	18510.07

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.36
extracted partial volume			
actual conditions	[m³]	:	1.416
in norm wet	[Nm³]	:	1.249
in norm dry	[Nm³]	:	1.229
volume flow in duct			
actual conditions	[m³/h]	:	10811
in norm wet	[Nm³/h]	:	9534
in norm dry	[Nm³/h]	:	9383
dust concentration			
actual conditions	[mg/m³]	:	0.25
in norm wet	[mg/Nm³]	:	0.29
in norm dry	[mg/Nm³]	:	0.29

protocol simultaneous isokinetic extraction measurement 11/11/2025 09:50
11/11/2025 10:52

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	23	7.8	-1.4	1.43	0.358	00:15:00	1.00	-251
1	2	23	7.8	-0.9	1.40	0.350	00:15:00	1.00	-242
2	1	23	7.8	-1.2	1.41	0.354	00:15:00	1.00	-245
2	2	23	7.8	-0.8	1.42	0.354	00:15:00	1.00	-246
		23	7.8	-1.1	1.41	0.354		1.00	-246

protocol simultaneous isokinetic extraction measurement

11/11/2025 10:54
11/11/2025 11:56

collector-no. 341

engineer	PB DF
plant name	Spray Boot RS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T2

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	1.58
ambient pressure	[mbar]	:	964
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	8
isokinetic factor		:	1
tare weight	[mg]	:	17605.35
gross weight	[mg]	:	17605.69

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.34
extracted partial volume			
actual conditions	[m³]	:	1.404
in norm wet	[Nm³]	:	1.238
in norm dry	[Nm³]	:	1.219
volume flow in duct			
actual conditions	[m³/h]	:	10776
in norm wet	[Nm³/h]	:	9503
in norm dry	[Nm³/h]	:	9353
dust concentration			
actual conditions	[mg/m³]	:	0.24
in norm wet	[mg/Nm³]	:	0.27
in norm dry	[mg/Nm³]	:	0.28

protocol simultaneous isokinetic extraction measurement 11/11/2025 10:54
11/11/2025 11:56

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	23	7.8	2.5	1.40	0.352	00:15:00	1.00	-237
1	2	23	7.7	2.2	1.40	0.348	00:15:00	1.00	-236
2	1	23	7.8	2.2	1.40	0.350	00:15:00	1.00	-237
2	2	23	7.8	2.1	1.41	0.354	00:15:00	1.00	-241
		23	7.8	2.3	1.40	0.351		1.00	-238

protocol simultaneous isokinetic extraction measurement

11/11/2025 12:00
11/11/2025 13:02

collector-no. 2039

engineer	PB DF
plant name	Spray Boot RS
place	CBE Plus
remarks	Normal Operation Dia = 700mm T3

operating parameter

normal density humid	[kg / m³]	:	1.27
water vapour	[%Vol]	:	1.58
ambient pressure	[mbar]	:	964
duct cross-section	[m²]	:	0.385

extraction parameter

change of meas. point	[h:m:s]	:	00:15:00
points / axis		:	2
nozzles diameter	[mm]	:	8
isokinetic factor		:	1
tare weight	[mg]	:	18319.21
gross weight	[mg]	:	18319.92

evaluation

meas. time	[h:m:s]	:	01:00:00
dust weight	[mg]	:	0.71
extracted partial volume			
actual conditions	[m³]	:	1.416
in norm wet	[Nm³]	:	1.238
in norm dry	[Nm³]	:	1.218
volume flow in duct			
actual conditions	[m³/h]	:	10845
in norm wet	[Nm³/h]	:	9479
in norm dry	[Nm³/h]	:	9329
dust concentration			
actual conditions	[mg/m³]	:	0.50
in norm wet	[mg/Nm³]	:	0.57
in norm dry	[mg/Nm³]	:	0.58

protocol simultaneous isokinetic extraction measurement 11/11/2025 12:00
11/11/2025 13:02

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	24	7.9	-0.4	1.43	0.356	00:15:00	1.00	-250
1	2	24	7.9	-0.4	1.43	0.358	00:15:00	1.00	-252
2	1	24	7.8	-0.4	1.41	0.352	00:15:00	1.00	-246
2	2	24	7.7	-0.6	1.40	0.350	00:15:00	1.00	-245
		24	7.8	-0.5	1.42	0.354		1.00	-248

Appendix 4
Gas (Instrument Measured Values & Results)

Site	**CBE Plus Ltd**
Date	**11/11/2025**
Plant	**Spray Booth LHS**
File Ref	**10720**

Date & Time			**VOC**	
Start	**End**		**wet**	**wet**
			ppm	**mg/Nm³**
11/11/2025 10:20	11/11/2025 11:19		71.36	114.69
		Mean	**71.36**	**114.69**
		Max	406.25	652.90
		Min	11.41	18.33

Results Correct to

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

Date/Time	**VOC**	**VOC**
	Wet	**Wet**
1 min log	**ppm**	**mg/Nm³**
11/11/2025 10:20	15.94	25.61
11/11/2025 10:21	13.59	21.85
11/11/2025 10:22	13.44	21.60
11/11/2025 10:23	12.19	19.59
11/11/2025 10:24	12.19	19.59
11/11/2025 10:25	12.34	19.84
11/11/2025 10:26	12.19	19.59
11/11/2025 10:27	11.41	18.33
11/11/2025 10:28	76.72	123.30
11/11/2025 10:29	107.19	172.27
11/11/2025 10:30	116.09	186.58
11/11/2025 10:31	116.09	186.58
11/11/2025 10:32	116.09	186.58
11/11/2025 10:33	116.09	186.58
11/11/2025 10:34	116.09	186.58
11/11/2025 10:35	140.63	226.00
11/11/2025 10:36	123.44	198.38
11/11/2025 10:37	103.13	165.74
11/11/2025 10:38	84.38	135.60
11/11/2025 10:39	76.56	123.05
11/11/2025 10:40	70.31	113.00
11/11/2025 10:41	59.38	95.42
11/11/2025 10:42	54.69	87.89
11/11/2025 10:43	53.13	85.38
11/11/2025 10:44	46.88	75.33
11/11/2025 10:45	45.31	72.82
11/11/2025 10:46	40.63	65.29
11/11/2025 10:47	39.06	62.78
11/11/2025 10:48	37.50	60.27
11/11/2025 10:49	34.38	55.25
11/11/2025 10:50	32.81	52.73
11/11/2025 10:51	31.25	50.22
11/11/2025 10:52	29.69	47.71
11/11/2025 10:53	28.13	45.20
11/11/2025 10:54	29.69	47.71
11/11/2025 10:55	29.69	47.71
11/11/2025 10:56	26.56	42.69
11/11/2025 10:57	25.00	40.18
11/11/2025 10:58	75.00	120.54
11/11/2025 10:59	93.75	150.67
11/11/2025 11:00	120.31	193.36
11/11/2025 11:01	382.81	615.23
11/11/2025 11:02	406.25	652.90
11/11/2025 11:03	187.50	301.34
11/11/2025 11:04	120.31	193.36
11/11/2025 11:05	98.44	158.20
11/11/2025 11:06	87.50	140.63
11/11/2025 11:07	75.00	120.54
11/11/2025 11:08	64.06	102.96
11/11/2025 11:09	57.81	92.91
11/11/2025 11:10	48.44	77.85
11/11/2025 11:11	50.00	80.36
11/11/2025 11:12	46.88	75.33
11/11/2025 11:13	42.19	67.80
11/11/2025 11:14	40.63	65.29
11/11/2025 11:15	37.50	60.27
11/11/2025 11:16	39.06	62.78
11/11/2025 11:17	34.38	55.25
11/11/2025 11:18	31.25	50.22
11/11/2025 11:19	32.81	52.73
Min	11.41	18.33
Max	406.25	652.90
Mean	**71.36**	**114.69**

Site	**CBE Plus Ltd**
Date	**11/11/2025**
Plant	**Spray Booth RHS**
File Ref	**10720**

Date & Time			**VOC**	
Start	**End**		**wet**	**wet**
			ppm	**mg/Nm³**
11/11/2025 11:35	11/11/2025 12:34		40.03	64.33
		Mean	**40.03**	**64.33**
		Max	187.50	301.34
		Min	6.25	10.04

Results Correct to

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

Date/Time	**VOC**	**VOC**
	Wet	**Wet**
1 min log	**ppm**	**mg/Nm³**
11/11/2025 11:35	98.44	158.20
11/11/2025 11:36	142.19	228.52
11/11/2025 11:37	176.56	283.76
11/11/2025 11:38	96.88	155.69
11/11/2025 11:39	48.44	77.85
11/11/2025 11:40	39.06	62.78
11/11/2025 11:41	34.38	55.25
11/11/2025 11:42	25.00	40.18
11/11/2025 11:43	25.00	40.18
11/11/2025 11:44	20.31	32.65
11/11/2025 11:45	17.19	27.62
11/11/2025 11:46	18.75	30.13
11/11/2025 11:47	15.63	25.11
11/11/2025 11:48	18.75	30.13
11/11/2025 11:49	15.63	25.11
11/11/2025 11:50	14.06	22.60
11/11/2025 11:51	17.19	27.62
11/11/2025 11:52	14.06	22.60
11/11/2025 11:53	10.94	17.58
11/11/2025 11:54	10.94	17.58
11/11/2025 11:55	12.50	20.09
11/11/2025 11:56	10.94	17.58
11/11/2025 11:57	10.94	17.58
11/11/2025 11:58	9.38	15.07
11/11/2025 11:59	9.38	15.07
11/11/2025 12:00	9.38	15.07
11/11/2025 12:01	9.38	15.07
11/11/2025 12:02	7.81	12.56
11/11/2025 12:03	6.25	10.04
11/11/2025 12:04	9.38	15.07
11/11/2025 12:05	7.81	12.56
11/11/2025 12:06	9.38	15.07
11/11/2025 12:07	7.81	12.56
11/11/2025 12:08	6.25	10.04
11/11/2025 12:09	6.25	10.04
11/11/2025 12:10	7.81	12.56
11/11/2025 12:11	7.81	12.56
11/11/2025 12:12	6.25	10.04
11/11/2025 12:13	6.25	10.04
11/11/2025 12:14	7.81	12.56
11/11/2025 12:15	6.25	10.04
11/11/2025 12:16	17.19	27.62
11/11/2025 12:17	12.50	20.09
11/11/2025 12:18	76.56	123.05
11/11/2025 12:19	120.31	193.36
11/11/2025 12:20	139.06	223.49
11/11/2025 12:21	126.56	203.40
11/11/2025 12:22	160.94	258.65
11/11/2025 12:23	187.50	301.34
11/11/2025 12:24	154.69	248.60
11/11/2025 12:25	81.25	130.58
11/11/2025 12:26	54.69	87.89
11/11/2025 12:27	53.13	85.38
11/11/2025 12:28	39.06	62.78
11/11/2025 12:29	29.69	47.71
11/11/2025 12:30	29.69	47.71
11/11/2025 12:31	23.44	37.67
11/11/2025 12:32	21.88	35.16
11/11/2025 12:33	21.88	35.16
11/11/2025 12:34	17.19	27.62
Min	6.25	10.04
Max	187.50	301.34
Mean	**40.03**	**64.33**

Appendix 5
Instrumental Gas Analyser Site Calibration Data

CES Environmental Instruments Ltd

GAS ANALYSER CALIBRATION SHEET

Gas Analyser Calibration		Client	CBE Plus Ltd	Date	11/11/2025
Instrument Type	FID	Job Number	10720	Test	Auth
Quality No.	C301	Site	Spray Booth	Test Period	1 hour each stack

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_3H_8	1000.00	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_3H_8	808.9 ppm	Certificate Number:	40-96767-001

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_3H_8	ppm	Certificate Number:	

Date	11/11/2025	Time		Amb Press (mbar)	990	Amb Temp. (°C)	10

Calibration Check - Pre-Sampling Test Gas Entered - Instrument	CO_2	O_2	CO	NO	SO_2	C3H8
Zero Reading						**0.00**
Span Gas 1 Reading						**809.00**
Zero Reading						**1.00**
Ambient Air						
Analyser T_{90} Response (sec)						**11.00**
<2x Repeatability @ zero	0.00	0.00	0.00	0.00	0.00	1.00

Leak Check - Pre-Sampling Test Gas Entered - Probe	CO_2	O_2	CO	NO	SO2	C3H8
Zero Reading						**1.00**
Span Gas 1 Reading						**810.00**
Span Gas 2 Reading						
Ambient Air						
Zero Drift (%)						0.10
Span Drift (%)						0.10

Date	11/11/2025	Time		Amb Press (mbar)	990	Amb Temp. (°C)	11

Calibration Check - Mid / Post Sampling Test Gas Entered - Instrument	CO_2	O_2	CO	NO	SO_2	C3H8
Zero Reading						**1.00**
Span Gas 1 Reading						**811.00**
Span Gas 2 Reading						
Ambient Air						
Zero Drift (%)						0.10
Span Drift (%)						0.20

Checks completed by: P.Broxham

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CES Environmental Instruments Ltd

GAS ANALYSER CALIBRATION SHEET

Gas Analyser Calibration		Client	CBE Plus Ltd	Date	11/11/2025
Instrument Type	FID	Job Number	10720	Test	Auth
Quality No.	C301	Site	Spray Booth	Test Period	1 hour each stack

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_3H_8	1000.00 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_3H_8	808.9 ppm	Certificate Number:	40-96767-001

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_3H_8	ppm	Certificate Number:	

Date	11/11/2025	Time		Amb Press (mbar)	990	Amb Temp. (°C)	10

Calibration Check - Pre-Sampling Test Gas Entered - Instrument	CO_2	O_2	CO	NO	SO_2	C3H8
Zero Reading						**0.00**
Span Gas 1 Reading						**809.00**
Zero Reading						**1.00**
Ambient Air						
Analyser T_{90} Response (sec)						**11.00**
<2x Repeatability @ zero	0.00	0.00	0.00	0.00	0.00	1.00

Leak Check - Pre-Sampling Test Gas Entered - Probe	CO_2	O_2	CO	NO	SO2	C3H8
Zero Reading						**1.00**
Span Gas 1 Reading						**810.00**
Span Gas 2 Reading						
Ambient Air						
Zero Drift (%)						0.10
Span Drift (%)						0.10

Date	11/11/2025	Time		Amb Press (mbar)	990	Amb Temp. (°C)	11

Calibration Check - Mid / Post Sampling Test Gas Entered - Instrument	CO_2	O_2	CO	NO	SO_2	C3H8
Zero Reading						**1.00**
Span Gas 1 Reading						**811.00**
Span Gas 2 Reading						
Ambient Air						
Zero Drift (%)						0.10
Span Drift (%)						0.20

Checks completed by: P.Broxham

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Appendix 6
Calibration Certificates

Certificate of Calibration

Date of Issue: 13th June 2025

Certificate No. CES2638
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.	14288454
Quality No.	C300
Calibration Date	13 06 25
Calibrated By Name	M.Rodgers

Ambient Conditions

Air Temperature (°C)	25
Barometric Pressure (mbar)	1003
Relative Humidity (%)	65

Instruments used to undertake calibration

E Type Pitot	UKAS Certificate No.K55647V	(Qu. No. C136)
Manometer Type FC012	UKAS Certificate No.27318	(Qu. No. C082)
Manometer Type FC012	UKAS Certificate No. 27319	(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 caibration 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 nozzel ot 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 thermpcouple 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: 13th June 2025

Certificate No CES2638
page 2 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	14288454
Quality No	C300
Calibration Date	13 06 25

Ambient Conditions

Air Temperature (°C)	25
Barometric Pressure (mbar)	1003
Relative Humidity (%)	65
Air Density @ 0°C (kg/m³)	1 277
Corrected Air Density (kg/m³)	1.1583

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**
7.1	1.009	7.2	7.5	**0.96**	3.526	3.600	**0.98**
45.0	1.002	45.1	46.7	**0.97**	8.846	9.000	**0.98**
89.5	1.004	89.9	91.5	**0.98**	12.487	12.600	**0.99**
149.6	0.999	149.5	156.9	**0.95**	16.104	16.500	**0.98**
235.9	1	235.9	249.3	**0.95**	20.233	20.800	**0.97**
Mean (excluding 4.0Pa)				**0.96**			**0.98**

Volume Flow

Nominal Flow Rate	Actual Flow Rate	Actual Flow Rate	Orifice Constant
l/min	l/min	m³/hr	
10.0	9.560	0.191	12.894
15.0	14.740	0.295	13.250
20.0	20.495	0.410	13.440
25.0	22.570	1.354	13.483
30.0	30.055	0.601	13.462
nent Orifice Constant(@1.5m³/hr) =			13.483

Barometric Pressure

Pressure Input	
Required Value (mbar)	**Indicated Value (mbar)**
995.0	995.0
1002.0	1002.0
1007.0	1007.0

Temperature

Temperature Input	
Required Value (°C)	**Indicated Value (°C)**
25.0	25.0
50.0	50.0
100.0	100.0
150.0	150.0
250.0	251.0
300.0	301.0

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

Certificate of Calibration

Date of Issue: 6th January 2025

Certificate No. CES2583
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.	5218792
Quality No.	C193
Calibration Date	06 01 2025
Calibrated By Name	D.Woolley

Ambient Conditions

Air Temperature (°C)	23
Barometric Pressure (mbar)	987
Relative Humidity (%)	44

Instruments used to undertake calibration

E Type Pitot	UKAS Certificate No. K55647V	(Qu. No. C136)
Manometer Type FC012	UKAS Certificate No. 27318	(Qu. No. C082)
Manometer Type FC012	UKAS Certificate No. 27319	(Qu. No. C081)
Barometer Type 104	UKAS Certificate No. K55933P	(Qu. No. C138)
Gallus Dry Gas Meter	UKAS Certificate No. N037163	(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-5 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 caibration 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 nozzel ot the Gravimat SCH-5. 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-5 display.

Temperature

The probe thermocouple was placed in a thermpcouple oven and heated. The temperature was measured using a calibrated thermocouple and temperature indicator. The resultant temperature was compared to the Gravimat SCH-5 display.

Current

A mA current source was injected into the Gravimat SCH-5 using a mA current generator. The injected current was compared to the Gravimat SCH-5 display.

Certificate of Calibration

Date of Issue: 6th January 2025

Certificate No. CES2583
page 2 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.	5218792
Quality No	C193
Calibration Date	06 01 2025

Ambient Conditions

Air Temperature (°C)	23
Barometric Pressure (mbar)	987
Relative Humidity (%)	44
Air Density @ 0°C (kg/m³)	1.277
Corrected Air Density (kg/m³)	1.203

Calibration Details

Flow and Extraction

Applied Pressure (Pa)	Pitot Correction	Applied Pressure Corrected (Pa)	SMP502 (Calculated) (Pa)	**Pressure Factor**	Calculated Velocity (m/s)	SMP502 Velocity (m/s)	**Velocity Factor**
11.0	1.018	11.20	10.5	**1.07**	4.314	4.177	**1.03**
37.0	1.005	37.19	35.5	**1.05**	7.861	7.681	**1.02**
84.0	1.007	84.59	81.5	**1.04**	11.857	11.639	**1.02**
149.0	0.998	148.70	144.5	**1.03**	15.721	15.497	**1.01**
235.0	0.999	234.77	226.5	**1.04**	19.753	19.402	**1.02**
363.0	0.982	356.47	349.5	**1.02**	24.341	24.102	**1.01**
523.0	0.983	514.11	504.5	**1.02**	29.231	28.957	**1.01**

Volume Flow

Nominal Flow Rate	Actual Flow Rate	Actual Flow Rate	Orifice Constant
l/min	l/min	m³/hr	
10.0	9.475	0.190	12.536
15.0	14.720	0.294	13.200
20.0	19.830	0.397	13.335
25.0	23.890	1.433	13.449
30.0	30.600	0.612	13.719
nent Orifice Constant(@1.5m³/hr) =			**13.449**

Barometric Pressure

Pressure	
Required Value (mbar)	**Indicated Value (mbar)**
987.0	987.0
1000.0	1000.0
1021.0	1021.0

Temperature

Temperature Input	
Required Value (°C)	**Indicated Value (°C)**
25.0	25.0
50.0	49.9
100.0	100
150.0	150.2
250.0	250.1
300.0	300.0

Current

Current Value	
Required Value (mA)	**Indicated Value (mA)**
0.0	0.0
5.0	5.0
10.0	10.0
15.0	15.0
20.0	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 7
Uncertainty Calculations

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

Limit value (ELV)		**mg.m^{-3}**	**Reference oxygen**		**% by volume**
Measured concentration	0.11	**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	1.423	uV_m	0.001	**m^3**	0.07		<=2%
Sampled gas Temperature	T_m	273	uTm	2	k	0.73		<=1%
Sampled gas Pressure	ρ_m	101.3	$u\rho_m$	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	0.16	um	0.09	**mg**	56.25	#DIV/0!	<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	UCM	0.01			**mg**	6.25		<=10%
(Instack filter - no rinse)								

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		
	H_m	0.010		0.010	$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$	
	T_m	0.004		0.007		
	ufs			0.012		1.24
Corrected volume	V	1.42	uV	0.018 **m^3**	$V = V_m f_s$	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		0.48

Parameter		**Value**	**Units**	**Sensitivity coeff**	**Uncertainty contribution**	**Uncertainty as %**
Corrected Volume (standard cc	V	1.42	m^3	0.08	0.00 mg.m^{-3}	1.25 %
Mass	m	0.16	mg	0.70	0.06 mg.m^{-3}	56.25 %
Factor for O2 Correction	fc	1.00		0.11	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	0.70	0.00 mg.m^{-3}	3.61 %
Combined measurement uncertainty					**0.06** mg.m^{-3}	

Expanded uncertainty as percentage of measured value	**112.79**	**% measured of value**	**expressed with a level of confidence of 95%**
			(Using a coverage factor k=2)
Expanded uncertainty in units of measurement	**0.13**	**mg.m^{-3}**	
Expanded uncertainty as percentage of limit value	**#DIV/0!**	**% ELV**	

Verified

Standard uncertainty associated with local velocities (BS EN ISO 16911-1:2013)

Measured velocity	5.80 **m/s**		**O2 concentration**	20.9 **% dry**	
Measured temperature	22.00 **°C**		**CO2 Concentration**	0.03 **%dry**	
Measured ambient pressure	96300.00 **Pa**		**H2O Concemtration**	2.32 **%**	
Duct Pressure, Abs	96400.00 **Pa**				
Differential Duct Press	100.00 **Pa**		**Mole Mass**	**28.589 kg/mol**	
			Gas Density	**1.276 kg/m³(0°C, 1013mbar)**	
Measurement points	4			**1.124 kg/m³(actual)**	

Allowable uncertainies

Max Allowable U Dry O_2 % v/v =	6	**Accuracy of absolute temp %**	1
Max Allowable U Dry CO_2 % v/v =	6	**Coverage @ 95% CI**	2
Max Allowable U H2O % v/v =	20		

Measured	**Min**	**Max**	**Mean**
Local static pressure (Pa)	100.00	100.00	100.00
Local dynamic pressure (Pa)	18.20	18.80	18.80

Relating to ambient pressure (Pa)	**Est Reading Error**	**Max permisable error**
	20	300

Instrumentation

Temperature measurement: K	295.00	**Accuracy +/-**	2.95
Pitot tube calibration factor	1	**Tolerance +/-**	0.02
Pressure indicator range: Pa zero to	1000.00	**Calibration U Pa +/-**	2.00
		Resolution (Pa)	1.00
		Drift (%)	0.10
		Lack of Fit (% of Range)	0.06

Gas composition

		MW		
Dry N_2 % v/v =	79.070	28.00	**Wet N_2 % v/v =**	79.556
Dry O_2 % v/v =	20.900	32.00	**Wet O_2 % v/v =**	20.415
Dry CO_2 % v/v =	0.030	44.00	**Wet CO_2 % v/v =**	0.029
Total %	**100.000**		**Total %**	**100.000**
H_2O =	2.320	18.00		

Calculated uncertainties	**Value**			
Standard uncertainty associated with the mean local dynamic pressures	**1.25**	Pa		
Standard uncertainty on the coefficient of the pitot tube	**0.01**			
Uncertainty associated with H2O	**0.23**	% volume fraction on wet gas		
Uncertainty associated with O2	**0.61**	% volume fraction water vapour		
Uncertainty associated with CO2	**0.00**	% volume fraction water vapour		
Standard uncertainty associated with the molar mass of gas	**3.38E-05**	kg/mol		
Standard uncertainty associated with temperature	**1.48**	k		
Standard uncertainty associated with ambient pressure	**173.30**	Pa		
Standard uncertainty associated with static pressure	**1.24**	Pa		
Standard uncertainty associated with density	**6.12E-03**	kg/m³		
Measurement uncertainty				
Calculation of uncertainty associated with the determination of local velocities			0.20	m/s
Expanded uncertainty k =	2		0.40	m/s

Uncertainty calculation for Gaseous Measurement Volatile Organic Compounds BS EN 12619

Limit value		**mg.m^{-3} (corrected)**	**Gas**	C3H8	
Uncertainty Requirement	15	**%**	**Full Scale**	1000	**ppm**
Measured concentration	71.36	**ppm**	**Cal gas conc**	808.9	**ppm**
Measured concentration	114.18	**mgC.m^{-3} (273K, 101.3kPa)**	**Conversion**	1.6	
Measured concentration	117.71	**mgC.m^{-3} (corrected)**	**Full Scale**	1600	**mg.m^{-3}**
			Cal gas conc	1294.24	**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	3.00	101.30	**273.00**
	Uncert	0.05		0.00	**1.00**
Factors		1.00	1.03	1.00	1.00
Uncertainty in factor		0.00	0.00	0.00	0.00
Correction Factor		**1.03**	uf	**0.00436881334867**	

Performance characteristics	**Value**			**specification**
Response time	11.00	seconds		180.000
Number of readings in measurement	60			
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	0.10	% 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	
1.83	mg/m3
0.11	% value

	ranges min	max	value at calib	
flow	18	30	24	l/hr
pressure	99.00	99.00	99.00	kPa
temp	283.00	284.00	283.00	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	3.00	3.00	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**		
Standard deviation of repeatability at zero		u_{r0}		for mean		use rep at span
Standard deviation of repeatability at span level		u_{rs}		for mean		0.10
Lack of fit		u_{fit}				3.70
Drift		u_{0dr}				1.06
volume or pressure flow dependence		u_{spres}				0.11
atmopsheric 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}				0.05
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}				1.32
Uncertainty of calibration gas		u_{calib}				1.32
Uncertainty in factor		uf				0.00

	Use largest negative or positive interferent effect	
NH3	0	0.17
CO2	0	0.18
H2O	0	0.05
N2O	0	0.17
CH4	0	0.17
	0	0.75
Interference uncertainty		0.75

Measurement uncertainty		Result	114.18	mg/m^3
Combined uncertainty			4.34	mg/m^3
Expanded uncertainty	k =	2	8.69	mg/m^3
Uncertainty corrected to std conds			8.95	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%**		**8.95 mg.m^{-3} at ELV**	
		$U_{95} \leq U_{req}$	**#VALUE!**	

Verified

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

Limit value (ELV)		**mg.m^{-3}**	**Reference oxygen**		**% by volume**
Measured concentration	0.57	**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	1.238	uV_m	0.001	**m^3**	0.08		<=2%
Sampled gas Temperature	T_m	273	uTm	2	k	0.73		<=1%
Sampled gas Pressure	ρ_m	101.3	$u\rho_m$	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	0.71	um	0.09	**mg**	12.68	#DIV/0!	<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	0.05			**mg**	7.042253521		<=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			
	H_m	0.010	0.010	$f_s = \frac{(100 - H_m)}{100} \frac{273}{T_m} \frac{\rho_m}{101.3}$		
	T_m	0.004	0.007			
	ufs		0.012			1.24
Corrected volume	V	1.24	uV 0.015	**m^3**	$V = V_m f_s$	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			0.48

Parameter		**Value**	**Units**	**Sensitivity coeff**	**Uncertainty contribution**	**Uncertainty as %**
Corrected Volume (standard cc	V	1.24	m^3	0.46	0.01 mg.m^{-3}	1.25 %
Mass	m	0.71	mg	0.81	0.07 mg.m^{-3}	12.68 %
Factor for O2 Correction	fc	1.00		0.57	0.00 mg.m^{-3}	0.48 %
Leak	L	0.01	mg.m^{-3}	1.00	0.01 mg.m^{-3}	1.15 %
Uncollected mass	UCM	0.03	mg	0.81	0.02 mg.m^{-3}	4.07 %
Combined measurement uncertainty					**0.08** mg.m^{-3}	

Expanded uncertainty as percentage of measured value	**26.86**	**% measured of value**	**expressed with a level of confidence of 95%**
			(Using a coverage factor k=2)
Expanded uncertainty in units of measurement	**0.15**	**mg.m^{-3}**	
Expanded uncertainty as percentage of limit value	**#DIV/0!**	**% ELV**	

Verified

Standard uncertainty associated with local velocities (BS EN ISO 16911-1:2013)

Measured velocity	7.80 **m/s**		**O2 concentration**	20.9 **% dry**	
Measured temperature	24.00 **°C**		**CO2 Concentration**	0.03 **%dry**	
Measured ambient pressure	96100.00 **Pa**		**H2O Concemtration**	1.58 **%**	
Duct Pressure, Abs	96200.00 **Pa**				
Differential Duct Press	100.00 **Pa**		**Mole Mass**	**28.670 kg/mol**	
			Gas Density	**1.280 kg/m³(0°C, 1013mbar)**	
Measurement points	4			**1.117 kg/m³(actual)**	

Allowable uncertainies

Max Allowable U Dry O_2 % v/v =	6	**Accuracy of absolute temp %**	1
Max Allowable U Dry CO_2 % v/v =	6	**Coverage @ 95% CI**	2
Max Allowable U H2O % v/v =	20		

Measured	**Min**	**Max**	**Mean**
Local static pressure (Pa)	100.00	100.00	100.00
Local dynamic pressure (Pa)	32.80	34.60	33.70

Relating to ambient pressure (Pa)	**Est Reading Error**	**Max permisable error**
	20	300

Instrumentation

Temperature measurement: K	297.00	**Accuracy +/-**	2.97
Pitot tube calibration factor	1	**Tolerance +/-**	0.02
Pressure indicator range: Pa zero to	1000.00	**Calibration U Pa +/-**	2.00
		Resolution (Pa)	1.00
		Drift (%)	0.10
		Lack of Fit (% of Range)	0.06

Gas composition

		MW		
Dry N_2 % v/v =	79.070	28.00	**Wet N_2 % v/v =**	79.401
Dry O_2 % v/v =	20.900	32.00	**Wet O_2 % v/v =**	20.570
Dry CO_2 % v/v =	0.030	44.00	**Wet CO_2 % v/v =**	0.030
Total %	**100.000**		**Total %**	**100.000**
H_2O =	1.580	18.00		

Calculated uncertainties	**Value**			
Standard uncertainty associated with the mean local dynamic pressures	**1.31**	Pa		
Standard uncertainty on the coefficient of the pitot tube	**0.01**			
Uncertainty associated with H2O	**0.16**	% volume fraction on wet gas		
Uncertainty associated with O2	**0.62**	% volume fraction water vapour		
Uncertainty associated with CO2	**0.00**	% volume fraction water vapour		
Standard uncertainty associated with the molar mass of gas	**2.93E-05**	kg/mol		
Standard uncertainty associated with temperature	**1.49**	k		
Standard uncertainty associated with ambient pressure	**173.30**	Pa		
Standard uncertainty associated with static pressure	**1.24**	Pa		
Standard uncertainty associated with density	**6.05E-03**	kg/m³		

Measurement uncertainty				
Calculation of uncertainty associated with the determination of local velocities			0.17	m/s
Expanded uncertainty	k =	2	0.34	m/s

Uncertainty calculation for Gaseous Measurement Volatile Organic Compounds BS EN 12619

Limit value		**mg.m^{-3} (corrected)**	**Gas**	C3H8	
Uncertainty Requirement	15	**%**	**Full Scale**	1000	**ppm**
Measured concentration	40.03	**ppm**	**Cal gas conc**	808.9	**ppm**
Measured concentration	64.04	**mgC.m^{-3} (273K, 101.3kPa)**	**Conversion**	1.6	
Measured concentration	66.02	**mgC.m^{-3} (corrected)**	**Full Scale**	1600	**mg.m^{-3}**
			Cal gas conc	1294.24	**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	3.00	101.30	**273.00**
	Uncert	0.05		0.00	**1.00**
Factors		1.00	1.03	1.00	1.00
Uncertainty in factor		0.00	0.00	0.00	0.00
Correction Factor		**1.03**	uf	**0.00436881334867**	

Effect of drift	
1.73	mg/m3
0.11	% value

Performance characteristics	**Value**			**specification**
Response time	11.00	seconds		180.000
Number of readings in measurement	60			
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	0.10	% 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		

	ranges min	max	value at calib	
flow	18	30	24	l/hr
pressure	99.00	99.00	99.00	kPa
temp	283.00	284.00	283.00	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	3.00	3.00	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**		
Standard deviation of repeatability at zero		u_{r0}		for mean		use rep at span
Standard deviation of repeatability at span level		u_{rs}		for mean		0.10
Lack of fit		u_{fit}				3.70
Drift		u_{0dr}				1.00
volume or pressure flow dependence		u_{spres}				0.11
atmopsheric 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}				0.05
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}				0.74
Uncertainty of calibration gas		u_{calib}				0.74
Uncertainty in factor		uf				0.00

	Use largest negative or positive interferent effect	
NH3	0	0.17
CO2	0	0.18
H2O	0	0.05
N2O	0	0.17
CH4	0	0.17
	0	0.75
Interference uncertainty		0.75

Measurement uncertainty		Result	64.04	mg/m^3
Combined uncertainty			4.04	mg/m^3
Expanded uncertainty	k =	2	8.09	mg/m^3
Uncertainty corrected to std conds			8.34	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%**		**8.34 mg.m^{-3} at ELV**	
		$U_{95} \leq U_{req}$	**#VALUE!**	

Verified